Epinion

A mapping and evaluation of the tender process for zero-emission bus services

Movia
Report
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1. Introduction

In September 2017, the European Investment Bank awarded financial support to Trafikselskabet Movia (Movia Public Transport) under the ELENA programme for implementation of the Transition to Electric Buses and Boats in Movia (TEBB) project.

One of the aims of the project is to map and evaluate the initial tender processes for zero-emission electric bus services carried out by Movia in 2017-2018. Movia therefore asked Epinion to make an evaluation covering:

- Invitation to Tender A16 (invitation to tender for electric bus services on the city bus routes of the Municipality of Roskilde)
- Invitation to Tender for a Framework Agreement on Electric Vehicle Charging Infrastructure in Urban space
- Invitation to Tender A17 (requirements for zero-emission vehicles on routes 2A and 18 in the the Municipalities of Copenhagen and Frederiksberg and routes 147, 157 and 156 in the Municipalities of Ballerup and Egedal)
- Invitation to Tender H5 (invitation to tender for harbour buses in the Municipality of Copenhagen)

Transition of Movia's bus services to zero emission has far-reaching implications for many parts of the Movia organisation, including tender processes, advice to municipalities, timetabling and follow-up on **services**.

The evaluation is to help anchor knowledge in Movia on how the extensive changes to the procedures of the organisation and its interfaces for collaboration have been implemented. The evaluation of processes and results will thus allow Movia to learn from successes and challenges. Also, the evaluation can be used to share Movia's experiences with other transport companies, cities, etc. which are about to implement electric public transport services.

The ELENA TEBB project will be implemented in the period from October 2017 to October 2021. Prior to project start-up, a number of activities have been carried out in the A16 and H5 tender processes. Consequently, the evaluation also includes activities prior to the ELENA project start-up if they are deemed to be important to the completion of the tender process.

Below we outline the key findings of the report, followed by an elaboration of the context-relevant factors which are relevant for the four tender processes. Next, we focus on each of the four tender processes, analysing activities and decisions in each tender process followed by an evaluation of the individual steps of the tender processes. The final part of the report takes a helicopter view and provides recommendations for the work further developing the transition to green public transportation.

MOVIA

Movia is Denmark's largest Public transport Authority and works to achieve increased mobility throughout Zealand by implementing a coherent, simple and environmentally friendly public transport system. Every year Movia carries more than 215 million passengers on almost 450 bus routes, nine suburban rail lines and five demand responsive transport schemes (Flextrafik).

Owned by municipalities and regions
Movia is owned by the Capital Region of Denmark, Region Zealand and the 45 municipalities in the two regions. Together with municipalities and regions, Movia advises on and plans public transportation by bus, local railways and demand responsive transportation across the borders of municipalities and regions.

Provider of regular public transport services
Movia does not own its own buses, but invites tenders for the bus services in open procedures and enters into contracts with private bus operators ("operators")[1] who then deliver the bus services. The operators have full responsibility for purchasing and operating bus equipment and garages.
Movia invites tenders for regular bus services in negotiated procedures under the EU Utilities Directive.

2. Summary

This report presents the results of the mapping and evaluation of Movia's work in connection with its invitation to tender for zero-emission bus services. A fact sheet for each of the four tender processes subject to evaluation is appended to the report.

2.1 Purpose and method

The purpose of the evaluation is partly to map the activities carried out in connection with the individual invitations to tender and partly to contribute to anchoring knowledge in Movia as to how the four tender processes have led to changes in Movia's procedures and cooperative interfaces. Also, we expect that the evaluation will be used to share Movia's experiences with other Public Transport Authorities, cities, etc. which are about to implement an electric or hydrogen bus system.

The methodical solution design has evolved around desk research and interviews with key stakeholders who have been involved in the four tender processes. Overall, it is our opinion that the method applied enables us to carry out an adequate mapping and evaluation of Movia's work with invitations to tender for zero-emission bus services.

[1] The bus operators are responsible for the operation of all bus services. They may tender for the regular bus services which Movia puts out to tender on behalf of the municipalities on Zealand, Lolland and Falster as well as the Capital Region of Denmark and Region Zealand. Read more here: https://www.moviatrafik.dk/busoperatoer

In 2017, the European Investment Bank awarded Movia a grant under the ELENA programme to implement a four-year project: Transition to Electric Buses and Boats in Movia (TEBB). The TEBB project was launched in a period characterised by breath-taking technological advances within electric bus technology and an increasing social and political interest in and agenda to reduce the emission of climate gases and local air pollution in the transport area. For many years, Movia has developed environmental targets as an integral part of its business and aims to make bus services fossil-free by 2030.

The evaluation comprises four tender processes which have all contributed to developing methods and guidelines for zero-emission bus services, more specifically:

- The A16 invitation to tender for electric buses on the city bus routes of the Municipality of Roskilde which involved a number of activities to identify the potential of electric bus services, including a dialogue with the market and stakeholders as well as the appointment of a steering committee and field trips.
- Invitation to tender for a framework agreement on charging infrastructure in public space which served the purpose of making it easy and advantageous for the operators to make use of chargers at bus termini in their tenders.
- The A17 invitation to tender (requirements for zero-emission vehicles on routes 2A and 18 in the Municipalities of Copenhagen and Frederiksberg and routes 147, 157 and 156 in the Municipalities of Ballerup and Egedal further developing the procurement model based on lessons learned from A16). The process also involved the initial experiences with the implementation of the framework agreement in an invitation to tender for bus services.
- The H5 Invitation to Tender for the operation of the harbour buses of the Municipality of Copenhagen which was based on a political desire to significantly improve the environmental performance of the Copenhagen harbour buses.

2.2 Conclusions and learnings from the mapping and the evaluation

Various conclusions and learnings worth emphasising can be drawn from the analysis of the four tender processes.

Technology is developing fast, and that requires Movia to keep up

The work of inviting tenders for zero-emission buses has taken, and is still taking, place in a fast-developing market. Market maturity has changed significantly since 2015 when the idea of electric buses first took shape in Roskilde until today when technology has become so mature that it is no longer at a test stage. The commercial market has embraced electric bus services and has begun to base business models on it, and today, electric bus services are very much perceived politically as a realistic option. New solutions and technologies are still being developed, and now hydrogen is being used as a propellant on a test basis.

The market expects technology to continue to develop fast and to see better solutions that will extend the driving range of the buses. For example, battery packs have improved and/or become cheaper in the past two years. This opens up for new opportunities for electric bus services. It must be assumed that technological developments will give Movia increased flexibility in future tender processes, for instance with respect to range and the number of buses required, and the landscape for charging stations in public space is likely to change.

Movia, operators and municipalities have built up key organisational knowledge and insight from their work with zero-emission buses.

Since 2015 when the efforts to introduce zero-emission buses really started with the A16 tender process, employees of Movia, municipalities and operators have built up important organisational knowledge and experience of emission-free bus services. This is evident from all interviews that have been carried out. Everybody says that the learning curve has been steep, important and interesting. Movia has had to find a new way of carrying out tender processes, the operators have had to adapt their business to electric service, and the municipalities have had to take the bold step of giving priority to a greener, but also more expensive bus fleet.

The knowledge and insights gained put all parties in a better position for future tender processes, which is also very clear in the A18 tender process where the questions asked by the operators did not concern the electric bus system to the same degree as in earlier tender processes (A16 and A17). Internally at Movia, lessons learned from earlier tender processes will be incorporated in future tender processes (A18 and A19); for example in the process of finding locations for charging stations in public space.

Emission-free buses and related tender work have generated positive attention.

The approach and the efforts that Movia has made in its work with zero-emission buses have generated positive and often international attention. This can be seen from the many inquiries and invitations to share Movia's knowledge and insights in their work. In many ways, the work with and the organisation of charging infrastructure, harbour buses and buses are innovative. In other words, Movia has gained a unique knowledge which is in demand.

Selecting which type of procedure to use and how to specify it are essential to the final solution model.

The lessons learned from the A16, A17 and H5 tender processes and the framework agreement on the charging infrastructure in public space show that the type of procedure chosen is central and essential to the end result of the tender process. For example, it was essential to the result of the H5 tender process that Movia opted for a competitive dialogue procedure in its tender process. Initially, Movia expected there to be an existing solution on the market, but the challenge was to come up with a solution. A competitive dialogue procedure fits well in a tender process that also involves development and innovation. However, a negotiated procedure is better suited for a tender process with a tried and tested content.

At the same time, experience also shows that when zero-emission bus services are being put out to tender, invitations to tender specifying functional requirements work better than invitations to tender which attach importance to technical requirements. The reason is that functional requirements create space for technological developments because there is no detailed description of how to perform the task from the outset. Instead the invitation to tender describes the expected environmental requirements and emission levels of e.g. CO2 and NOx. In this way, the invitation to tender has some measure of built-in flexibility which benefits both Movia and the operators. Very rigid tender requirements may entail restrictions with regard to the technology that can be used for zero-emission bus services whereas more flexible functional requirements have a positive impact on innovation and the tenderer's options to submit the best tender in terms of price and solution.

Early market dialogue has played a vital role in all tender processes.

In connection with the four tender processes, Movia has taken time to make inquiries into and enter into a dialogue with the market in different ways. This includes field trips with the purpose of finding inspiration and gaining experience, but Movia has also to a wide extent used analyses identifying the potentials of technology, as well as dialogue meetings with operators, suppliers, politicians and other parties interested in zero-emission bus services. In the A16 tender process and the framework agreement on charging infrastructure in public space, it resulted in the appointment of steering and working groups as a formal framework for the initial dialogue, consultation and drafting of guidelines. In the course of the A17 tender process, Movia made use of market dialogues by holding briefing meetings in connection with the publication of the contract documents.

In the H5 tender process, Movia chose to use a competitive dialogue procedure where a close involvement of tenderers is an essential element of the process. It is clear to Movia and the tenderers involved that this early dialogue and involvement have had a positive impact on the final results of the tender process as the parties have been able to identify opportunities, limitations and realistic scopes for action early in the process. Likewise, it is also emphasised as a process which has strengthened collaboration between Movia and the tenderers. The tenderers have all felt that Movia has listened to their concerns about special terms of tender and that Movia has also been prepared to find alternative solutions. Movia also speaks of the same good will, and the good will of all stakeholders has paved the way for solutions and compromises.

The ELENA funds have helped secure additional resources and organisational power to complete tender processes for zero-emission bus services.

The ELENA grant has had a great impact on Movia's work with zero-emission requirements in connection with the invitation to tender for bus and harbour bus services. The ELENA programme has contributed to promoting and carrying out the development work required in connection with the incorporation of new requirements about zero emission in invitations to tender for regular bus services. The financial support has partly helped increase the quality of the contract documents and thus indirectly the quality of the tenders submitted and partly speeded up the processes as it has, inter alia, been possible to buy in external assistance e.g. from lawyers and technical consultants.

The introduction of zero-emission buses has led to new routines, procedures and tasks within Movia.

The transition to invitations to tender with zero-emission requirements has resulted in new ways of working, different procedures and new types of tasks within Movia. More specifically, it has led to extended collaboration and communication with the municipalities with the choice of fuel as a new topic. Here Movia is now charged with the additional task of identifying common solutions across stakeholders.

A different and new task is inspections to identify locations for charging infrastructure in public space. Here Movia has also had to take on a new role as a liaison and protector of interests between the municipalities, suppliers of charging infrastructure and operators. In connection with the preparation for the A17 tender process, the framework agreement was pressure tested for the first time, and Movia was also pressed for time when locations for charging infrastructure were to be inspected. This meant that there was not enough time to introduce new parties to each other, to plan

the work and to align expectations between the parties, which resulted in some uncertainty about procedures and processes.

The experience is, however, that the processes have proceeded much more smoothly in the subsequent tender process. One of the reasons is that Movia has continuously summarised and evaluated its processes, in particular the preparation and execution of inspections to optimise them and improve the communication between the parties. Also, the supplier has appointed a project manager who works closely with Movia, and Movia has become aware of the areas requiring external consultancy services so as to be able to draw in the necessary resources as and when needed. In general, the learning curve has been steep, and there have been many eye openers when organisations that are new to each other must cooperate to enter into unknown territory.
The steering committee format has had a massive positive impact on the end results of the tendering rounds, but has also demanded resources of Movia.

Movia faces the task of integrating electric bus services in the day-to-day operation.

The work with the A16, A17 and H5 tender processes as well as the framework agreement on charging infrastructure in public space has been characterised by development, search learning and innovation. To varying degrees, the four tender processes have explored new approaches and ways to invite tenders for and operate public bus transportation. This goes for Movia, the municipalities and operators. Therefore, there is a key task in converting the development work into day-to-day operations among the operators, the supplier of charging infrastructure and Movia internally.

The political ambitions and the priority given to green transition in the municipalities have a significant impact on the processes of inviting tenders for emission-free bus services.

It is clear from the analysis of the four tender processes that the local political objectives for and priority given to a green transition of public bus transportation play a vital role. Both the A16 and H5 processes were characterised by involving only one municipality (the Municipality of Roskilde and the Municipality of Copenhagen respectively) which both had a clear political prioritisation of the additional costs associated with zero-emission bus services. Conversely, Movia had a heavier workload in the A17 tender process as it involved several municipalities which were to agree on the desired solutions for the bus services. Not all municipalities had determined in advance their willingness to pay for the transition to zero-emission bus services. Likewise, situations may occur where the municipalities have environmental ambitions that can be hard to live up to or be inappropriate for the tendering, which was the case in the discussion about cabin heating in the A17 tender process.

Even though there is a clear tendency in society and in the political arena to give utmost priority to the climate and the green transition, there remains a continuous task for Movia to navigate in the political field of tension between the climate targets of the municipalities and practical solutions.

2.3 Recommendations

The mapping and evaluation have resulted in a number of recommendations focused on Movia's work and on a wider context. Below is a short summary of the recommendations:

1	Make efforts internally to share knowledge and learning about zero-emission bus services throughout the Movia organisation.
2	It is important to continue to allocate time and resources to stay updated on technological developments.
3	It would be an advantage to brand Movia towards the general public as being at the forefront of a transition to zero emission.
4	Maintain tender processes with functional requirements focusing on environmental requirements rather than technical requirements. It provides better solutions and calls for innovation.
5	Dare choose the right type of procedure based on the situation instead of merely copying the previous model.
6	Make early involvement of market players a permanent part of the tender processes.
7	Use steering and working groups in development processes.

3. Context comprehension

The first part of the report focuses on mapping Movia's activities in connection with the four tender processes and then pointing out the significance of these activities to the process. Before that, it is, however, important to understand the context in which these tender processes have unfolded.

Climate and environmental considerations are increasingly higher on the social and political agenda, including the emission of climate gases and local air pollution from the transport sector. Movia has for several years worked with environmental targets. Most recently in the Strategic Traffic Plan 2016 in which Movia - together with its municipal and regional owners - has formulated a target of making bus services fossil free by 2030.

Some of Movia's municipalities and regions have more ambitious targets and aim to make their bus services emission-free. The Municipalities of Copenhagen, Frederiksberg and Rødovre have, for instance, decided that in all new invitations to tender, the buses operating within the areas of the municipalities must be emission free. The Municipality of Copenhagen has also decided that in 2025, all buses in the Municipality of Copenhagen must have changed over to emission-free operation. The Municipalities of Roskilde, Ballerup and Egedal have decided to change parts of their bus networks to an electric bus system, and several other municipalities are requesting emission-free bus services.

DEFINITIONS

Zero-emission/emission-free means that there is no emission from the bus motor. In other words, the bus does not emit CO2 or local air pollution when using the fuel. Zero-emission buses are powered by electric motors. A clear advantage of electric motors is a significantly lower emission of noise. Like in regular buses, there will be emission of particulates from tyres and brakes. The zero-emission solutions relevant to Movia are currently electric buses and hydrogen buses.

Fossil free means that the fuel used is renewable (i.e. a non-depletable resource such as solar or wind energy), and no fossil fuel is being used. Fossil-free fuels include synthetic biodiesel and biogas. Zero emission is also fossil free, whereas fossil free bus services are not necessarily emission free.

The technical solutions available today to make emission-free bus services a reality and which are relevant for Movia are electric buses and hydrogen buses. Electric buses are equipped with one or more electric motors to power a traction battery. The traction battery will be recharged when connecting the electric bus to the electricity grid. The vehicle will be recharged either at the bus depot only or in a combination of the bus depot and chargers in public space. Hydrogen buses are electric buses equipped with a fuel cell that converts hydrogen into electricity which is used to run the electric motor(s) through the traction battery.

