

Go electric

zero-emission service logistics in cities

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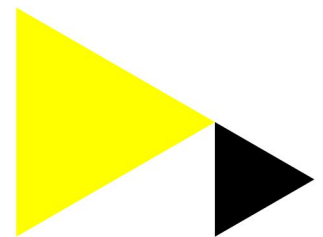
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Amsterdam University
of Applied Sciences

Go Electric: Zero-emission service logistics in cities

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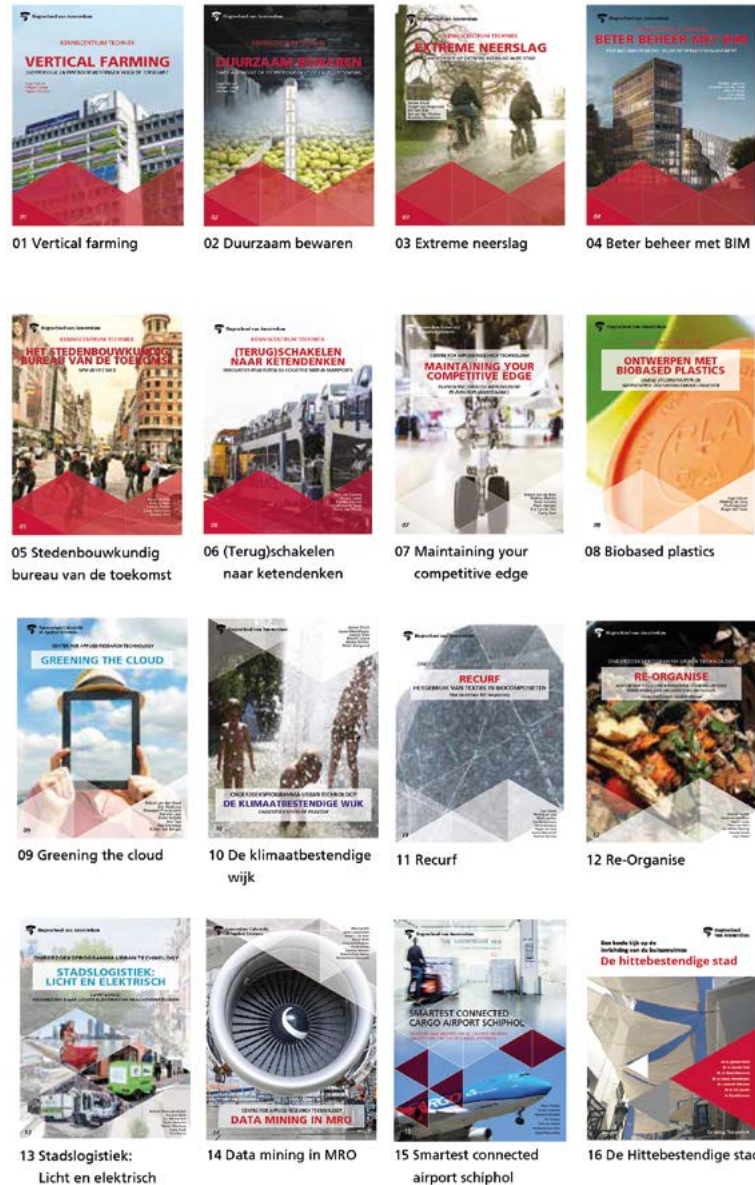




Go Electric: Zero-emission service logistics in cities



Previously published in this series:



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In this publication series, the Faculty of Technology of the Amsterdam University of Applied Sciences (AUAS) compiles the results of practice-based research. The publication is aimed at professionals and provides access to knowledge and expertise gained through practice-based research by the AUAS in the Amsterdam metropolitan region. This publication provides the reader with tools to achieve improvement and innovation in technical professional practice.

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- ▶ Urban Technology

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The series is published by the Faculty of Technology of the AUAS. Each publication is produced by a team of authors consisting of AUAS staff, and sometimes also of representatives from other organisations and knowledge institutions.

Summary

Service organisations carry out installation, repair and maintenance work in homes, offices and public spaces. Service logistics is responsible for 25 to 35% of the kilometres travelled by vans in the Netherlands and for 10 to 15% of the CO₂ emissions from road freight transport in the Netherlands. The range of solutions for zero-emission transport is diverse, growing and improving. The action radius of electric vans is increasing, the adoption of cargo bikes is rising, and there are more opportunities for cooperation around logistics hubs, new supply concepts and smart charging solutions. Despite this, of all vehicles used by service organisations in the Netherlands, still only a small proportion are zero-emission. At the same time, ambitions for zero-emission zones in cities are becoming increasingly concrete in both national and local implementation plans for 2025-2030.

This publication presents the results of the 'Go Electric' project: an investigation into zero-emission (ZE) service logistics in urban areas. The Amsterdam University of Applied Sciences (AUAS) and the Arnhem and Nijmegen University of Applied Sciences (HAN) have spent two years working on this project together with service organisations,

providers of ZE transport solutions, industry and network organisations, and the City of Amsterdam. Using case studies, workshops, interviews and trip data analysis, they have developed practical knowledge about logistics concepts, charging strategies and behavioural interventions with the aim of accelerating the transition to ZE transport. The result provides service organisations with tools to formulate plans for ZE transport and to embed them into their business operations.

The main conclusions are:

1. The road to ZE mobility does not start with the vehicle.

One-for-one replacement of fossil fuel powered vans with electric versions is not the right approach. The transition to ZE service logistics involves strategic, tactical and operational decisions relating to customer service, the recruitment and deployment of staff, the organisation of logistics hubs and inventories (including relevant partners), route planning, the composition and financing of ZE vehicle fleets (including fitting-out of vehicles) and charging infrastructure. If the right approach is taken, improvements in service logistics are possible with less travel time for service engineers, fewer lost hours and fewer vans.

2. Service engineers play a key role in the successful development of ZE service logistics.

The ambitions of service organisations in the coming energy transition are high and technical personnel are needed to realise them. This is exactly what is currently lacking in the sector. For the introduction, roll-out and monitoring of ZE transport to be a success, involving service engineers is key. Involve them in the choice and fitting out of vehicles, the charging options, the development of logistics hubs, and the inventory strategy (including in vehicles) and then follow-up on their experiences. Communicate, experiment and evaluate. The first five engineers may be willing, but ensure that the whole team participates enthusiastically.

3. Clients dictate the speed at which service organisations can start working with ZE transport.

Clients play an important role in the prospects for zero-emission transport to be deployed. The tendering process, and later the planning of assignments, determines where and how work will take place. It is on that basis that service organisations deploy their engineers. Contracts determine the scope for any sustainable supply chain cooperation; by arranging to work together,

can we use fewer vehicles and reduce vehicle kilometres? For example, by requesting zero-emission transport in their tenders, clients can help to create a level playing field in which zero-emission transport becomes the new norm.

4. Solutions providers should work together to create a strong proposition that helps to unburden service organisations.

For fleet managers, the roll-out of ZE transport is a new task involving a great deal of uncertainty. Particularly during the first few years, fleet managers, together with their suppliers, will be faced with many surprises and adjustments. It is also a challenge for those selling ZE vehicles: how to develop a customer-friendly offer that benefits both parties? The range of zero-emission transport services on offer is developing slowly, both in quantity and in quality. The offerings available today are still fragmented and providers' business models are yet to be made scalable. However, the market is rapidly expanding and service organisations cannot wait until 2025 or 2030 to prepare for ZE service logistics.

Colophon

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Foreword

Without transport everything would come to a standstill... and without maintenance even more so. When there is a breakdown, who isn't happy to see an engineer arriving at their door to fix everything straight away? Whether it's the heating system, a lift, respiratory equipment, a forklift truck or a faulty beer tap, the customer is satisfied if things continue to run smoothly thanks to preventive maintenance, timely modifications and software updates.

A service engineer can only get the job done if he or she has the right tools and parts with them. The trusty diesel or petrol van must soon become emission-free. City authorities demand it and customers expect it. How, then, can you be sure of arriving on time? Will you be able to take enough equipment and supplies with you? Where will you charge your battery? Are there alternatives to vans?

Together with service organisations and mobility service providers, we set out to determine exactly what was needed for zero-emission service logistics to succeed.

Replacing every fossil-fuel powered van with an electric van was not the right answer. Thanks to the practical data that service organisations were willing to share with us, we were able to work with our research partners on real-life solutions, which included investigating combinations of vehicles, new logistics concepts and the behaviour of employees. It was an enlightening journey.

The report is now in front of you and provides insightful information about the impact of zero-emission transport on your operations and your service engineers. We are still far from being finished; there are still many questions left to answer. Vehicle suppliers must provide appropriate vehicles. Charging infrastructure is still not ready. National and local authorities need to provide clarity on the regulations. And: engineers need to get used to the new situation.