3.1 European Local Energy Assistance (ELENA)

The European Investment Bank has provided financial support to Movia under the ELENA programme to implement the Transition to Electric Buses and Boats in Movia (TEBB) project (see the below fact box for more information on the programme). Movia's ELENA project focuses on developing invitations to tender for zero-emission bus services and is consequently a key project in relation to Movia's climate target of making its bus services fossil-free by 2030. Already before the ELENA project, Movia's focus was on converting to a greener bus fleet, but the financial support has helped Movia succeed in developing the general conditions of contract for bus and harbour bus services capable of meeting the zero-emission requirement.

FACTS

ELENA – European Local Energy Assistance
by the European Investment Bank

ELENA is part of the European Investment Bank's (EIB) broader effort to support the EU's climate and energy policy objectives. It is a joint initiative between EIB and the European Commission intended to help local and regional authorities prepare energy efficiency or renewable energy investments (source: ELENA factsheet).

ELENA provides grants for technical assistance to prepare for the implementation of investment programmes within energy efficiency, distribution of renewable energy and transport in urban areas. The grant can for instance be used to finance costs related to feasibility and market studies, the preparation of tendering procedures, contractual arrangements and project implementation units (source: www.eib.org).

In September 2017, the European Investment Bank awarded Movia a grant of EUR 1.1m under the ELENA programme to implement the Transition to Electric Buses and Boats in Movia (TEBB) project.

3.1.1 The importance of the ELENA grant to Movia

The experience (see also the below sections) is that the quality of the contract documents has increased and that the electric vehicle transition is proceeding at a faster pace. This has in particular been the case for invitations to tender for harbour bus services and for the framework agreement on the charging infrastructure in public space − two areas which are both new to Movia.

The financial support has covered a large part of the legal assistance which has been necessary in all four tender processes. In the tender processes where Movia has tested new procurement models or has developed entirely new contract documents, the legal assistance has been essential as

various legal questions have been raised throughout the process and there has been a need for consultation on contract conditions.

In addition to the legal assistance, the financial support has enabled Movia to order external analyses on areas outside Movia's core competencies. The analyses have collected and gathered information on developments within electric bus services and examined specific technical challenges e.g. with respect to the emission of particulates from the diesel heater of electric buses.

In addition, Movia has received external technical advice on e.g. maritime technology in connection with the invitation to tender for harbour bus services and external advice from an expert who helped Movia identify be most appropriate locations for charging stations for electric buses.

Internally, the financial support from ELENA has enabled Movia to upgrade the organisation for longer development processes in the form of more internal resources, including a project manager for the TEBB project. Movia's department of contracts further works to disseminate the internal knowledge of electric operation throughout the organisation as electric operation is relevant for other employees and units of the organisation. More specifically, some of the financial support has therefore also been used to recruit a professional facilitator who headed an internal workshop for relevant employees in the autumn of 2019 for the purpose of improving internal implementation and competence development in electric operation.

Movia's efforts to create a transition to greener public transportation have received quite some international attention and interest. Besides invitations to speak at international conferences, several foreign Public Transport Authorities have asked Movia to share its knowledge of how to structure tender processes for zero-emission buses. The interest is in all four tender processes, but at present (2019) Movia is seeing particular interest in the A16 tender as the electric buses in Roskilde have gone into service.

Finally, this evaluation is also part of the external advice that is bought in for the TEBB project and thus financed by ELENA funds.

3.2 Early lessons about invitations to tender for electric buses

Prior to the four tender processes subject to this evaluation, Movia has had some experience with tenders for and testing of electric buses. The early tests of electric buses have helped increase the level of knowledge of electric bus services possessed by Movia and market operators who have been involved in the further development work.

In **2007-2008**, Movia thus carried out a tender process for electric bus services on route 11A in Copenhagen. The contract was awarded to Arriva which launched 11 units 8 m electric buses in 2009. The electric buses were in service until the end of 2014.

In **2014-2015**, Movia tested, together with the operators Arriva and Keolis, two 12-metre electric buses manufactured by the Chinese electric bus manufacturer BYD. In 2012, Movia entered into a contract with BYD to lease the two electric buses. The electric bus market was very immature at the time, and therefore, Movia chose not to put the acquisition of the electric buses out to competition. The project was supported financially by the Danish Transport, Construction and Housing Authority, the Municipality of Copenhagen and the Danish electric utility Ørsted.

In **2015**, Movia assisted the Municipality of Copenhagen in inviting tenders for the rental of electric buses and charging infrastructure in public space for the charging of the electric buses. The contract was awarded to a consortium consisting of the Finnish electric bus manufacturer Linkker and the Dutch charging infrastructure supplier ("supplier") Heliox. The electric buses were put into service on route 3A in Copenhagen in the period from August 2016 to January 2019. The participation of the Municipality of Copenhagen in the tender process and its project manager role have had a great significance for its knowledge of electric bus services and its understanding of the possibilities and challenges associated with the technology. The project was supported financially by the Danish Transport, Construction and Housing Authority, the Municipality of Copenhagen and the energy company E.ON.

In **2016**, Movia invited tenders for the operational leasing of two electric buses under a six-year contract with an option for renewal by up to four years. The tender process was completed prior to the A15 tender process, at which time the bus services on bus route 65E were put out to tender. The conclusion of the contract for the electric bus services was conditional on a contract being concluded with an operator on the operation of the two electric buses in the A15 tender process and on the Capital Region of Denmark having the necessary financial resources to pay for the operation of bus route 65E. It was, however, decided to abandon electric bus operation on bus route 65E as the Capital Region of Denmark was facing massive savings in 2017 and there was uncertainty about passenger load on the bus route. Consequently, Movia had to cancel the invitation to tender for the two electric buses.

4. Mapping tendering activity

In this chapter, the individual tender processes are mapped individually, starting with the A16 tender process followed by the framework agreement on charging infrastructure, the A17 tender process and finally the H5 tender process. The purpose of the mapping exercise is to create an overview of the individual tender processes. After each mapping exercise, the tender processes will be evaluated.

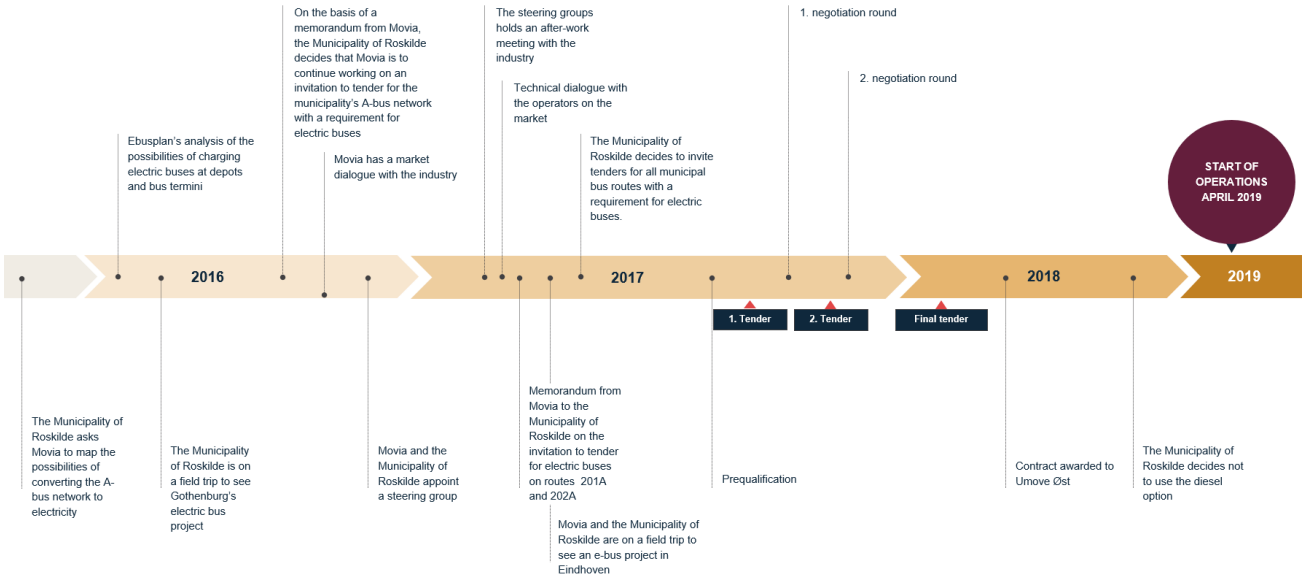
4.1 Activities relating to the A16 tender process

The Municipality of Roskilde has a long-held ambition to reduce noise and air pollution from its bus services. The ambition stems from Roskilde's efforts to make the town centre more attractive. This has, among other things, involved bus service changes to fewer routes and to higher frequency routes and a consequent increased emission of noise. From the very beginning, there has been political will and support to invest in greener public transportation in the town. Consequently, Roskilde began in 2015 to look into the possibilities and potentials to electrify its bus services, and in that connection, the municipal administration contacted the operators on the market to learn about their experience with electric bus services.

At the same time, Movia had a dialogue with the operators about electric bus services and charging infrastructure, discussing concerns and challenges related to electric bus services, including how to handle charging infrastructure in public space.

The Municipality of Roskilde and Movia entered into a collaboration in order to examine the possibilities to electrify the A-bus routes of Roskilde. The below timeline illustrates the process of phasing in electric buses in Roskilde (A16). Below, we detail the process and content of invitation to tender.

Figure 1: Timeline of activities relating to the A16 tender process



4.1.1 A mapping of the potential of electric buses

In addition to its political ambitions, the Municipality of Roskilde also had a desire to work with a tendering strategy which partly provided flexibility in the selection of solutions and partly provided an opportunity for a dialogue with the market, including a dialogue about the allocation of risks in order to minimise price-raising risk premiums. In the autumn of 2015, the Municipality of Roskilde asked Movia to look into the possibilities of changing bus services on it's A-bus network wholly or partly to electrically powered buses. Movia was awarded a grant from the *Electric Vehicle Pilot Scheme* of the Danish Energy Agency to finance an analysis of the possibilities of using electric buses charged at bus depots or termini and plug-in hybrid buses on the A-bus network of Roskilde (bus routes 201A and 202A). The analysis was carried out by the German consultant Ebusplan in the spring-summer of 2016.

On the basis of Ebusplan's analysis of the usability and costs of operating electric buses, plug-in hybrid buses or diesel-powered buses, and Movia's own analyses of costs of hybrid buses, Movia prepared a memorandum for Roskilde's administration in the autumn of 2016 about the possibility and the costs of using buses fully or partly powered by electricity on the A-bus network of Roskilde:

- The analyses of Ebusplan showed that a solution using bus termini charged buses would be most suitable for bus routes 201A and 202A as that would provide most environmental value for money. The analysis further showed that depot-charged electric buses would have insufficient driving range.
- That the annual additional cost of electric buses charged at bus termini relative to regular diesel-powered buses would be about DKK 3.9m. Moreover, there would be initial construction costs for charging stations totalling DKK 9.2m. The additional costs relative to diesel-powered buses using fossil-free HVO bio diesel would be DKK 2.6m per year.
- That there would be a need for more buses to service the routes with the existing structure as, for several of the analysed bus routes, the bus timetables did not provide enough time to allow termini-charged buses and plug-in hybrid buses to recharge. To achieve timetable compliance, it would be necessary to bring in more buses, which would add to the costs.

In the autumn of 2016, the Planning and Technical Committee of Roskilde went on a field trip to Gothenburg in Sweden and was introduced to Volvo's electric and plug-in hybrid bus systems. At this time, the different solutions were still at a test stage, but provided a good insight into potential solutions.

4.1.2 Market dialogue

Movia and the Municipality of Roskilde had a continuous dialogue with the market throughout the development of the A16 tender. In the autumn of 2016, Movia initiated a market dialogue with the operators about the tender for electric bus services and the ownership of the charging infrastructure in public space. In January 2017, Movia and the Municipality of Roskilde organised an after-hours meeting about the electric bus service tendering process in order to bring relevant stakeholders together and inform them about the plans of Movia and the Municipality of Roskilde to invite tenders for electric bus services in Roskilde. Operators, bus and charging infrastructure suppliers and other stakeholders showed great interest in the meeting. At the meeting, Movia and the Municipality of Roskilde presented their preliminary thoughts about electric bus services in Roskilde. This was the

first invitation to tender for regular buses services in Denmark where an entire bus route was to be served by 12-metre electric buses. The meeting participants provided various input to the electric bus tender, including a recommendation to defer the planned launch of the electric buses in December 2018 to spring 2019 and the identification of the greatest risk factors and challenges which could potentially affect prices in the tenders. The key risk factors proved to be:

- A too tight schedule that does not allow sufficient time for preparing tenders, ordering buses and installing charging infrastructure
- A too short guaranteed contract term
- The need for flexibility e.g. changes to timetables and the number of in-service buses
- The installation of charging infrastructure in public space
- Energy consumption for cabin heating
- Technology maturity

In March - April 2017, Movia carried out a **technical dialogue** with the operator market on the electric bus contract in Roskilde which uncovered various risks experienced by the operators in connection with electric bus operation. Against this background, Movia prepared a number of recommendations for changes to Movia's general terms and conditions for regular bus service contracts:

- An extension of the guaranteed contract term to ten years instead of Movia's general term of six years as there were at the time considerable uncertainties as to the residual and resale value of an electric bus
- Reduction and increase in the number of in-service buses according to a specific compensation model based on the operator's uncertainties as to the residual and resale value of used electric buses
- Adjustment of the possibility of adapting the number of timetable hours as an extension of the number of timetable hours could be problematic for the operators because electric buses have a shorter range than diesel-powered buses and/or would require stops to charge the traction battery
- Gradual increase in electric bus operation requirements as experience from other cities showed that there may initially be some operational challenges
- Slight adjustment of the penalty regime for the start-up period requiring the operator to present an action plan for how to handle operational challenges if they occur. That could facilitate smoother collaboration in the adaptation to the new technology

4.1.3 Steering committee and political consideration

At the end of 2016, Movia and the Municipality of Roskilde set up a **steering committee for the contract for electric bus services in Roskilde** Members of the steering committee included relevant professionally qualified employees of Movia and the Municipality of Roskilde, Movia Head of Contracts and Head of Strategy and Construction as well as the Chief Executive and the Road Manager of the Municipality of Roskilde. Movia was responsible for project management. In the period from January 2017 to March 2018, the steering committee held 13 meetings. The meeting frequency was highest in the period leading up to the completion of the contract documents at the beginning of July 2017.

At the start-up meeting with the Municipality of Roskilde, Movia informed the municipality that if the launch of electric buses was postponed by ½-1 year, it would be possible to draw on the framework agreement on charging infrastructure in public space that Movia was about to put out to tender at the time. However, Roskilde did not wish to postpone the launch as it was important to them to be a pioneer and the first municipality to have an all-electric A-bus network:

> *"When we discovered that we could become the first municipality to run all-electric buses, we decided that it was a top priority, which has prompted some good storytelling, both internally in the municipality and externally"*
>
> Ivan Hyllested, Road Manager, Municipality of Roskilde

The Municipality of Roskilde decided that not only the A-bus network was to be electrified. At the time, there was an open window in all bus route contracts in Roskilde, which meant that if the Municipality of Roskilde did not require electric buses on the other routes in Roskilde, they would not have the opportunity to convert these bus routes to electric service until 2025 at the earliest − and perhaps not until 2031. Therefore, the municipality asked Movia to look into the possibility of going all-electric. Movia assessed that the additional cost of all-electric buses on the other bus routes in Roskilde would be around DKK 2-2.5m annually − a cost that the Municipality of Roskilde would have to finance itself. The steering committee decided to require electric bus operation on all bus routes in Roskilde, but tenders for routes 203, 204, 205, 206, 208, 209 and 212 were required to include an option for ordinary diesel bus services.

At the beginning of 2017, it was clear to the steering committee that it was necessary to clarify the options for charging of electric buses in public space. On the basis of the market dialogue, Movia already knew that the operators did not agree on whether they preferred to be responsible for the installation and operation of the necessary charging infrastructure or whether they preferred Movia or the municipality to be in charge. As the Ebusplan report had recommended charging at bus termini as the most relevant charging strategy for routes 201A and 202A, the steering committee assessed that in order to achieve sufficient competition, it was necessary to support bus solutions based on charging in public space.