Walther Ploos van Amstel

Professor of City Logistics, Amsterdam University of Applied Sciences

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Chapter 1

Questions from practice

The 'Go Electric' project involved two years of practical research into the potential that zero-emission transport (ZE transport) has for service logistics. This chapter outlines the background context of the project, followed by the purpose and the methodology of the research. It ends with an overview of the partners involved in the project.

1

1.1 Emission-free service logistics: practice what you preach

Service organisations perform installation, repair and maintenance work in homes, offices and public spaces. Examples include internet and energy suppliers, electricians, plumbers, window cleaners and gardeners. In large cities, service workers are constantly on the move. One in four vans in Dutch cities belongs to a service organisation (AUAS, 2018). A study by Connekt (2017) showed that 35% of van kilometres in the Netherlands are driven in order to deliver a service (see Figure 1.1). This makes service logistics an important sector when it comes to achieving the city logistics commitments made in the Dutch climate agreement.

More and more service organisations are considering changing their mobility policies, for example by using electric or smaller vehicles, using logistic hubs or by reorganising the flow of materials. They

are responding to ever stricter regulations for polluting, fossil-fuel powered vehicles in cities (including environmental zones and low-emission zones), policies aimed at making cities car-free and rules that discourage parking. There are also underlying motivations at play. The growing value of ZE transport in service organisations' offerings is becoming increasingly important: customers are requesting ZE transport when tendering, and service organisations also find that it fits in with their corporate image. Meanwhile, service organisations themselves are working on sustainable technologies such as the installation of solar panels and charging stations. Sustainable fleets and mobility policies fit in with this; practice what you preach.

For the 'Go Electric' project, service organisations worked together with universities, businesses and industry associations to develop practical knowledge about ZE transport for service logistics in urban areas.



Go Electric: Zero-emission service logistics in cities

'We see service logistics as the transport of personnel, materials and equipment for installation, repair and maintenance work in homes, offices and public spaces. The difference between service logistics and freight logistics is that with service logistics, a specialist service is provided at the customer's location.'

Susanne Balm, Project Leader in Sustainable Logistics
Amsterdam University of Applied Sciences

Figure 1.1: Share of kilometres travelled by vans in the Netherlands (Connekt/Topsector Logistiek, 2017)

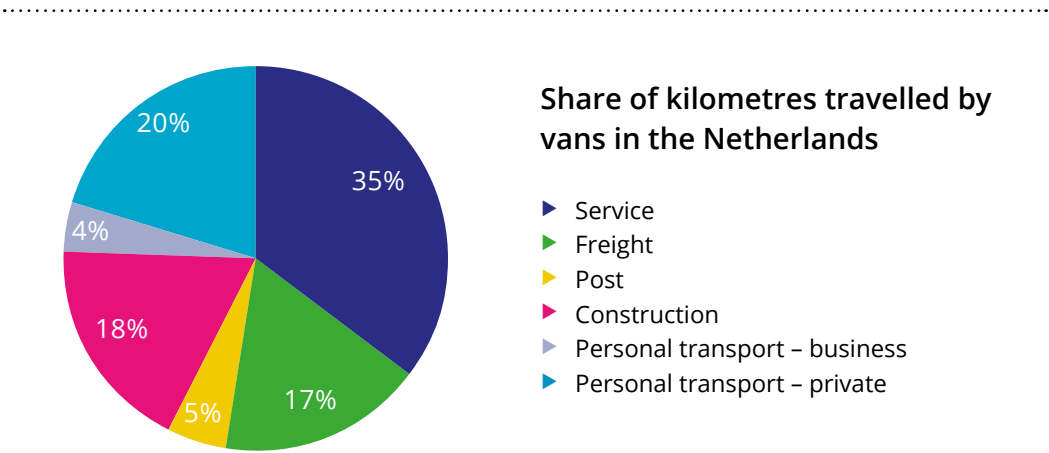
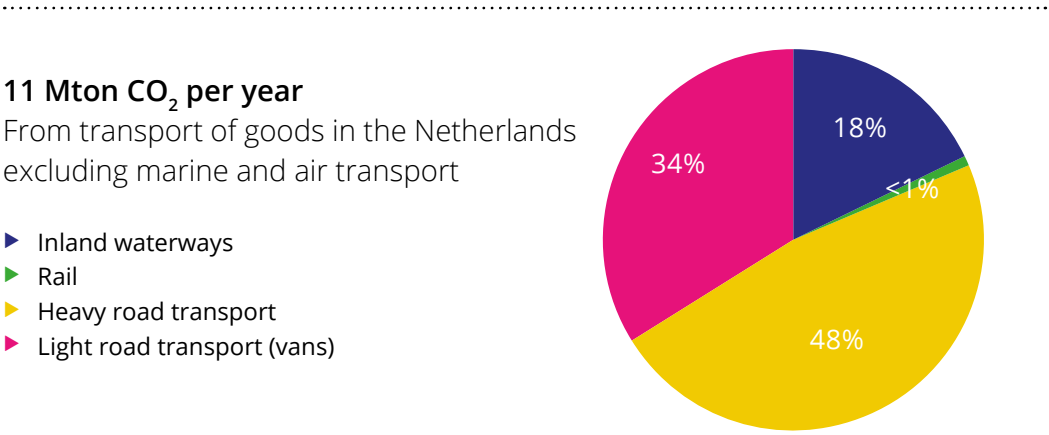