At the end of January 2017, Movia forwarded a **memorandum to the Municipality of Roskilde** recommending Roskilde to decide on five points:

- Point 1 that Movia puts the operation of electric buses on routes 201A and 202A out to tender
- Point 2 that the Municipality of Roskilde arranges for the necessary infrastructure by installing and operating charging stations in public spaces to support point 1
- Point 3 that the operation of routes 201A and 202A is put out to tender on terms that mitigate the operator's risks, but also reduce the flexibility of the municipality, including a longer guaranteed contract term, less extensive penalty provisions and a reduced option for cutting timetable hours in the contract term relative to conventional bus service tenders
- Point 4 that the time schedule for the electric bus tender process provides the best possible conditions for a financially and operationally successful project and ensures that the electric buses will be launched on 14 April 2019
- Point 5 that the operator is allowed to use diesel buses to a limited extent to ensure operational reliability when electric operation is not feasible

At the beginning of February 2017, the **steering committee** visited **Eindhoven** to see the electric bus system which had just been launched with 43 electric articulated buses. The field trip helped the steering committee understand the electric bus system used, including the choice of bus equipment, garaging and charging of the electric buses.

At the end of March 2017, the Roskilde City Council decided to allocate DKK 10m to the installation of the necessary charging infrastructure and that they expected the annual additional costs of electric bus operation on routes 201A and 202A to be around DKK 3.5m. At the time, the municipality paid for a trial electric bus and for HVO biodiesel for two buses. The costs of the trial electric bus and HVO biodiesel would no longer be incurred when the two bus routes are electrified.

The Municipality of Roskilde invited tenders for charging infrastructure in public space, and the contract was awarded to Siemens. The operators were free to use the Municipality of Roskilde's contract with Siemens or to provide their own charging infrastructure on special conditions. The tender process was carried out in the period from March-October 2017 in an open procedure in accordance with sections 56-57 of the Danish Public Procurement Act[2].

4.1.4 Adapting the tendering and contract model to promote electric buses

On the basis of the technical dialogue with the operators, Movia made together with the Municipality of Roskilde various changes to Movia's contract and procurement model in spring 2017. The purpose was primarily to mitigate the risks seen by the operators in connection with the operation of electric buses and thereby reduce or avoid price-raising risk premiums in the operators' tenders. Below, we go through the changes to the model contract.

A longer guaranteed contract term

Prior to the A16 tender process, Movia has for some years invited tenders for regular bus services with a guaranteed six-year contract term with an option to renew by two years on three occasions. The maximum total contract length is thus 12 years (6+2+2+2 years). The operator's right to have the contract renewed depends on the quality delivered by the operator. The procedure used to assess the quality is detailed in the box below.

[2] Act No. 1564 of 15 December 2015.

QUALITY ASSESSMENT

The level of the quality delivered by the operators is assessed on the basis of customer satisfaction and service level. If the operator deliver the offered customer satisfaction and service levels, the operator is entitled to a renewal of the contract[3]. If the operator meets the minimum requirement, but not the offered level, renewal is possible only through an agreement between Movia and the operator.

Customer satisfaction: assessed using a questionnaire distributed among the customers, inquiring into their evaluation of the customer experience. The questionnaire will then be used to develop a quality index. The minimum requirement for the quality index is 810 (800 for routes in the Copenhagen City centre).

Level of service (level of bus service provided): measure of the share of scheduled bus services delivered. The minimum requirement is a service level of 99.9. This means that 99.9% of the scheduled bus services must be delivered.

The operators have a strong incentive to deliver the agreed quality and to have their contract renewed as the operators must depreciate the bus equipment over a period of 10 or 12 years to be competitive. If the operator does not qualify for renewal of the contract for the full period ending at the end of the 10th contract year, the operator may suffer a financial loss as the residual value of the buses is lower than their depreciation value. In diesel bus contracts, the operators have accepted this risk. The reason is that the operators have detailed knowledge and experience of the market which enables them to assess a possible loss of value. They also have clear expectations of the resale value of used buses and their possible use for other contracts.

The situation was different on the electric bus market in the A16 tender process. The operators were not in a position to set the value of a used electric bus after six or eight years as there was no market for used electric buses at the time, and therefore it was not possible to determine the potential demand for a used electric bus after six or eight years. Therefore, the operators were worried about Movia's 6+2+2+2 year contract model and would feel compelled to depreciate the electric buses over the guaranteed contract term. To avoid a price-raising risk premium for a six-year depreciation of the value of the electric buses, Movia and the Municipality of Roskilde decided to change the contract term to a ten-year guaranteed contract term with an option for renewal for a term of two years. The quality would still be assessed based on service level and customer satisfaction.

[3] The right to renew the contract is also subject to the condition that sanctions against defects on quality will not exceed an average of DKK 5,000 per bus per year.

Reduced flexibility in adapting the scope of services

In regular bus service contracts, Movia has ample latitude to increase or reduce the number of timetable hours (the number of hours that the bus is in scheduled service) and the number of in-service buses (the number of buses required to complete the bus runs using conventional buses)[4] The operator will typically also buy a number of spare buses to ensure that he can deliver the bus services even if one or more buses are taken out of service for maintenance or repair work. In case of a reduction or increase, the operator will be paid on the basis of the bus runs put out to tender. The operator's bill will be divided into *overheads, bus-related costs* and *costs related to timetable hours.* The idea of breaking down the individual cost elements is to make the bus services scalable.

BILLING MODEL

Overheads: are non-variable costs for depot, fuelling and charging infrastructure.

Bus related costs: cover primarily costs of purchasing bus equipment.

Costs related to timetable hours: are costs of drivers' wages, fuel and other operating costs.

Other budget items such as costs of operations management, return and risk premiums must be expected to be spread out over the three cost elements.

If the number of timetable hours is reduced, the operator's payment will be reduced in proportion to the fewer costs that the operator will have for drivers' wages, fuel, etc. If one peak hour run is reduced, the operator's payment will be reduced by one in-service bus in addition to any reduction in the number of timetable hours. In case of an increase in operations, the opposite will apply.

In conventional bus service contracts, Movia may increase the number of timetable hours by up to 69% over a 12-year period; 30% in the first six contract years and the next six contract years by 30% of the number of timetable hours in the sixth contract year. Similarly, Movia may reduce the number of timetable hours by up to 36% over a 12-year period corresponding to 20% in the first six contract years and the next six contract years by 20% of the number of timetable hours in the sixth contract year.

The operators experienced a high risk in electric operation relative to Movia's general procurement model for operating flexibility. The reason was that such an increase in timetable hours could only to

[4] The number of bus runs in peak hours determines the number of in-service buses required to deliver the bus services. The term *in-service buses* is also used in electric bus operation and means the number of diesel buses that would have been required to deliver the bus services. However, it often requires more electric buses than diesel buses to provide the same transportation services as electric buses have a shorter range and need charging breaks.

a limited extent be covered without buying new electric buses, and as mentioned in preceding sections, there was uncertainty about the resale value of used electric buses and the possibility of reusing used electric buses in new contracts. The operators also saw a significant risk in extending operations in the course of the contract term as a later acquisition of new electric buses will give a shorter depreciation period for the new bus.

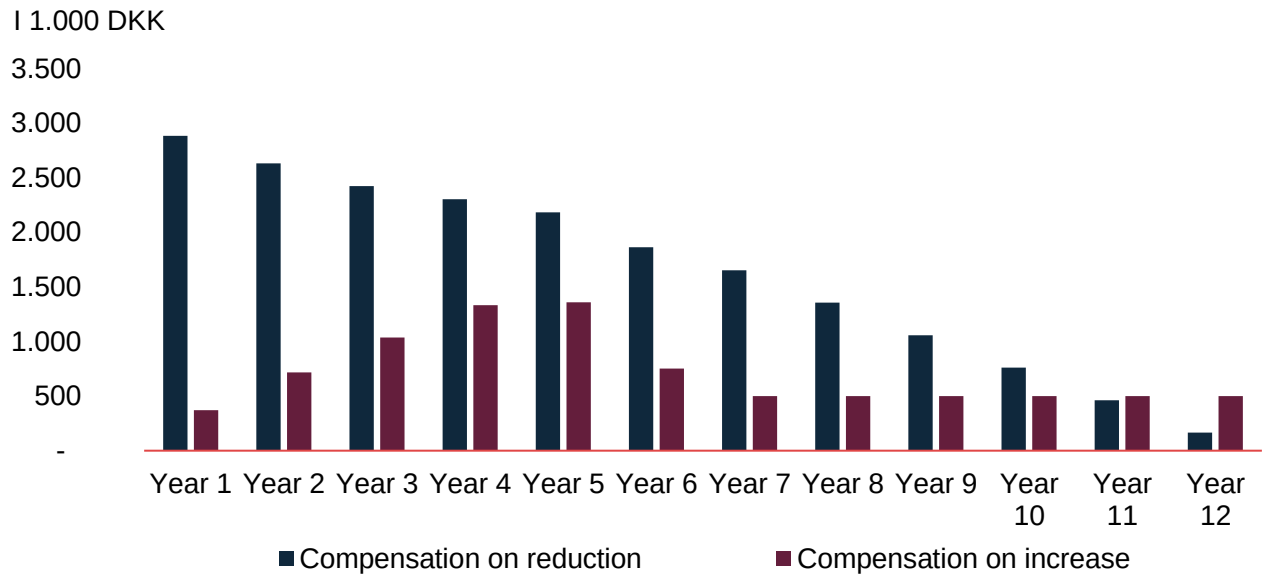
Some operators advocated that Movia should abandon the possibility of reducing or increasing the number of in-service buses entirely. In Movia's experience, however, it is necessary to be able to adapt bus services if demand for bus services increases or a municipality and/or region need to implement savings on bus services.

With the A16 tender process, Movia wanted to maintain the usual options for increasing or reducing timetable hours[5]. However, any increase in the scope of bus services was to be subject to the range and charging breaks of the electric buses as electric buses − as opposed to conventional buses − have a limited range and may require charging breaks in the course of a service day. If it would not be possible to absorb the desired increase in the number of timetable hours using the existing buses, the operator would be entitled to increase the number of in-service buses.

Movia and the Municipality of Roskilde therefore agreed on a solution maintaining Movia's rights to reduce and increase, but entitling the operator to financial compensation in case it was necessary to buy a new in-service bus or to take an in-service bus out of service. The operator would thus receive a lump sum compensation and receive regular payment for one additional in-service bus in case of an increase. The below figure illustrates the compensation model for the A16 contract.

[5] The model is, however, adapted so as to allow for an increase in the number of timetable hours by 30% or a reduction by 20% in the first seven contract years and another 30% of the scope of service in the 7th contract year in the subsequent five contract years. Besides, a restriction has been incorporated, limiting the reduction in the number of timetable hours to a maximum of 7.5% per year.

Figure 2: Compensation model in case of increases or reductions in in-service electric buses



The amount of compensation depends on the timing of the increase or reduction. In case of a reduction in the number of electric buses, the amount of compensation is reduced the further into the contract period the reduction is made. The idea is that the operator has realised the planned depreciation of the bus in the preceding years.

In case of an increase in the number of electric buses, the amount of compensation will increase in the first five contract years after which the amount of compensation will be reduced and then even out from the seventh contract year. The idea behind the compensation curve is that the further into the contract term the reduction or increase is made, the shorter the remaining period over which the bus is to be written off. The reason why the compensation is reduced from the sixth contract year is that it is assumed that it will be possible to use electric buses acquired in year 6 and onwards for a new contract when the existing contract expires.

Gradual phasing-in of electric bus services

Movia's tests of electric buses and electric bus tests in other European cities had shown that electric bus operation could pose some initial challenges. Experience indicated that challenges with the high-voltage systems of the buses (e.g. battery and electric motors) could only be expected to a minor extent, but that there could be quite some challenges with regular bus technology such as doors and cabin heating systems. Movia wanted to enable the operator to tackle any start-up problems. Together with the Municipality of Roskilde, Movia therefore decided to allow the operator to use diesel buses to a limited extent in the first two years of operation. In the first year of operation, the operator was allowed to use diesel buses for 15% of the planned number of bus runs without incurring a penalty. Likewise, the operator was allowed to use diesel buses for 10% of the planned number of bus runs. For each day an operator had to use one diesel bus, it would count as one wrong type of bus used.

Bonus

To encourage the widest possible use of electric buses and thereby reduce the potential use of diesel buses in the first two years of operation, the operators suggested during the technical dialogue a bonus scheme to incentivise the operators. Movia and the Municipality of Roskilde decided to incorporate a bonus scheme in the contract:

- If the operator delivered 91% electric bus service in the first year of operation, the operator would be entitled to a bonus of DKK 100,000. The amount of bonus could increase gradually up to DKK 500,000 when the operator had delivered electric bus operation of at least 99.2%.
- In the second year of operation, a bonus of DKK 100,000 would require an electric bus operation of 94%, and a bonus of DKK 500,000 would require an electric bus operation of at least 99.5%.

To make the bonus scheme manageable, it was important to Movia that the measurement of the wrong type of bus used could be connected to an existing data parameter.

Handling late or cancelled journeys in the running-in period

Under its contract regime, Movia can sanction cancelled journeys (e.g. as a result of bus breakdowns) and delays. Movia and the operators have many years of experience in this area when it comes to diesel operation, but lacked the same experience in electric bus operation. During the technical dialogue, the operators made it clear that if Movia did not allow the operators greater latitude in a start-up phase with respect to the penalty for cancelled or late journeys, the operators could feel compelled to add a risk premium to their tenders as they were not sure that they would be able to deliver the quality for punctuality and completed service that they wanted. Movia complied with the operators' request by entering a clause in the contract that for the first six months after the start of operations, Movia would grant exemption from sanctions for cancelled journeys and failures to meet the timetable. It would be a prerequisite for the exemption that the operator entered into a three-party collaboration with Movia and the Municipality of Roskilde in which the operator was to present action plans for rectification of the mistakes that led to cancelled journeys and/or failures to meet the timetable and that the operator implemented the planned measures. Movia, the Municipality of Roskilde and the operator would be obliged to participate in the three-party collaboration in the period from the start of operations until the bus services proved to be steady.

Requirement for electric operation, but freedom to choose electric bus solution

Usually, Movia makes functional requirement rather than technical requirements. This means that the invitation to tender does not demand the use of a specific technology such as for instance hybrid buses, but instead compliance by the buses with a limit value for CO2 emission (e.g. 0 g CO2/km) and fulfilment of a special environmental standard (e.g. EURO VI). In the A16 tender process, Movia agreed with the Municipality of Roskilde to require the operators to use electric buses (a technical requirement) because Movia and the Municipality of Roskilde assessed that the only alternative technology to electricity that would meet the zero-emission requirement was hydrogen buses. At the time, hydrogen bus technology was not at a stage where it was a commercial alternative to electric buses.

Electric bus operation was put out to tender with different options for the installation of charging stations. The tenderer could choose between electric buses which were only charged at the operator's garage, or buses which were primarily charged on chargers in public space. The tenderer could

choose to base its tender on charging stations installed by the Municipality of Roskilde. Alternatively, the tenderer could choose to install and own the necessary charging stations in public space itself. If the latter solution was chosen, Movia would be entitled to take over the charging infrastructure on expiry of the contract without having to compensate the operator.

Cabin heating

Another major challenge in electric bus operation relative to diesel bus operation that became apparent in the A16 tender process is the energy used to heat the cabin. Most electric bus models are equipped with an air-conditioning system that uses electricity to cool and heat the driver's seat and the passenger cabin, but when the outdoor temperature falls below approx. 0°C, the energy required to heat the cabin increases dramatically. This may pose a great challenge for electric buses charged at bus depots as such an energy consumption reduces the range of the bus significantly. Buses charged at the bus termini have the advantage that a longer charging time at the bus termini can compensate for the higher amount of energy used to heat the cabin.

To give the tenderers as many technical solutions to work with as possible, Movia and the Municipality of Roskilde decided to permit the use of a heater as long as the heater uses a second generation biofuel.[6] Movia assessed that the marginal cost of using an HVO heater would be significantly higher than the cost of electric heating, which would give the operator a strong incentive to reduce the use of the heater to a minimum. Movia also provided greater flexibility in the dimensioning of the bus system by permitting an indoor climate of 16-22°C in the electric buses in the winter months as Movia assessed that it would not be a problem for the passengers compared to the 18-22°C usually required by Movia.

In addition, various contractual issues were adjusted to make the start-up phase easier for the operators as Movia knew that the operators had only limited experience with electric bus operation. It included issues such as delivery time and the use of electric buses. The other matters are dealt with in further detail in the below table.

[6] By "second generation" Movia means that the fuel must not be produced from crop which can be used as food (e.g. palm oil, sunflower, corn, rape and soya).

Table 1: Other changes to contract terms for the A16 tender process

Penalty for late delivery

In contracts for the operation of conventional buses, the operator will be liable to pay a penalty of DKK 2,000 per bus per 24 hours in case of late delivery. As a result of the challenges Movia had experienced with punctual delivery of electric buses in pilot projects, Movia decided to increase the penalty for late delivery of electric buses. The level of penalty for late delivery was DKK 3,000 per bus per day in the first 30 days, after which date the level of penalty would increase by DKK 1,000 per bus per day for each period of 30 days or part thereof by which the delivery of the bus was late. However, the maximum penalty could not exceed DKK 7,000 per bus per day.

Right to later use of electric buses

To accommodate the uncertainties as to whether the bus suppliers would be able to deliver the electric buses for the start of operations, Movia made it possible for the tenderers to offer diesel operation in a start-up period. For routes 201A and 202A, it was possible to offer diesel operation from 14 April 2019 to 30 June 2019 and for the other city bus routes the operator could defer the use of electric buses to 14 April 2021. In the evaluation of the tenders, Movia attached positive weight to the use of electric buses from the start of operations.

More time for tender submission

In invitations to tender for diesel bus services, the tenderers typically obtain parallel offers from a number of bus suppliers, but in connection with the A16 process, several tenderers assessed that it would lead to a better solution if they entered into close collaboration with one or a few bus suppliers. In this way, electric bus solutions were optimally tailored to the terms of tender. For both operators and their Danish bus supplier partner, it was completely new to work with electric bus solutions, and therefore, there was a special need for extra time to prepare the tender in detail. The period for prequalification and tender preparation was extended from 4 to 6½ months.

Training of drivers

With the transition to electric bus services, the operators needed time prior to the start of operations to provide training to the drivers in driving the electric buses. According to Movia's general conditions of contract, the Danish Transfer of Undertakings Act is applicable to the transfer of employees in case an operator takes over the bus operation from another operator. Movia therefore agreed a number of terms with the operator who risked having to give up the operation of the city bus routes of Roskilde on the secondment of employees prior to the date when the operator may cease to operate these routes – i.e. prior to the start of operations using electric buses.

Site for bus depot

The location of a bus depot may be an important competition parameter in electric bus service contracts as a location close to the termini of the bus routes gives less deadhead and thus fewer costs for drivers' wages and fuel. It can be difficult for the operators to find suitable sites because of distance requirements to noise-sensitive built-up areas, and local plans to use sites for purposes other than bus depots.

4.1.5 Negotiation rounds

Nine tenderers were selected to participate in the tendering for the operation of the city bus routes of Roskilde. The tender process included two negotiation rounds. The tenderers submitted tenders prior to the first and second negotiation rounds and a final tender. Only the final tender was binding. In the two negotiation rounds, the tenderers were given feedback on their tenders and an evaluation of the ranking of the tender in relation to the most economically advantageous tender at the time.

The award criterion in the A16 tender process was the most economically advantageous tender identified as the best relationship between price and quality. The tenders were evaluated on the basis of the weighted scores for the sub-criteria:

- Price (weighting 40%)
- Quality of service (weighting 35%)
- Environment (weighting 10%)
- Quality of equipment (weighting 15%)

In the evaluation of the sub-criterion *Environment*, interior and exterior noise had a high value. The tenderers could use used buses for the first 2½ months on routes 201A and 202A, and used buses for the first two years on the other city bus routes. By offering electric bus services from the start of operations, the tenderer would achieve a higher score for the other environmental properties of the buses (CO2 emission and emission of NOx and particulates). The idea behind permitting the tenderers to use used diesel buses was to handle any challenges for the bus manufactures in delivering electric buses for the start of operations and thus ensure the best possible competition among the bus suppliers.

In the evaluation of *Quality of service*, it weighed positively if the tenderers offered flexibility in running electric buses. By that, Movia meant that the operators offered a bus system which would allow Movia to change and extend the scope of the bus services.

In the evaluation of *Quality of equipment*, it weighed positively if the charging stations in public space had a high design quality. The Municipality of Roskilde would, as described above, install Siemens' charging infrastructure solution in public space if the winning tenderer based his tender on the charging solution of the Municipality of Roskilde. Siemens' solution for charging infrastructure in public space and any solutions offered by the tenderers were evaluated on the same criteria. Installing charging infrastructure in public space was seen by the Municipality of Roskilde as a necessary evil, and solutions without charging infrastructure in public space was given the highest possible score for design quality of a charging station in public space. Accordingly there were some sure points to score by offering depot charged buses.

As it was the first time that Movia offered electric bus operation using 12-metre electric buses, Movia wanted to make sure that the tenderers had the necessary knowledge about electric buses to successfully provide an electric bus service. In the evaluation of the tender, it was therefore assessed positively if the tenderer presented well-described and well-documented approaches to the implementation of the electric bus solution, the necessary number of spare buses, the description of day-to-day operations, prevention of errors and defects, remediation of errors and defects and a description of how to charge the buses. During the two negotiation rounds, the tenderers and Movia

matched their expectations to the implementation of electric bus operation. Movia saw the requirement that the tenderer should describe these special electric-bus related matters as essential to the successful tender process. As the tender process proceeded, the tenderers' descriptions of the electric bus operation were brought to a level where there were only minor differences between the solutions offered.

Negotiated procedures including a prequalification process are governed by Article 47 of the Utilities Contracts Directive[7].

4.1.6 Result

In February 2018, the contract to operate the city bus routes in Roskilde was awarded to the operator Umove Øst which offered a solution with Chinese Yutong electric buses to be charged at the bus depot and which chose to place the garage and the bus depot on the site provided by the Municipality of Roskilde. On 28 February 2018, the Municipality of Roskilde opted out the offered diesel operation solution and decided to run all bus services on its city bus routes with electric buses.

The operation of the 20 electric buses was launched on 14 April 2019 as planned. The annual additional price for the Municipality of Roskilde compared to the former diesel bus contract was DKK 1m per annum, corresponding to 2% of the contract price. However, the Municipality of Roskilde could have achieved a saving of DKK 1.7m per annum if they had chosen the diesel option on routes 203, 204, 205, 206, 208, 209 and 212. As Umove does not base its electric bus solution on charging in public space, there were no associated initial costs for Roskilde. Accordingly, the actual costs of electric bus operation have proven to be significantly lower than estimated prior to the invitation to tender.

Because the winning tender did not include urban charging points, Movia and Umove made a new agreement on the special terms for cancelled journeys in the running-in period as nothing in the tendered electric bus solution called for special terms in relation to delays. The special terms would only be applicable in case of cancelled journeys as a result of problems with the high-voltage system of the buses (e.g. battery and motor).

4.1.7 Evaluation of the process

Steering committee

The Municipality of Roskilde and Movia agreed that the appointment of a steering committee in connection with the A16 tender process has been essential for the entire process of developing the contract documents and implementing the tender process. As mentioned, the steering committee consisted of representatives of Movia and the Municipality of Roskilde who had the necessary technical insight and decision-making power. The composition proved to be important for the progress.

[7] Directive 2014/25/EU of the European Parliament and of the Council of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal services and repealing Directive 2004/17/EC.

It meant that the steering committee has been able to effectively define and discuss problems that arose in the process and use the discussions to make decisions on how to shape the invitation to tender. The steering committee constellation therefore also helped ensure that everybody was on 'the same side' and working for a common solution. In other words, there was a forum for discussion of questions, principles and solution models for the A16 tender process and the invitation to tender for the contract to install charging stations in public space.

The close collaboration between the Municipality of Roskilde and Movia was key to the course of the process as it was the first time that the contract for entire bus routes was put out to tender with a requirement for all-electric service, and therefore, it was necessary to modify some of the existing contract terms to reduce the risks experienced by the operators. These changes meant, however, that the Municipality of Roskilde would accept an increased risk, including the installation of charging infrastructure in public space and reduced flexibility in terms of adapting the scope of bus services. By going through the development process in a steering committee form, Movia made sure that the Municipality of Roskilde understood the need for and significance of changing contract terms and that the Municipality of Roskilde supported the solutions chosen.

Delimited case for development

Another key lesson learned from the A16 tender process is that it is advantageous for the development work with new tender principles and models if it takes place within one municipality. Only the Municipality of Roskilde was relevant for the A16 tender process because the bus routes put out to tender were to run in Roskilde only. Such a delimitation means that fewer stakeholders are involved in the development work and the decision making. It also meant that the political ambitions about electric bus operation were clear. The Municipality of Roskilde also expresses satisfaction with the collaboration and sees it as an advantage that they have also used resources on engaging in the development work:

> *"The combination of our commitment to change some standards and Movia's commitment to listen to what we had to say, together with their knowledge about what has worked previously has been a good combination"*
>
> Ivan Hyllested, Road Manager, Municipality of Roskilde

As Ivan Hyllested, Road Manager of Roskilde points out here, both parties were interested in establishing a mechanism for effective collaboration and achieving good results. The willingness and clear lines of both parties are assessed as being a strength for the course of the process.

Market dialogue

Today, both suppliers and operators look back at the dialogue with the Municipality of Roskilde and Movia as a positive experience. Here we think of the after-hours meeting, the market dialogue and, for the winning operator, the subsequent dialogue. The experience is also that the Municipality of Roskilde - as opposed to other municipalities - is quite advanced in their understanding of zero-emission bus services and the consequences it has and what it takes. According to the winning operator, both Movia and the Municipality of Roskilde have been very sympathetic to the process that they as operator had to go through:

” Being part of the dialogue with the Municipality of Roskilde and given the opportunity to give our input has been positive. Even though we are further ahead in technology, the Municipality of Roskilde distinguishes themselves by being so actively involved and at such an advanced stage. So that has resulted in a really good collaboration ”

Johnny B. Hansen, CEO, Umove Øst

Changes to contract terms

The tendering operators saw it as a positive thing that Movia was prepared to change traditional contract terms and that the Municipality of Roskilde was also prepared to accept an increased risk. Likewise, as a result of the current dialogue with the market, the operators have felt that their concerns and input were heard and taken into consideration in the changes to the general conditions of contract that were made. One of the circumstances that is mentioned is the extension of the contract term from six to ten years. As a result of the change, the operators have submitted tenders with a better price and the risks involved in tendering for A16 were perceived as lower. It is, however, pointed out that a contract term of ten years may lock a solution on a market at a time when technology is developing rapidly. The perception is that this model is the safe way rather than a procurement model requiring increased innovation. However, Movia is of the opinion that it is more important to design a sustainable and safe contract model securing the daily bus services for the citizens of Roskilde and limiting the additional price of electric bus operation.

A contractual issue that tenderers point out as inexpedient is the customer satisfaction penalties and bonuses which are structured in the same way as in diesel bus contracts − an assessment that depends on the customer responses to a number of questions. Here attention is, among other things, called to the evaluation of noise level which for electric buses differs considerably from that for diesel buses. The concern of the operators is that the noise level of electric buses will be the ‘new normal’ for customers even though the evaluation scale remains unaltered. At present, it is, however, not possible to assess whether these concerns are legitimate.

The A16 tender process is seen as an example of ‘the perfect storm’ with good timing in terms of political willingness, technological developments and Movia’s preparedness to engage in the work with zero-emission solutions. The development process has been characterised by openness and a willingness to share information about electric bus operation and related risk elements, and at the same time the parties involved have been prepared to allocate the resources required for the development work.

LESSONS LEARNED FROM THE A16 TENDER PROCESS

It is a clear advantage for the Public Transport Authority to appoint a steering committee that gathers relevant key persons from the Public Transport Authority and municipalities to create a common understanding of challenges and the need for alternative solutions.

It is advantageous for the development work on new tender principles and models if it is limited to one municipality with clear political objectives and economic priorities.

A close dialogue with the market about the risks and challenges they see in new technology strengthens collaboration and draws attention to potentially problematic contract terms.

4.2 Activities relating to tendering for a framework agreement on charging infrastructure in public space

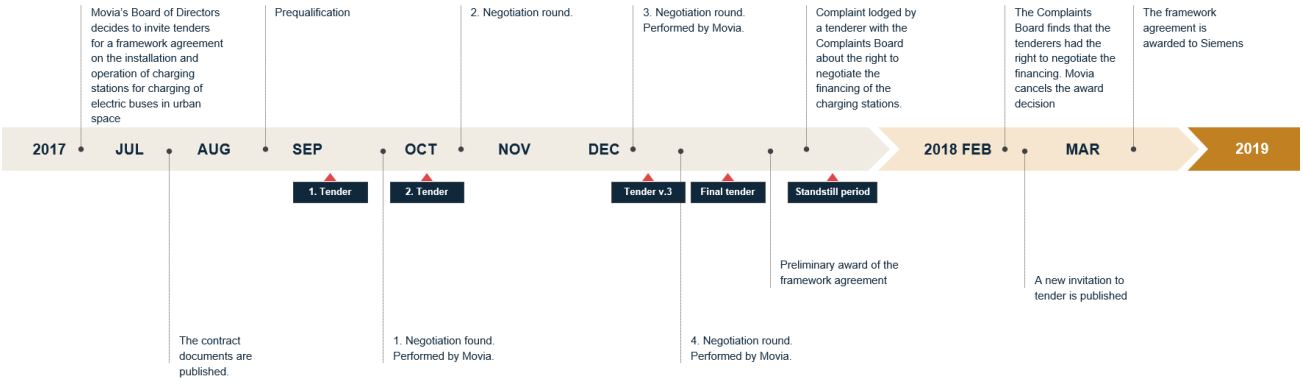
In order to be able to meet municipalities' and regions' zero-emission requirements, it became relevant to find a model for the management of charging infrastructure in public space. Charging infrastructure in the public space (at bus termini) makes it possible to fast charge the electric buses on the route and thereby increase the range of the buses without it being necessary to return to the depot for recharging. Solutions for charging electric buses in public space have undergone significant development, and chargers from a number of suppliers are available in several European countries. Therefore, Movia had several places to look for inspiration for the technical options available. However, no cities or Public Transport Authorities had yet based a business model for charging infrastructure in public space on a framework agreement. Movia therefore entered untested territory.

The need for a framework agreement was already apparent in the A16 tender process where Movia had an ongoing dialogue with the operators about charging infrastructure in public space among other things. Until the A16 tender process, there had been a clear division of work between Movia and the operators where Movia was in charge of planning bus routes, timetables and the like, and the operators provided the bus services. The operators were therefore also responsible for any matter that concerned the running of the buses. Through the dialogue, the operators clearly stated their position: If they were to be responsible for installing and operating charging infrastructure in public space, several operators would be discouraged from participating in the tender procedure.

It was clear to Movia that they had to find a model for how to handle charging infrastructure in public space and how to regulate the collaboration between the parties involved. First and foremost, the installation of charging infrastructure in public space meant that a supplier of charging infrastructure would become involved as a third party in the collaboration between Movia and the operators. In addition, the installation of charging stations in public space would require a more extensive collaboration between Movia and the municipalities. Part of Movia's work of developing the framework agreement therefore consisted in establishing guidelines for the obligations to be assumed by the parties involved.

The below figure provides a chronological overview of activities associated with the development of the contract documents and the framework agreement tender process. Subsequently, the individual activities will be detailed.

Figure 3: Timeline of activities relating to the framework agreement on charging infrastructure in public space from the time when the decision to invite tenders was taken



4.2.1 Development in the working group

As part of the project, Movia appointed a working group with the purpose of gathering representatives of the relevant parties to discuss guidelines and principles for charging infrastructure in public space.

The members of the working group were carefully selected by Movia on qualitative criteria such as knowledge and understanding of the area, an interest in finding solutions and a will to seek compromises. Neither the operators nor the suppliers were included in the working group. Instead, a representative of the Danish EV Alliance, a member of the trade organisation Danish Energy, joined the working group to represent the suppliers. The reason was that Movia wanted an insight into the possibilities offered by the suppliers without risking distorting competition. The working group consisted of:

- Movia (contracts, infrastructure and legal)
- The Capital Region of Denmark
- The Municipality of Copenhagen
- The Danish EV Alliance, Danish Energy

In addition, a steering committee consisting of Movia's Executive Board was appointed to review and approve the procurement model proposed.