Figure 1.2: Share of CO₂ emissions by modality (CE Delft, 2016)

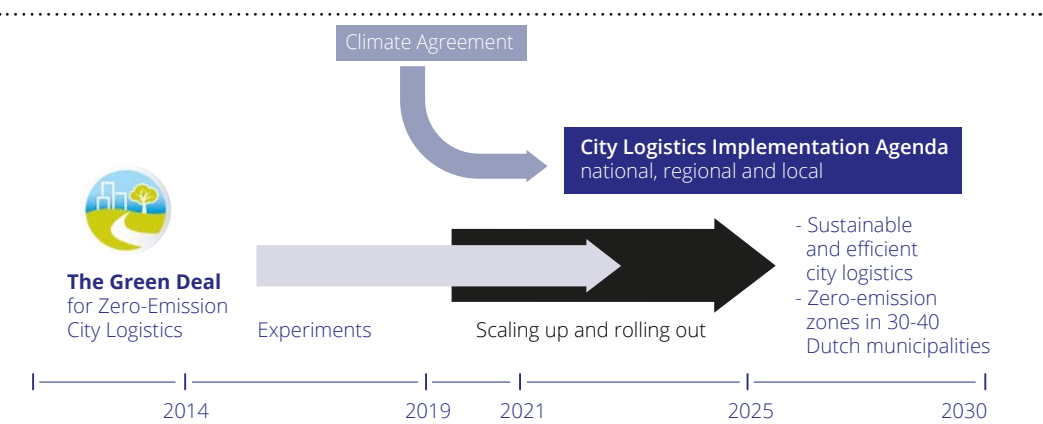


The **Green Deal for Zero-Emission City Logistics** (Green Deal ZES) was signed in 2014 by a list of Dutch governmental bodies, businesses and institutions. The parties to the Green Deal ZES want city centres to be supplied efficiently and emission-free by 2025.

One of the 600 measures in the Dutch climate agreement is the introduction of inner city zero-emission zones for city logistics in 30 to 40 Dutch municipalities by 2025.

The **City Logistics Implementation Agenda** consists of an action plan with national guidelines, regional cooperation and scope for local customisation in preparation for the introduction of zero-emission zones.

Figure 1.3: The Green Deal for Zero-Emission City Logistics (Op weg naar ZES, 2021)



1.2 Sustainability, accessibility and liveability

Mobility is one of the five Dutch industry sectors that must fulfil the mandate set out in the Dutch climate agreement¹. The share of CO₂ emissions in the Netherlands originating from the mobility sector is about 20% (Statistics Netherlands/CBS, 2018). Freight transport in the Netherlands (excluding maritime shipping and aviation)

is responsible for emitting approximately 11 Mton CO₂ emissions per year (CE Delft, 2016), 34% of which is due to vans (see Figure 1.2). The Mobility Platform (one of the working groups which drew up the agreement) outlined ambitions in the Dutch climate agreement in which sustainability and accessibility go hand in hand. In order to achieve 'smart, sustainable cities with optimal flow of people and goods', the aim is to reduce business car use by 8 billion kilometres in 2030, make optimal use of

¹ In June 2019 the Dutch cabinet presented the climate agreement. Under the agreement, the cabinet set a national target to emit 49% less CO₂ by 2030 in comparison with 1990. The agreement contains more than 600 commitments to reduce greenhouse gas emissions (Ministry of Economic Affairs and Climate, 2019).

infrastructure and use only clean modes of transport (Ministry of Economic Affairs and Climate, 2019). A key objective is the introduction of zero-emission zones for freight and delivery vehicles in the inner cities of 30 to 40 municipalities in the Netherlands by 2025. To ensure consistency in the schemes adopted by municipalities, national agreements were made in 2020 for a gradual transition to emission-free vans and lorries. These are laid out in the City Logistics Implementation Agenda (Government of the Netherlands, 2021), with the aim of reducing CO₂ emissions by 1 Mton in 2030. By standardising entrance conditions for zero-emission zones on a national level, organisations know where they stand. However, there is still room for local flexibility in granting exemptions. See Figure 1.3.