Through six-seven months the working group discussed a large number of issues relating to charging infrastructure in public space. There was a continuous idea generation and concept development process to find solutions which were realistic for suppliers, operators, municipalities and Movia. The working group considered questions such as:

- Ownership of charging infrastructure in public space
- Operational reliability
- Managing repairs and maintenance

- Maintaining competition between the suppliers in connection with an invitation to tender for a framework agreement
- Maintaining competition in connection with all parts of the framework agreement
- Securing identical conditions for the operators in relation to using the framework agreement
- Securing low prices

Market survey

As part of the working group's work, Movia carried out a market survey to try to obtain feedback from the European suppliers in order to examine market conditions. The response was limited, and Movia therefore drew on its experience from tests of buses charged at bus termini on route 3A in Copenhagen, input from the Danish EV Alliance on behalf of the market and the dialogue with the operators. In addition, Movia entered into a dialogue with Radius' project department (Distribution System Operator) concerning connection to the grid.

Dialogue with the operators

Towards the end of the working group's work, Movia had a dialogue with the operators to find out whether the operators were prepared and able to install charging infrastructure in public space. Movia also wanted the operators' input to a procurement model for a framework agreement on charging infrastructure from a third-party supplier. The operators indicated that they did not have the expertise required to handle charging infrastructure on the local technical level in terms of obtaining approval of the design, permission to place chargers in urban space, etc. Also, experience from the A16 tender process in Roskilde showed that suppliers of charging stations submitted different prices and service levels in their tenders depending on the size of the operator. The working group therefore also sought to find a solution that would place the operators on an equal footing when tendering for competing for the electric bus services of the future.

Tendering model

Movia's Executive Board decided in February 2017 that Movia was to invite tenders for a framework agreement on the installation and operation of charging stations to charge electric buses in public space. The contract documents were based on the recommendations of the working group.

The underlying business model was designed to match the expertise of the parties involved and in such a way that their obligations were based on the core services of each individual party. Movia therefore wanted to invite tenders for a framework agreement on a standard solution and price for charging stations in public space which made the supplier responsible for delivering, installing, servicing and maintaining the charging infrastructure. Through a framework agreement on charging infrastructure, Movia would secure price, performance and service level obligations from a system supplier which were applicable to all operators who wanted to use chargers at bus termini in their tenders. Likewise, Movia assumed responsibility for the collaboration with the municipality in relation to the construction work required to install chargers in urban space. In this way, the operators could focus on operating the electric buses.

4.2.2 Negotiation and tendering processes

In July 2017, the first version of the contract documents was published, and at the beginning of September 2017 Movia entered into negotiations with three suppliers. There were four negotiation rounds during which the contract documents were currently adjusted.

During the negotiation rounds, all contract documents were reviewed, but some provisions dominated. A key issue was **financing**. Movia wanted a framework agreement with continuous repayment over a period of 12 years on charging stations, which proved to be difficult for the suppliers to handle in their accounts. Because of great uncertainty as to the scope of services actually delivered (from 0 to 100 charging stations), the suppliers could not handle the financing of the charging stations. Moreover, too much capital, which might not be used at all, would be tied up over a period of potentially eight years (the maximum term of the contract).

After lengthy negotiations and searches, Movia chose to continue with finance leases managed by Movia through a lessor. Movia subsequently entered into a leasing framework agreement with KommuneLeasing.

The leasing framework agreement allows municipalities and regions to finance the cost of charging stations in public space through their current contribution to the bus services, and they can thus accommodate the payment in their budgets. Only very few municipalities can pay a multi-million sum in connection with the start-up of new contracts for bus services.

Other predominant subjects were uptime requirements, penalty regime, management of operational reliability, evaluation of design, costs of excavation works etc., insurance and allocation of responsibilities in case of mistakes or defects between the supplier, the operator and Movia.

The framework agreement was **awarded preliminarily** on 20 December 2017 with a subsequent stand-still period of ten days. In this period, one of the tenderers brought a complaint before the Danish Complaints Board for Public Procurement concerning the right to negotiate the financing of the charging stations. The subject-matter of the complaint was that there was a financing obligation in the original contract documents and that it constituted a material change that this financing obligation was eliminated during the negotiations. In February 2018, the Complaints Board rendered its decision, holding that the negotiation of a reduction in the tenderers' financing was permitted, but it was not permitted to eliminate it entirely during the negotiations.

Subsequently, Movia decided to **cancel the award decision and shortly after issue a new invitation to tender for the framework agreement**, with appropriate adjustments to the contract documents. However, the changes were minor so Movia could reissue the invitation to tender for the framework agreement without negotiations and do so within the shortest possible deadline under the EU procurement rules. The short deadline was necessary in order for the framework agreement to become effective for the coming A17 tender process and to give Movia and the winning operator time to carry out the necessary preparatory activities.

As described, the reissue of the invitation to tender provided the opportunity to make various appropriate adjustments to the contract documents and led to a 30% reduction all tendered prices.

The below table provides an overview of the changes made to the contract documents throughout the negotiation process.

Table 2: Challenges and changes to special terms of tender

	Original contract documents	Reasons for the changes	Changes to terms of tender
1	Installation agreement for 10+2 years	A desire for greater flexibility to adapt to future changes to operator contracts	Installation agreement 6 years with an option for Movia to extend by another 2+2+2 years and to have shorter installation agreements in connection with existing charging stations
2	The overall weighting of criteria: price 45%, quality 55%, aesthetics passed-not passed.	To be able to rule out solutions on the basis of aesthetics. It is also important to give the design of the charger a weighting in the award. The need to have a high-quality well-working solution where low-price and low-quality opportunists will face difficulties.	The overall weighting changed to: price 40%, quality 45%, aesthetics 15% (including an evaluation of the flexibility of the solution in relation to urban space).
3	The underlying weighting of price: basic price 65%, electricity 20% and options 15%.	The profit on electricity has too much weighting relative to the financial share of the amount used for evaluation purposes.	The underlying weighting of price is changed to reflect the individual price's share of the total amount: basic price 80%, electricity 5% and options 15%.
4	Only possible to use diesel to a temporary charging station with a generator to produce electricity.	HVO biodiesel makes it possible for the CO2 emission of a bus route to remain zero despite the use of a generator, which affects the environmental accounts of the municipalities and the environmental profile of the bus route.	Demand for the use of HVO for a temporary charging station with a generator to produce electricity.
5	The supplier is obliged to maintain and update the Movia database. Loss of data is deemed to be an indirect loss.	Need to protect against inappropriate loss of data from the charging stations in connection with downtime and maintenance windows.	Requirement that data generated in periods of downtime or maintenance windows may not be lost and must be available after the end of the downtime or maintenance windows.

6	No requirement or expectations for connection time (time spent on lowering and raising the pantograph)	Significant differences in connection time from system to system	The connection time is included as an underlying element in the evaluation

4.2.3 Collaboration agreement with municipalities and regions

The framework agreement provides for increased collaboration between Movia and the municipalities on the installation of charging stations to be placed on the municipal areas or third-party roads or sites. The reason is that with the framework agreement, Movia assumed responsibility for coordinating the preparatory work of inspecting potential locations for charging infrastructure before inviting tenders for the bus services, including finding sites for the charging stations and determining the need for any physical changes to urban space in connection with the installation of charging stations.

The installation and operation of charging infrastructure for electric buses on bus routes, including routes across municipality borders, make special demands on the collaboration between the authorities affected. To establish a uniform set of ground rules for the municipalities and regions that share the responsibility for bus routes put out to tender with a zero-emission requirement, Movia therefore prepared **a collaboration agreement for the installation of infrastructure to charge electric buses and plug-in hybrid buses in public space**. The collaboration agreement must be signed by all municipalities and regions who wish to invite tenders for zero-emission bus routes.

Some of the most important aspects of the collaboration agreement include:

- The obligation of municipalities and regions to investigate and inspect potential locations for charging stations together with Movia and the supplier. The inspection will subsequently form the basis for the supplier's price which operators can use in their tenders.
- The obligation of municipalities and regions to make suitable sites available to Movia for the installation of charging stations.
- The allocation of costs between municipalities and regions for the installation and operation of charging stations and in connection with their relocation.

4.2.4 Result

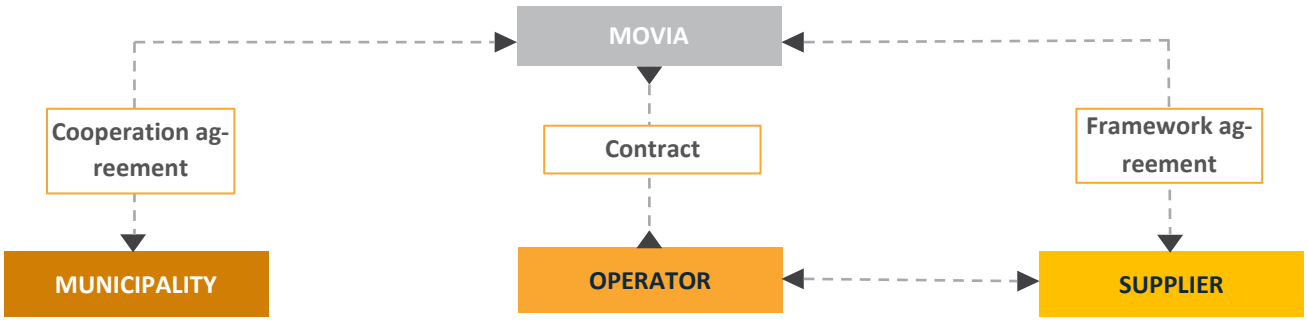
After the reissue of the invitation to tender, the framework agreement was awarded to Siemens A/S in March 2018. Siemens was thus granted exclusivity to install and operate charging stations in public space and the supply of electricity throughout the contract term for regular public bus services arranged by Movia. The framework agreement runs for a term of three years with an option for renewal for five terms of one year. The individual installation agreements made under the framework agreement run separately for up to twelve years and follow the specific contract of the bus operator.

Business model for charging infrastructure in public space

With the framework agreement, a new business model is introduced in Movia where the supplier of charging infrastructure, Siemens A/S, is introduced as a third party to the collaboration between Movia and the bus operator. The roles are divided as follows:

- **The supplier** is responsible for delivery, installation and maintenance of charging stations in public space and the supply of electricity. The supplier is responsible for all aspects until the point when the pantograph connects to the bus and supply the necessary electricity. Further, the supplier pays any loss of current in electronic equipment and any standby electricity.
- **The bus operator** is as previously responsible for bus services (including the purchase and operation of buses), depots, including charging infrastructure on such depots. The operator is responsible for placing the bus correctly relative to the charging mast so that the pantograph can be connected to the high-voltage system of the bus. The operator pays directly to the supplier for the use of electricity for the buses.
- **Movia** is the contracting authority responsible for the contracts and acts as a liaison to the municipalities. Movia is also responsible for coordinating inspections of potential locations for charging stations in public space.

Figure 4: Cooperative relationship between stakeholders in connection with charging infrastructure in public space



Financing and ownership of charging infrastructure

When ordering charging infrastructure, municipalities and regions may choose between the following financing options:

- Finance leasing through a public leasing company (KommuneLeasing) with a monthly leasing payment.
- Upfront payment to the supplier. In case the financing parties agree, all or part of the costs of installing the charging stations can be paid through an initial payment.

If the relevant municipalities and regions choose a solution where the charging infrastructure is financed over the contract term, a leasing agreement with KommuneLeasing is entered into. For the same contract term as the 'Framework agreement on Charging infrastructure in public space', KommuneLeasing will provide an amount for finance leasing to buy charging infrastructure, including

chargers, control cabinets, cables and network connections, physical adjustments to bus termini, etc. Under the leasing framework, specific leasing agreements are entered into, which will in practice correspond to the content and costs for the installation agreements concluded with the supplier. KommuneLeasing will thus be the owner of the charging infrastructure.

If the relevant municipalities and regions wish to pay for the charging infrastructure upfront, it will be owned by the supplier until the end of the contract with the operator. On expiry of the contract, Movia may choose to take over the charging station at no costs or have the supplier scrap it.

Locating and ordering charging stations

- Together with the relevant municipalities and the supplier, Movia decides on the exact location and number of charging stations offered on the individual routes in tenders requiring zero-emission vehicles. Subsequently, price quotations are obtained from the supplier.
- The charging mast can be located 50 to 250 cm from the kerb and is available in different colours.
- Special additional services in the form of other requests for design, gloss, control cabinet wraps, greening, etc. are paid by the municipality as a lump sum payment.
- Thereafter, the operators may choose to submit tenders for electric bus services with charging infrastructure in public space, including the requested number of charging stations and their power level (150 kW, 300 kW or 450 kW).
- Movia enters into an installation agreement with the supplier on charging infrastructure in public space for the relevant electric bus route included in the operator's tender.

Section 4.3.4 describes the implementation of the framework agreement in connection with a specific invitation to tender (A17).

4.2.5 Evaluation of the process

Favourable conditions for the operators

From Movia's point of view, the framework agreement is an essential element in the transition to a future with zero-emission buses as it provides the operators with a better basis for using the technology for charging at bus termini in their tenders. With the agreement, Movia has strived to create favourable conditions for the operators to prevent that they are forced to assume responsibility for areas within which they have no expertise when tenders are invited for zero-emission bus routes. Most operators indicate that the framework agreement gives them more options when they are to assess which technological solution is most suitable for the specific project. A few operators feel well prepared to take on the entire task themselves. However, there is broad agreement among the operators that one of the key advantages of the framework agreement is that they do not have to cooperate with municipalities on the installation of charging infrastructure in urban space and that they can expect a fixed price and fixed criteria for the practical management of operations. Where, for some operators, it opens up to new possibilities in tendering, other operators argue that the framework agreement puts the brake on the innovative development of new fuel technologies because the operators have a fixed agreement they can lean on instead of finding new and cleverer solutions. From the operators' point of view, there are various practical and pricing advantages of such a framework agreement which contribute to making the use of charging stations in public

space easier in their tenders and future operations. It is, therefore, Movia's opinion that the framework agreement has resulted in, and will also in future result in, a number of positive impacts, including:

- Increased competition among the operators by ensuring uniform conditions and prices across the operators, large and small.
- More zero-emission options where the operators are free to choose the technology to use.
- Uniform design in the urban landscape as the supplier has an exclusive right to install in Movia's area.
- A uniform technical solution for chargers in public space.
- Increased efficiency in making binding agreements that the players perform tasks and fulfil responsibility with their respective core business areas.
- Lower prices through the use of Movia's size to put prices out to competitive tender.
- Smooth handling of the installation of charging infrastructure in public space.

Working group

It is further the opinion of Epinion that the appointed working group has been decisive for the outcome of the framework agreement. In particular, the working group has helped kick-start the new collaboration constellation between Movia, the municipality, the region, the operator and the system provider. In this context, Movia points to the importance of appointing the right representatives of the organisations based on their skills and knowledge of the market and a fundamental interest in finding solutions and a will to seek compromises.

Alternative finance

The same compromising approach has also been used in the tender process itself where funding challenges have played the greatest role. Movia's request for current payment of the charging infrastructure was not an option for the system suppliers. Rather than imposing on the operators the risk of the investment, Movia tried to find an alternative solution in the form of finance lease which would consider the interests of all parties.

Likewise, Movia sought to make it easier for the suppliers to enter into a framework agreement in the cases where Movia could not offer a guarantee for orders to the supplier who might then be left with a loss if only few orders were placed under the framework agreement. Movia took an open and constructive approach where the suppliers felt heard and taken seriously throughout the tender process. That meant that already in this process, Movia began to build up a relationship with the supplier as a new collaborative partner. And in this case indeed, good relations are essential because the framework agreement is not an independent deliverable, but a deliverable that comes into play by virtue of other tender processes and requires collaboration between the parties involved.

LESSONS LEARNED FROM THE FRAMEWORK AGREEMENT

By making a framework agreement on the installation of charging infrastructure, the Public Transport Authority creates favourable conditions and equal competition for the operators on the market.

Clear and formal agreements ensure that the stakeholders involved commit themselves and make it easier for the transport company to navigate in new collaboration constellations.

By involving representatives of all relevant stakeholders in the development of new types of tender processes, the Public Transport Authority can issue realistic and thoroughly prepared contract documents. Ultimately, it gives a better end result of the tender process.

4.3 Activities relating to the A17 tender process

At the same time as the A16 tender process was rounded off in Roskilde, Movia started up the A17 tender which included routes 2A and 18 in the Municipalities of Copenhagen and Frederiksberg as well as routes 147, 157 and 156 in the Municipalities of Ballerup and Egedal. Also in this invitation to tender, Movia requested a zero-emission solution. As opposed to the A16 tender process, the A17 tender process involved several municipalities which were to agree on the environmental requirements to be made to the bus services.

In its Budget for 2017, the Municipality of Copenhagen decided that: "*Movia's future invitation to tender for bus services in Copenhagen is to require the bus services to be delivered with the use of electric buses or other buses delivering the same positive impacts as electric buses in terms of zero emission of CO2, significantly lower noise level in urban space and reduced local air pollution.*"[8]. In the Budget for 2019, the Municipality of Copenhagen further decided that all bus routes which are wholly or partially financed by the Municipality of Copenhagen must, to the extent possible, be converted to electric operation by 2025. And that, to the extent possible, support should be obtained from the other municipalities co-financing bus routes in Greater Copenhagen[9]. Likewise, the Municipality of Frederiksberg decided in 2018 to require that all future bus services put out to tender were to be zero emission. The objective is that all public bus services in Frederiksberg is to be powered by electricity or hydrogen by 2030[10]. In the Municipality of Ballerup, there was also a strong desire to introduce zero-emission buses, and it was decided to require zero-emission operation on city bus routes and fossil-free operation on other bus routes in future invitations to tender[11]. The last municipality involved, the Municipality of Egedal, did not have the same political objective of giving priority to zero-emission buses. As a result of the lack of agreement among the municipalities, Movia and the operators faced a more challenging process in terms of procurement technical aspects as they were to include options in the invitation to tender to the effect that the municipalities did not have to decide whether to opt for zero-emission bus services until the winning tenderer had been selected.

In the same way as in the A16 tender process, Movia worked with options for conventional bus services so that in practice, two solutions were put out to tender, a zero-emission solution and a fossil-free solution. In that way, the municipalities were able to assess the additional price of choosing zero emission. The A17 contract documents were generally very similar to the A16 contract documents as Movia had already gone through extensive development work in connection with the A16 tender process which had given Movia experience and a dialogue with the market which was brought into the A17 process:

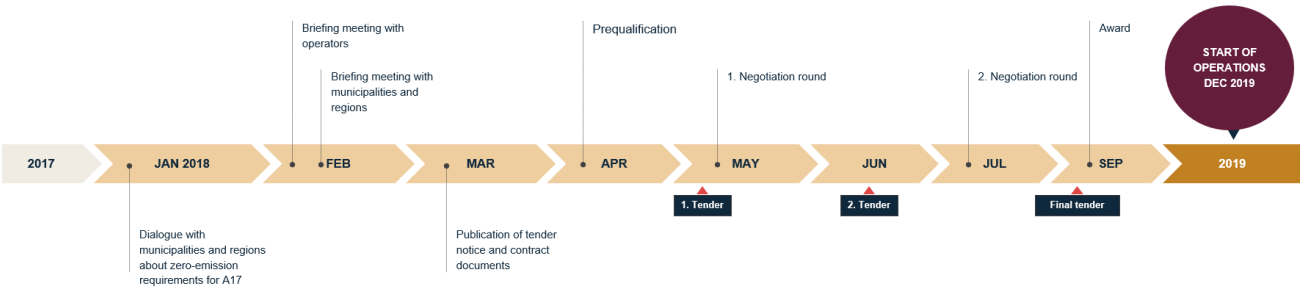
> *"We have had an advantage in that all development work had been made in dialogue with the Municipality of Roskilde, so that we already had a ready-made model we could present to them and say: this is roughly how we should go about it"*

[8] Budget 2017: GREEN CITY AND INFRASTRUCTURE, The Municipality of Copenhagen.
[9] Budget 2019: CLEAN AIR IN A GREEN COPENHAGEN, The Municipality of Copenhagen.
[10] Frederiksberg Electric Vehicle CITY NO.1. Now and towards 2030, The Municipality of Frederiksberg, 2019
[11] The Assembly Hall of the Local Council at the Town Hall of Ballerup, the Municipality of Ballerup 2018

Jeppe Gaard, Head of Contracts, Movia

As is clear from the below timeline of activities in the A17 tender, the process was significantly shorter than the A16 tender process.

Figure 5: Timeline of activities relating to the A17 tender process



4.3.1 Adapting the terms of tender from A16 to A17

Basically, the A17 exercise was very similar to the process that Movia went through in the A16 tender, and the overall principles of the contract documents were repeated. Movia used its experience and learnings from the A16 tender to adapt the terms of the A17 tender process.

Managing flexibility in operations

In the A16 tender process, Movia had given the operators various aspects for which they could be given scores in the tender submission, e.g. for how to manage electric bus operation, spare parts, servicing and maintenance of the buses. One of these aspects was scores for flexibility offered by the operator in the operation of the bus services. Movia had some latitude with regard to the evaluation of flexibility based on information from the operators on charging time, the range of the bus, and the mileage by which the operation could be extended. Through the A16 process, Movia discovered that the method was unsystematic, which made it difficult for Movia to compare the flexibility offered across the tendered solutions.

In order for Movia to be able to ensure the necessary flexibility to extend the bus routes, Movia had to find another evaluation model. The solution was a model based on routing which depended on mileage. Specifically, Movia required an option for extension of the routing by 10%. Likewise, the operational flexibility was turned into an evaluation criterion, meaning that the tenderers could achieve scores by offering a greater degree of operational flexibility with an option for extension of

the routing by more than 10%[12]. As a result, the operators had to actively assess the impact of the extension on the bus system in terms of battery capacity and need for charging. Movia could then easily assess the operational flexibility of the solutions offered. From Movia's point of view, this model had another advantage in that it internalised expenses associated with a subsequent extension of the routing.

From the operators' point of view, the zero-emission requirement is not only about changing from one fuel to another. It is also about running the services in an entirely new way, and some operators saw the flexibility requirement as a requirement that added to costs as it led to an over-dimensioning of the bus system. At the same time, operators tendering for both A16 and A17 say that for them the learning curve has also been steep and that they had far more knowledge of the technical options available when bidding for A17. Put differently, the operators had built up the necessary technical knowledge to assess the operational flexibility offered by the different bus solutions. They no longer entered entirely untested territory.

Reduction of penalty for late delivery

One of Movia's concerns in the A16 tender process concerned the progressive penalty system involving a risk that an operator could be liable to pay as much as DKK 7,000 per bus per day. In conventional bus services, the maximum penalty is DKK 2,000. The assessment was that such a high penalty level could make the bus suppliers add a risk premium for the delivery of buses to the operators which would result in higher prices in their tenders. Therefore, Movia decided to introduce the same penalty level in the A17 tender as for diesel buses. That was assessed as being enough to create an incentive to avoid late delivery.

Introduction of technology neutrality

One of the most important changes from the A16 tender to the A17 tender was the change from technical requirements for electric buses to a technology-neutral functional requirement for zero emission. When Movia invited tenders for electric bus services in the A16 tender process, Movia required the bus services to run with electric buses, i.e. a technical requirement. The reason was that at the time, Movia did not consider fuel cell buses as a real commercial alternative as it was an expensive and too immature technology. A requirement for electric operation would therefore not reduce competition on the market. In other words, Movia did not make specific requirements as to the technology to be used. Instead Movia left it for the operator to select the technical solution. This meant that it was now possible to offer fuel cell buses:

> *"In the A16 tender process, we were in a situation where we believed that fuel cell buses was not a real commercial alternative. Issuing an invitation to tender with a technical requirement for electric buses would therefore not reduce competition because it was after all where the market was*

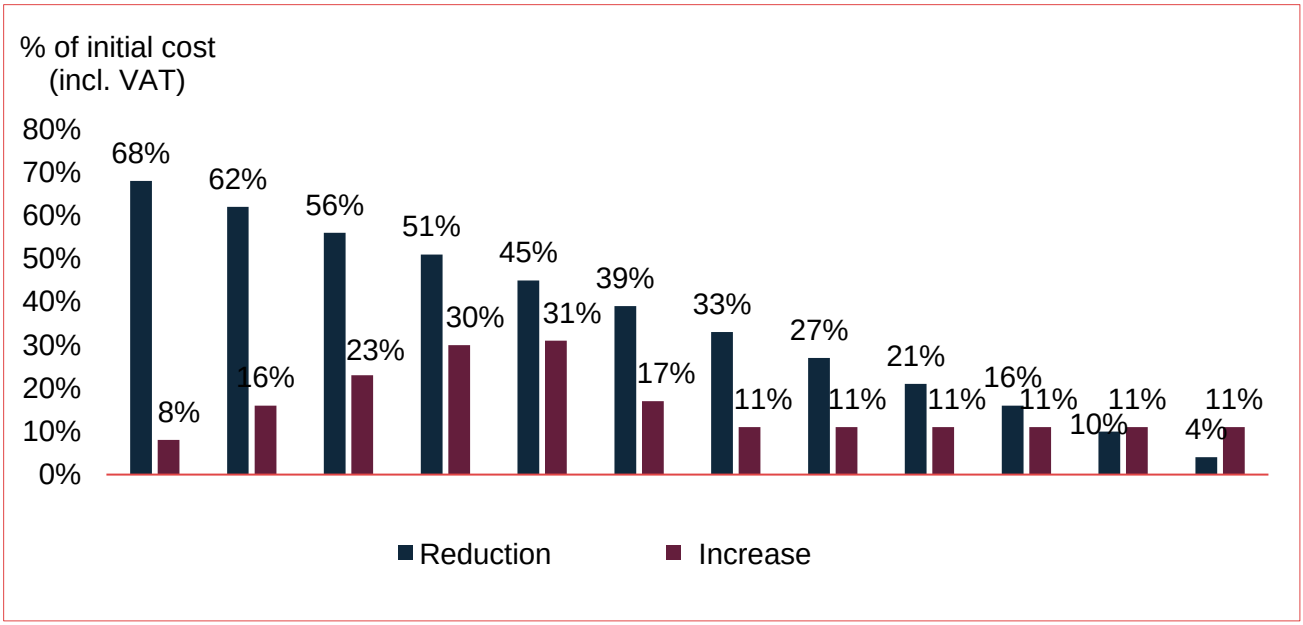
[12] The tenderers could earn scores by offering an option for extension of the routing by more than 30%.

at the time. The fundamental change in the A17 tender was that we gave the operator the opportunity to offer fuel cell buses. In that way we left it to the operators to select the technical solution
”

Victor Hug, Project Manager, Movia

It also meant that the compensation model was changed from being a fixed price in case of an extension or a reduction to a percentage of the purchase price for the bus given as compensation. The below figure shows how the new compensation model is calculated:

Figure 6: Compensation model for the A17 tender



Option to offer temporary fossil-free buses did not work as intended

Movia chose to invite tenders for the contract to run bus route 18 requiring 18 bus runs with zero-emission buses from the start of operations and allowing the operators to offer fossil-free buses on the other five peak-hour bus runs. At the same time, it was incorporated in the invitation to tender that Movia has a special right to reduce bus route 18 by these five buses until December 2022 without compensation to the operator. The reason is the Movia's bus network was to be reorganised in the autumn of 2019 in connection with the launch of the Copenhagen Metro's new circle line. As bus route 18 was a new bus route, Movia was unsure as to how many passengers would use the bus route after the launch of the metro circle line. Therefore, Movia needed increased flexibility to cut the peak-hour bus run, which resulted in the requirement for an option to reduce the number of buses. On the other hand, Movia did not wish to impose on the operators the additional risk associated with a possible reduction by five zero-emission buses. Movia therefore chose to allow the operators to offer buses using fossil-free fuel for the five peak-hour bus runs. And the buses offered could also be used buses. Movia would thus accept that not all buses were zero-emission buses until December 2022, and the tenderers could thus defer their acquisition of the last five zero-emission buses.

However, it proved that several tenderers did not see it as an advantage to offer (used) fossil-free buses instead of new zero-emission buses. The reason was that a subsequent use of zero-emission buses would give a shorter depreciation period for the buses, and at the same time, the fossil-free buses would use a more expensive fuel than electricity. Another challenge was that the operator was allowed to use non-emission-free buses on peak-hour runs only. In that way, the operator could not rotate these buses on the other bus runs in the course of a day of operation. In case an operator wanted to offer only electric buses on bus route 18, Movia expected that the operator would, wholly or partially, pay the risk that through to December 2022, Movia may reduce by up to five electric buses without compensation through a risk premium in its invitation to tender.

Summary of adapted terms of tender from A16 to A17

1	Managing flexibility in operations
2	Reducing penalty for late delivery
3	Introducing technology neutrality
4	Option to use diesel buses was not exercised

4.3.2 Discussion of emission-free cabin heating

One of the things that was discussed during the negotiations was the question of the environmental requirements for cabin heating. It was a request from the Municipalities of Copenhagen and Frederiksberg for the cabin heating in the zero-emission buses to also be emission-free. Movia was uncertain as to how a requirement for emission-free cabin heating would affect the solutions offered and to which extent such a requirement would raise the price of the bus services. Movia agreed with the two municipalities that route 2A and route 18 were put out to tender with a requirement for emission-free cabin heating, but that Movia would look into the financial consequences of the requirement as part of the negotiations with the tenderers.

The operators pointed out that the requirement for emission-free cabin heating would lead to a significantly increased consumption of electricity in case of low outdoor temperatures, which could be a challenge to electric bus operation. This applied in particular to solutions based on charging of the buses at the operator's garage because the increased electricity required to heat the cabin could potentially lead to a need for 1-2 more electric buses than if the cabin heating was not required to be emission-free.

In spring 2018, FORCE Technology carried out a survey of NOx and particulate emissions from diesel heaters using ordinary diesel, biodiesel (FAME) and HVO biodiesel for Movia. The analysis showed that the use of especially HVO, but also biodiesel, reduces particulate emissions significantly compared to ordinary diesel. Movia also examined how many days a year the temperature in Copenhagen is below 0°C and 5°C respectively.

It was Movia's assessment that by requiring emission-free cabin heating, Movia would enter untested territory and the requirement would reduce competition between the operators as some electric bus solutions would not be feasible. Also, Movia expected the requirement to result in considerably higher prices in the tenders. Therefore, Movia recommended the Municipality of Copenhagen

and the Municipality of Frederiksberg not to require emission-free cabin heating and instead require emission-free cabin heating when the outdoor temperature exceeded 5°C. If the outdoor temperature was 5°C or less, it was permitted to use a second generation biofuel such as HVO to heat the cabin. Both municipalities supported Movia's recommendation, which was incorporated in the general conditions of contract.

4.3.3 Result

The contracts for bus services on route 2A in the Municipalities of Copenhagen and Frederiksberg and routes 147, 157 and 156 in the Municipalities of Ballerup and Egedal were awarded to Arriva. Arriva offered an electric bus solution with charging of the buses at bus termini for route 2A, an electric bus solution with depot charging for routes 147, 157 and 156 and a solution with HVO biodiesel for the option for routes 147, 157 and 156. Both electric buses were of the make VDL. The contract for bus services on route 18 was awarded to Anchersen which offered a solution with BYD electric buses charged overnight at bus depots.

After the award of the contract to the operator, Ballerup and Egedal were to decide whether they wanted to exercise the option for fossil freedom and thus opt out of the zero-emission solution. The additional price for electric bus operation compared to the use of HVO biodiesel was DKK 1.9m p.a., which corresponded to 13% of the contract price. Compared to the cost level under the existing diesel bus contract, the additional price of electric bus services was however only 11%, which meant that the municipalities would have achieved a lower cost if they had chosen HVO biodiesel compared to the cost level under the existing contract. The municipalities agreed about choosing an electric bus solution.

It is difficult to estimate the additional costs of electric bus services on route 2A and route 18 as the routes were new or diverted and the buses operating the routes had a different capacity before and after the transition to electric buses.

4.3.4 Application and implementation of the framework agreement

Movia wanted to use the framework agreement on charging infrastructure in public space for the A17 tender process. Because the invitation to tender was re-issued, the framework agreement was not finally awarded until March 2018, and the A17 contract documents were published in the same month. That left Movia, the supplier and the municipalities only little time to inspect locations suitable for the installation of charging infrastructure. The supplier needed the inspections to prepare price quotations for the individual locations to be included in the A17 tender.

The short time frame combined with it being the first time that the framework agreement was to be used in practice created a difficult situation. There was limited time to introduce new parties to each other and to plan the work. Movia was not entirely sure which persons and skills to involve at the different times in the process. As a result, many more persons were present for the first inspection than was necessary, which made it more difficult to summarise the outcome of the inspection. Subsequently, there was, therefore, uncertainty as to what exactly had been decided, and Movia had to spend extra time on clarifying the decisions made with the parties involved.

The inspections and the subsequent work of describing exactly what action was to be taken on a given location proved to be much more time-consuming than expected. The reason was that the below conditions were to be taken into consideration in connection with the inspections and the subsequent work:

- Ownership of the areas to be used for charging infrastructure
- The general traffic flow at the bus terminus and any necessary construction works in connection with the adaptation of a bus terminus for the charging infrastructure
- Development and/or local plans for the area and any future changes to the bus terminus
- Elements to support the bus drivers in positioning the electric bus correctly at the charging mast, including permission from the road authority

Based on the lessons learned from the A17 tender, Movia became aware that there was a need for further clarification of the division of roles and procedures. To be able to improve the process of preparing for and installing charging infrastructure in public space and at the same time make it clear to both the internal and external collaborative partners, Movia continuously summarised lessons learned and adjustments to the process in a "Process and Responsibility Document". The document was developed to give Movia an overview of roles and responsibilities at the various stages from the preparation of the invitation to tender to implementation and operation to draw on in future processes.

If the tenderers chose to use the framework agreement to install charging infrastructure in public space in their tenders, the cost of the charging infrastructure over a 10-year period was added to the contract price for the bus services offered by the tenderer in the evaluation of the tender. In that way, solutions with and without charging infrastructure in public space were evaluated on equal terms. For route 2A a government subsidy of up to DKK 5m for the Municipalities of Copenhagen and Frederiksberg for the installation of charging infrastructure in public space was, however, deducted from the total tender price.

Some important lessons were learned from the challenges in the first process with the implementation of the framework agreement in connection with the A17 tender:

- **New collaborative partners and procedures** require time, adaptations and flexibility on the part of all parties involved. In new collaboration constellations, it is important to expect the unexpected and pick up on lessons learned in the process.
- **There will be a running-in phase** when organisations which fundamentally speak different languages need to work together. In the practical implementation of the framework agreement, Movia has had to deal with various new matters such as the handling of employer's liability, existing buried cables, unforeseen costs and risks, ordering connection to the grid, etc. Conversely, the supplier has seen it as a challenge that already early in the process, Movia needed to know the exact costs of installing charging infrastructure on a given location.
- **Clear balancing of expectations with the municipalities** in relation to the work they would be required to do up to, during and after inspections of locations for charging infrastructure and making allowances for political processes that require time.
- **The collaboration agreement with the municipalities was important** as it provided a prior agreement on the allocation of responsibilities. Likewise, it brought clarity about the re-

sponsibility of the municipalities to ensure that the land required for the charging infrastructure was placed at disposal for a period of 12 years and was earmarked before the publication of the invitation to tender.

- **The charging infrastructure must work at a bus station/terminus** and to ensure a good traffic flow, it may be necessary to make minor or major physical adaptations. In this connection, it must be clear who draws, makes driving curves and determines the costs of these changes and who carries out the work subsequently.
- **Good contact to the road authority** during preparation and installation processes provides for a smooth process and prompt resolution of any challenges.

4.3.5 Evaluation of the process

Experience and knowledge of zero emission

The A17 tender process was characterised by a large part of the development work of implementing zero-emission requirements in the bus tender having been carried out in connection with the A16 tender process. Movia already had the framework for the contract documents which were tailored to the market developments and the technologically feasible environmental requirements. The operators had also been through a process of adapting their way of submitting tenders to comply with the zero-emission requirement. The operators said that when they were to tender for A17, they had become more familiar with the contract documents and the technology. The experience of both Movia and the operators meant that the A17 tender process was shorter. Minor changes were made to the contract documents based on lessons that Movia learned from the A16 process and because the context of the procurement was different. The invitation to tender involved more municipalities and lots, whereas A16 involved only one lot with a requirement for electric bus services and where the electric bus services were limited to one municipality. The changes did not prevent the operators from submitting tenders, and they did not see the changes to the contract terms as problematic.

Navigating in the political context

The biggest issue in the process was cabin heating - an issue that arose when the Municipalities of Copenhagen and Frederiksberg specifically requested entirely emission free buses. It was a requirement which was difficult for Movia to handle. Movia's systematic analyses of testing emissions from diesel, biodiesel and HVO and of how many days a year the heater was likely to be in operation and Movia's thorough market dialogue on the costs of making the requirement were essential in order to be able to provide the municipalities with solid arguments. Movia had built up a strong case which is deemed to be vital for the municipalities agreeing to change the requirement for complete emission freedom to a delimitation criterion for the use of a biofuel heater.

The A17 process also shows that the political stakeholder landscape affects the tender process. Throughout the process, Movia had to navigate between the different municipalities' political ambitions and goals for green transition. This was most evident in connection with routes 147, 157 and 156 which involved the Municipalities of Egedal and Ballerup and where the two municipalities did not agree on the willingness to pay for zero emission. This resulted in a more difficult working process for Movia than in the A16 process. It also made it necessary to invite tenders for an option for fossil freedom, which made the process more onerous on both the tenderers and on Movia.

In the long view, Movia is interested in reducing the complexity of the invitation to tender by allowing municipalities and regions to make more specific requirements to the environmental performance of the buses – i.e. requirements for zero emission or fossil freedom. However, it requires that Movia will be able to advise municipalities and regions more specifically on the additional costs of zero emission and fossil freedom and on the budget consequences of the individual solutions. At present, Movia has too little experience, which means that today Movia states a rather large range for the additional cost of zero-emission solutions when advising municipalities and regions.

If the municipalities and regions make clear environmental objectives and the necessary financial prioritisation to achieve the objectives, it will contribute to reducing the complexity of the invitations to tender.

LESSONS LEARNED FROM THE A17 TENDER PROCESS

Both Movia and the operators have built up extensive experience in inviting tenders for zero-emission bus services, but the field is still under development, which may require changes to existing contracts or tender requirements.

It is easier for the Public Transport Authority to work with invitations to tender that requires zero-emission vehicles if the political stakeholders agree on clear political objectives and economic prioritisation.

The ongoing reflection of the collaboration processes with parties involved in the application of the framework agreement on charging infrastructure in public space may help increase the efficiency of the processes in future.

4.4 Activities relating to the H5 tender process

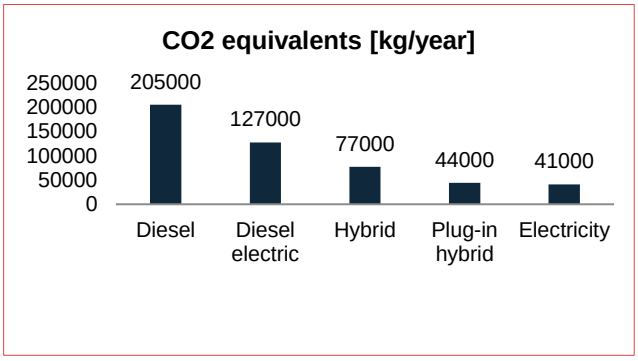
The first harbour buses were launched in Copenhagen in year 2000 and operated on the route between the Danish Royal Library and Nordre Toldbod (the Northern Custom House). Subsequently, the route has been extended several times, and today, it runs between Teglholmen and Refshaleøen. Since their launch, the harbour buses have been popular and a Copenhagen icon. With an increasing number of passengers, it was easy to tell the good story of the Copenhagen harbour buses, and even though they have faced significant competition from new bicycle bridges, future metro lines and bus routes since 2016, the harbour buses remain a political win.

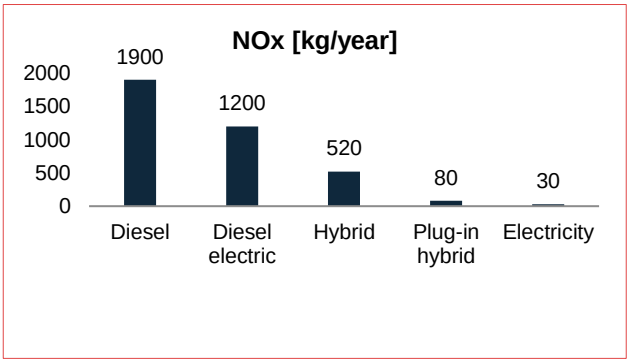
"The harbour bus is truly part of Copenhagen's DNA. You do not see a broadcast on Copenhagen in Danish or any other television networks without a harbour bus passing"

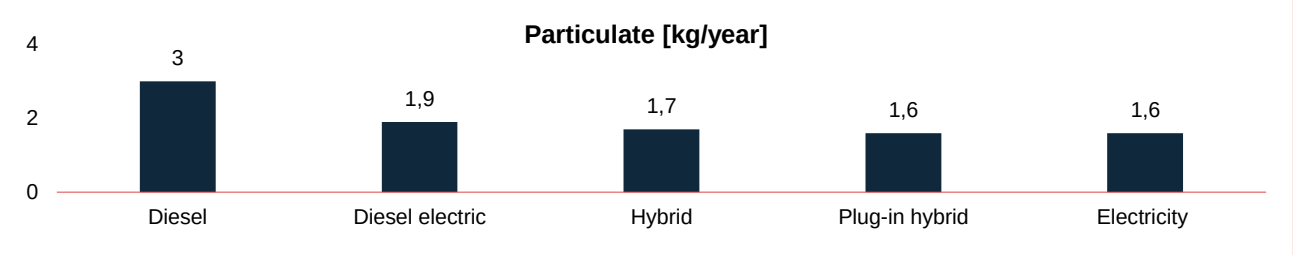
Gert Højbjerg Mortensen, Senior Consultant, Movia

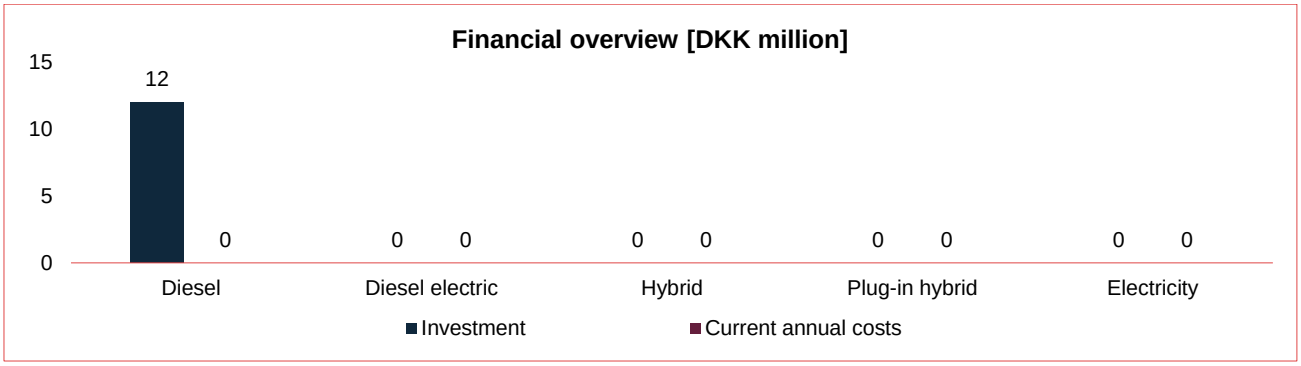
Since 2018, the existing harbour buses have used HVO biodiesel, which reduces particulate pollution from the harbour buses by 30-40%. Before using HVO, the harbour buses were responsible for almost two-thirds of the total emission of particulates from bus services in Copenhagen so when the services were to be put out to tender again, both Movia and the Municipality of Copenhagen looked into the potential of converting to greener harbour buses. The Municipality of Copenhagen commissioned the consultancy company NIRAS to prepare a report, and their preliminary investigations led to a clear conclusion: a transition to greener harbour buses could only be a success. This is shown in the below graphs prepared by NIRAS to map the potential of green harbour bus operation. The graphs show that hybrid and electric solutions provide significantly lower emissions of CO2, NOx and particulates compared to the existing operation, and at the same time, the investment costs are level with the costs of diesel boats – and the current expenses will even be lower.

Figure 7: Results from analysis prepared by NIRAS for the Municipality of Copenhagen (Source: Lars-Chr. Sørensen, Martin Herse-Lyngsø, Rikke Aavang Andersen, Erik Wormslav, NIRAS, for the Municipality of Copenhagen, 2017)





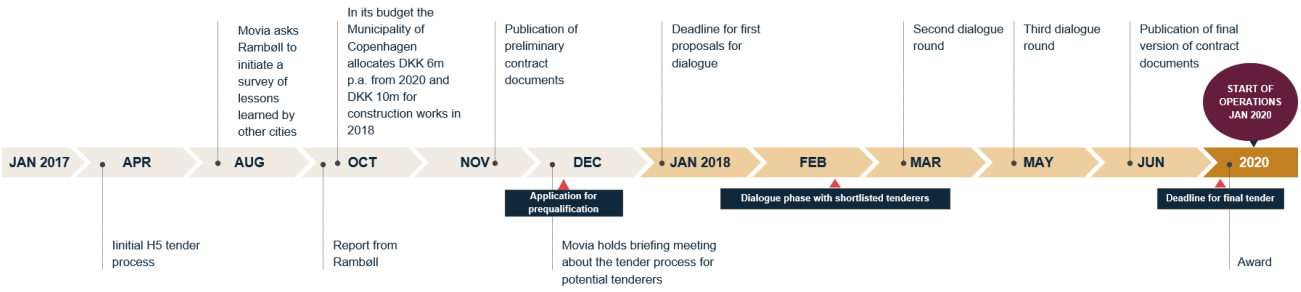




With this insight, the Social Democratic Party, the Red-Green Alliance, the Socialist People's Party and the Danish People's Party agreed to allocate DKK 6m every year from 2020 and DKK 10m for construction works in the 2018 Budget of the Municipality of Copenhagen for a significant improvement of the environmental profile of the harbour buses in terms of the emission of noise, CO2, particulates and NOx[13]. These political ambitions formed the basis for Movia's preparation of contract documents for the harbour bus tender.

The below figure provides an overview of the work processes in connection with the H5 contract. The respective activities will subsequently be detailed.

Figure 8: Timeline of activities and decisions in connection with the H5 tender process



4.4.1 Initial scanning for possibilities for zero emission

Movia wanted the H5 tender process to be streamlined to Movia's climate and environmental goals in the same way as the bus service tenders. The future invitation to tender was therefore to use the technological options and usable fuels for harbour buses as its starting point. For this purpose, Movia engaged the consultancy company Rambøll to look into the operation of harbour buses and developments within the boat industry in relation to e.g. fuels, boat equipment and mooring. This knowledge was to help Movia be precise in its requirements specification of the technical aspects in

[13] Budget 2018, the Municipality of Copenhagen

terms of environmental considerations, harbour bus equipment and the quality of harbour bus services. The below table provides an overview of the primary findings of the report.

Table 3: Experience from case cities based on Rambøll's report

	Experience from Amsterdam and Gothenburg
1	**Organisational structure and form of ownership** Contract term of approx. 12 years + option to extend Special boats are owned by private transport companies and not operators as it is assessed to be too great a risk cost for the operators A 80% subsidy for operating expenses
2	**Invitation to tender for the boats** Moderate competition on the market for environmentally friendly propulsion systems for harbour buses Possible to make high requirements for emission of pollution and propulsion systems Easy to obtain offers for hybrid boats which are future-proof for electric operation
3	**Harbour bus transport in general** High manoeuvrability boats Speed between 6 and 10 knots
4	**The boats** Made of steel Propellers in both ends
5	**Crew and safety** At least 2 persons trained as shipmasters
6	**Fuel** Depends of the environmental requirements made Most experience in hybrid boats. Not yet all-electric boats. It must be possible to convert new boats to hybrid or all-electric fuel
7	**Pollution** Particulate filters may be problematic as they clog, but GVB in Amsterdam has learned that a hybrid solution makes the use of particulate filters more effective. It is expensive, but possible to measure emissions from particulate filters and exhaust cleaning systems on the boats.
8	**Calling at the harbour bus stop** Double-ended boats are efficient for bicycles and swift boarding and disembarking. Dolphins are useful regardless of the way in which the boat will be mooring to the bus stop (motor power or hook).
9	**Routes** Free harbour buses create considerable passenger increase Primarily for commuters as an alternative to bridges

10	**Passengers** Substantial passenger increase and tremendous customer satisfaction in both cities The way in which passengers are counted differs (manually or using video)

The investigations of the Municipality of Copenhagen and Movia had different angles on the problems, and the tasks given to NIRAS and Rambøll therefore supplemented each other very well. However, the findings of the two reports gave the same picture, i.e. that fully electric boats were the cheapest, best and most environmentally friendly solution. Both reports emphasised that the findings were subject to considerable uncertainties and that consequently, the report could not reassure Movia that an all-electric solution was the right path for the tender process. Movia was, however certain that there was a solution for the green transition of the harbour bus services. The challenge was to find out how such a solution was to be put together. Therefore it was chosen to let the market help find the right solution through a competitive dialogue in the tender process. The competitive dialogue procedure is governed by article 48 of the EU Utilities Directive[14].

4.4.2 Dialogue phase

On the basis of information from the consultants' reports, Movia developed an invitation to tender with preliminary general conditions of contract which were to form the basis for a dialogue between Movia and tenderers. Movia made requirements for completely or partially emission-free operation. This enabled the tenderers to offer all-electric service or a solution with partially electric service where the batteries would be charged partly by connecting to the grid and partly through a generator operated by an internal combustion engine. The tender process dialogue was to enable the tenderers to submit a satisfactory final tender.

In November 2017, five tenderers were selected to participate in the H5 tender exercise, and at the end of December, they submitted their first proposal for a dialogue. Three of the five selected tenderers chose to participate in the subsequent dialogue rounds which began in January 2018. The idea of the dialogue phase was that Movia would have a dialogue with the individual tenderer based on the submitted proposal. In each dialogue round, great emphasis was placed on the parties giving each other good and adequate feedback to eliminate uncertainties and challenges in the contract documents.

In the period from January to May 2018, the dialogue process was repeated the maximum three times described in the contract documents. After the end of this process, Movia found that the tenderers' dialogue proposals were adequate for the tender process. The tenderers were therefore encouraged to submit final tenders. The below figure illustrates this process:

[14] Directive 2014/25/EU of the European Parliament and of the Council of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal services and repealing Directive 2004/17/EC.

Figure 9: Dialogue process for the H5 tender

Areas discussed in the dialogue phase:

- **Options and scope of services**: option to extend the harbour bus service by two boats with up to 3,500 running hours per in-service boat
- **Boat equipment**: Movia requested that it be possible to obtain a licence to carry at least 20 standing passengers. It would weigh positively in the tender evaluation if the boats offered could be licensed to carry more than the specified number of seated passengers.
- **One-man control of the boats:** Movia requested a dialogue on the option for one-man control of the boats, including how to provide the operator with an incentive to pursue such an option.
- **Air draught**: Adapted to make the harbour bus services put out to tender possible.
- **Ice reinforcement**: running of harbour buses in 5 cm of new ice.
- **Capacity and layout:** at least 60 seated passengers in dry weather, 20 standing passengers, a plus if the boats can carry more seated passengers.
- **Indoor climate and windows**: discussion of windows and positive impact of view for passenger comfort.
- **Toilet facilities for passengers.**
- **Mooring facilities**: dialogue about conversion of existing bus stops.
- **Boat transfer on contract expiry:** discussion of binding boat transfer, including financial compensation to the tenderer to avoid an unnecessary risk premium in the tender.
- **Emissions:** Dialogue with the tenderers about limit values for particulate and NOx emissions.
- **Noise:** The specific terms for noise measurements and the calculation of noise emission were determined by Movia in the dialogue phase.

In the first dialogue round, the tenderers offered very different fuel system and equipment solutions. A variety that continued throughout the dialogue rounds. Emissions were a central part of discussions during the dialogue rounds, and the tenderers especially used the dialogue to home in on the technical definitions and limit values for emissions that Movia operated with. One of the challenges was the definition of hybrid operation because it is difficult to compare two solutions where one solution uses a large generator that runs for a short time, and another solution uses a small generator that runs for a long time. It was decided to compare the amount of total energy that was delivered by the generator (non-emission-free operation) against the amount supplied from the grid (emission-free operation).

For each dialogue phase, Movia further specified and increased the requirements. In the second round, Movia requested completely or partially emission-free operation with respect to NOx and particulate emissions, and 50% of the total energy consumption of the boats was to come from emission-free fuels. With that, the next dialogue proposals focused on solutions which could delivery this.

Movia still saw challenges with the emission of local air pollution from the boat generators and tried to define the maximum emissions on the basis of various industry standards. That led to a dialogue round with focus on details. At the time there were no clear standards for the determination of non-emission-free operation (generator operation) in the maritime area. Nor did Movia find any standard describing sufficiently low generator emissions. Through the dialogue rounds, it became increasingly clear to the tenderers what Movia requested and which requests the tenderers were able to meet. In particular, it became clear that the likelihood of the tenderers being able to deliver an all-electric solution increased. However, Movia was still not certain that a purely electric solution was feasible within an acceptable financial framework and did not want to demand purely electric operation in the final general conditions of contract. The below table shows Movia's requirements in the final contract documents based on the dialogue rounds.

Table 4: Terms in the final contract documents

Emissions

Applicable to each boat:	Applicable to the boats combined:
• At least 10% of the energy used by the boat must be supplied by emission-free fuels • No more than 90% of the energy used by the boat may be supplied by non-emission-free fuels	• At least 55% of the energy used by the boat must be supplied by emission-free fuels • No more than 45% of the energy used by the boat may be supplied by non-emission-free fuels

Limit values for the emission of particulate number (PN) and NOx

Measuring parameter	Conditions of measurement	Limit values*
NO_x	Stated as dry gas	100 ppm
PN	Stated at current temperature and humidity in fresh outside air	$2{,}5 \cdot 10^5$ number/cm^3

4.4.3 Result

In July 2018, the contract was awarded, and Arriva again won the contract to operate the Copenhagen harbour buses with a tender that included:

- Four in-service boats + one replacement boat. All new builds.
- An all-electric solution where the boats are to charge at termini. The charging infrastructure will be built and financed by the tenderer.
- Room for 80 passengers, which was 20 more than the minimum requirement
- Room for 8 bicycles
- No standing passengers as approval could not be obtained from the Danish Maritime Authority at the time when the contract was to be concluded.
- A letter of intent to work towards one-man control and an agreement on distribution of the financial implications in this connection. It was not possible to obtain approval of one-man control from the Danish Maritime Authority at the time when the contract was to be concluded.

- An option for another two boats with up to 3,500 timetable hours per boat. The option is not priced as it is difficult to predict fluctuations in boat prices. The option must be priced according to the principles as those applied in the basic contract.

Prices in the winning tender were level with the existing diesel boat services and thus below the budgeted cost level.

The Municipality of Copenhagen chose to use the unused budget to extend the harbour bus services. In its 2019 Budget, the Municipality of Copenhagen has therefore allocated funds to extend the harbour bus services to include Nordhavn and another two bus stops in Sydhavn, which activates the option for the two in-service boats. As a result of the extension and the consequent change in service patterns, it is also necessary to change the configuration of the charging infrastructure and the number of boats in the contract already concluded, which resulted in additional costs. After the extension, the payment under the contract is now in line with the budget.

4.4.3 Evaluation of the process

Uncomplicated stakeholder situation and political prioritisation

It has been essential to the process that the H5 tender process was characterised by an uncomplicated stakeholder situation which involved only the Municipality of Copenhagen. There was one contracting entity with a very clear political authority and financial prioritisation in the budget. Therefore, Movia has not had to deal with several municipalities, but has been able to focus on finding the best solution to meet the request of the Municipality of Copenhagen.

Seeking necessary information and resources

It was the first time that Movia carried out a tender process with a competitive dialogue procedure, which is a time- and resource-intensive process. At the same time, Movia's knowledge of harbour bus services was limited because this type of contract is not often put out to tender. Therefore, the tender process demanded quite different resources than Movia was used to and which Movia had to find outside its organisation. The ELENA-supported legal assistance guided Movia through the tender process, which to Movia was untested territory. The consultancy assistance from Rambøll gave Movia an insight into the market at the time and the case cities which were relevant to learn from. The technical assistance from Odense Maritime secured the technical level in the tender process on the part of the supplier. It is our assessment that Movia's attention to the need for external resources combined with the possibility of obtaining the necessary assistance have helped create a more efficient and smooth tender process despite the time-consuming procurement method.

Competitive dialogue procedure

To Movia and the tenderers who took part in the dialogue phase, the competitive dialogue procedure was seen as a good and constructive procurement model. Movia was aware that they did not have the skills to develop the best contract documents within the organisation, but that the market possessed far more extensive knowledge and experience of boat operation. It is therefore Movia's opinion that the selected procurement model which provides for a close dialogue with the market led to an end result which exceeds Movia's original expectations:

"I am very pleased with the process because we ended up with a result which we had not dared dream of on the basis of the Rambøll report. We did end up with all-electric services, where we had probably expected some kind of hybrid combination [...] The competitive dialogue definitely brought us much further than we had hoped"

Jeppe Gaard, Head of Contracts, Movia

The awareness of the need to involve the market in the development process impacted backwards to the operators who took part in the dialogue phase. According to the tenderers involved, boats are fundamentally different from buses which are more of an off-the-shelf product. Boats are built specifically for the relevant city or harbour where they are to be used. In other words, harbour bus services require a higher degree of technical specialisation to fit the environments in which they are to operate and the technological zero-emission possibilities. Movia's decision to carry out the H5 tender as a competitive dialogue procedure is seen by the tenderers as a positive measure. All parties involved assessed that the competitive dialogue was a clear advantage, and they were therefore prepared to allocate the resources required to find the best solution. The end result was an environmentally ambitious tender within the framework of the contracting authority.

LESSONS LEARNED FROM THE H5 TENDER PROCESS

- For an efficient process, it is important for the organisation to draw on external experts when the organisation does not have expert knowledge and competencies.
- A competitive dialogue procedure as procurement model is useful when the solution is expected to exist in the market, but is not known at the time of the tender process.
- Clear political desires and financial prioritisation give the Public Transport Authority a stronger position to find the best solution.
- Dynamic adaptation of the contract documents may result in more favourable tenders

5. Recommendations and conclusions

Below are our conclusions and recommendation based on the mapping and evaluation.

High degree of satisfaction with the work carried out by Movia

In all four tender processes, stakeholders and operators have been very satisfied with the way in which Movia has approached the task of securing zero-emission bus services. The satisfaction among the operators centres on Movia's readiness and commitment to cooperate.

The municipalities indicate that Movia has been a good sounding board and advisor. Movia is seen as having considerable knowledge of the technical options available and has kept up to date on the solution models gradually developed by the market − a knowledge which not all municipalities necessarily possess themselves.

High learning curve for Movia and the operators

The evaluation shows that working with the zero-emission tender process has given a high learning curve internally in Movia and for the operators. In connection with the A16 tender process, the operators had only limited knowledge of zero-emission bus services, whereas in the A17 tender process, it became clear that knowledge of and insight into the technical options were at a higher level. This manifested itself in the tenders submitted and the questions asked.

Movia employees have succeeded in keeping up to date on developments in the zero-emission vehicle market, and since A16, they have become better at preparing an invitation to tender that meets the request for zero-emission buses without compromising on the flexibility needed by Movia, municipalities and regions. At the same time, the close market dialogue has contributed to a solid knowledge and understanding of the operators' business.

Working with functional requirements and a competitive dialogue procedure has proven the right thing to do

The procurement method selected and the way the invitation to tender has been specified are essential for the subsequent process and ultimately for the tenders that Movia received from the tenderers. The evaluation shows that a functional requirements specification has been a feasible path. And that the competitive dialogue procedure is a good procurement method when the contract put out to tender requires scanning for new technologies within areas where there is only little experience.

Both Movia and the operators are fond of functional requirements specifications. They provide flexibility and make it possible to integrate new solutions to the benefit of both Movia and the operators. Likewise, functional requirements specifications are a good method for including more innovation in the tenders as the operators are free to select the technical solution.

A close dialogue with the market positively received

A dialogue with the market has proven to be a successful initiative which has been received positively by the market. It is seen as an offer for a mutual and open dialogue. In addition to opening up the tender process, it has also manifested itself in better solutions and stronger collaboration with

the operators. It has especially proven useful in connection with more recent and less tested technologies.

Steering committees and working groups - a feasible model

The evaluation further shows that steering committees and working groups have had a great impact on the development work. It is a model which all parties involved have found relevant and useful. It seems to be an efficient way to formalise the collaboration with the relevant parties in development works and may speed up important decision-making and consideration processes. In other words, it helps facilitate the tender process.

5.1 Recommendations

Going forward, the evaluation points to areas which Movia would benefit from continuing to develop. This has resulted in the below recommendations:

1	**The first recommendation is to ensure that the internal organisational learning is disseminated further throughout Movia.** It is important to communicate new information and insight built up among the Movia employees to the rest of the organisation. First steps have already been taken to organise a workshop about the special circumstances relating to electric bus services, but it is also important to consider that other employees must build up an understanding of new features. When the understanding is in place, the organisation can proceed to the next step and discuss how the new knowledge, methods, etc. may be incorporated in key tasks. The lessons learned from other projects are that it is easy to proceed too quickly when handing over knowledge.
2	**The second recommendation is about the importance of keeping up to date on technological developments.** Movia should continue to allocate resources and time to keep up to date on the development currently taking place in the market. Partly to ensure that Movia knows what is going on and can be on the forefront of future tender processes in relation to more cost-effective technologies and partly for branding purposes (see below).
3	**The third recommendation is that Movia should communicate more towards the general public and show how far Movia already is on transition to zero emissions**. Movia is in many ways at the forefront of zero-emission bus services, and it could be beneficial to intensify communication towards Movia's own customers as well as to the general public. Movia is very active at conferences giving presentations on zero emission and often receives visits from abroad, from municipalities and other transport companies. In other words, communication among stakeholders and peers in the industry is very well covered. The general public does not necessarily have the same knowledge of Movia's great work in the transition to zero-emission buses. Movia should therefore consider a communication and PR effort specifically aimed at the wider public. This could be in the form of articles or telling the experiences that people and passengers have with zero emission buses or SoMe activities, etc. - all of which will offer a positive narrative of Movia's work in this field.
4	**A fourth and important recommendation is to maintain tender processes based on functional requirements** To both Movia and the operators, tender processes based on functional requirements are useful. They provide flexibility and make it possible to integrate new solutions to the benefit of all parties. In other words, functional requirements are a good method for including more innovation in the tenders.

5	**The fifth recommendation is to dare choose the right type of procedure based on the situation instead of merely copying the previous model.** Movia has been successful in using the competitive dialogue procedure when the contract requires scanning for new technologies within areas where there is only little experience. It was the first time Movia chose this procurement method, which involved untested territory, but which ultimately proved to be the right solution.
6	**Early involvement of market players is the sixth recommendation.** It means that Movia needs to consider when it makes sense to make information and dialogue meetings an integral part of the work of developing contract documents. On the face of it, the evaluation shows that it makes sense especially when the technologies are more recent and less tested. The analysis shows that a close market dialogue throughout the process results in better solutions and stronger collaboration with the operators.
7	**The last and seventh recommendation is to continue to use steering committees and working groups in development processes.** As is clear from the evaluation, steering committees and working groups have had a great impact on the development work. It has proven a good way to formalise the collaboration with the relevant parties in development works and may speed up important decision-making and consideration processes.

6. Method

The initial research has provided a solid basic understanding of the project and its activities. It has created a basis for mapping activities and decisions in connection with the four tender processes which are described and visualised for Movia's future use. In this way, we have also identified knowledge gaps which have guided the subsequent data collection. In addition, desk research also includes investigating the technical movements and development trends within electrification of public transport to guide Movia in their future work.

By supplementing with interviews of Movia's employees, we have been able to couple the employees' experiences with the processes to decisions and project activities. Together with the other insights, we have provided knowledge about the significance of decisions and processes to Movia's internal and external work processes.

Stakeholder interviews have provided knowledge from the outside. Knowledge about how the close collaborative partners have experienced the tender processes, their involvement and collaboration with Movia - before, during and after the tender processes.

DATA COLLECTION AND METHOD

Desk research

- Versions of the invitation to tender
- Memoranda internally and to stakeholders
- Work products
- Consultants' reports
- Technical analyses
- Minutes of steering committee meetings
- Presentation material
- Technological developments

Interviews with employees

- Project manager
- Specialist consultant
- Project manager and consultant (ELENA)
- Head of Contracts
- Senior Consultant

Stakeholder interviews

- The Municipality of Copenhagen
- The Municipality of Roskilde
- Siemens
- Arriva
- Umove

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