In addition to the introduction of zero-emission zones, the development of car-free city centres is also having an impact on the way in which businesses deliver products and services in city centres, residential areas, campuses and office parks. They experience higher parking fees, a reduction in the number of on-street parking spaces, more

30km/h zones and more one-way streets. Limiting weight is also an important measure for areas with vulnerable infrastructure, such as bridges and canal embankments in historic inner cities such as Amsterdam, Utrecht and Delft.

1.3 The zero-emission vehicle market

The availability and affordability of ZE vehicles is growing (ElaadNL, 2020; Frevue, 2017; Netherlands Enterprise Agency/RVO, 2018). Large vehicle manufacturers such as Nissan, Mercedes and Peugeot all have electric vans on the market. There are also more and more lightweight variants on the road: e-bikes, scooters or small distribution vehicles (AUAS, 2018). Despite the growing supply of ZE vehicles, their use remains as yet limited. At the end of 2020, there were 6247 registered electric vans in the Netherlands. That is less than 1% of the total number of vans (see Figures 1.4 and 1.5). ZE transport requires more innovation than merely the replacement of a vehicle. It requires a charging infrastructure and a

Figure 1.4: Share of electric vans in the Netherlands (CBS, 2020; RVO, 2021)

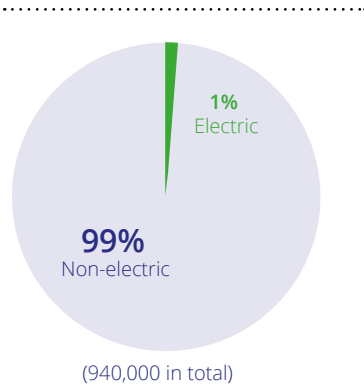
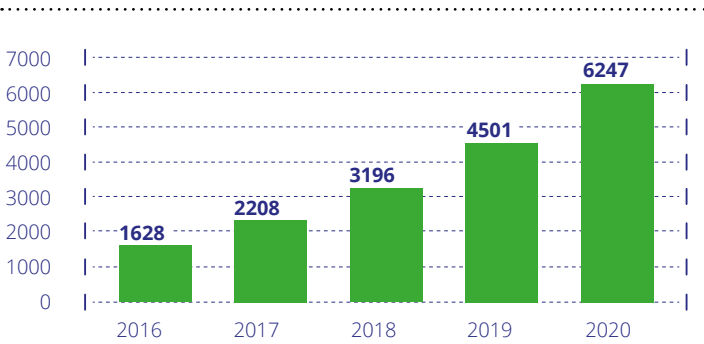


Figure 1.5: Number of registered electric commercial vehicles <3.5 tonnes (RVO, 2021)



strategy for recharging the batteries. The limited action radius and limited loading space (in m³) require a different approach to logistics planning and how materials are handled. Consideration must be given to the purchase and financing of both the vehicle and the electricity. A different perspective is also required when it comes to the driving and travelling behaviour of employees.

There are many different enterprises (including SMEs) on the ZE-transport market that can provide support to organisations in this area. They supply a variety of vehicles, charging infrastructure and systems for fleet management, or provide advice. For example, Urban Arrow develops cargo bikes, Fleetkennis manages lease contracts, Laadpunt Nederland provides support in the choice of charging infrastructure and Deudekom offers a logistics hub with charging facilities (see Chapter 3 for more in-depth information). Service organisations with large fleets present opportunities for entrepreneurs in the ZE transport market. This study addresses the question of what combination of services is needed to support those service organisations in the process of achieving zero-emission service logistics.

1.4 Questions from practice

The research project was based on practical questions raised by service organisations and providers of solutions. These parties each have questions about emission-free transport from their own sectors. The questions from various practice partners are described below.



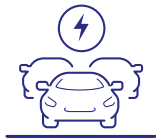
Service organisations have set targets for zero-emission transport, but are still looking for ways to attain them.

‘Due to our climate objectives, we are increasingly associated with sustainability. So you can't really arrive at the customer's premises with a stinking diesel van. Electric transport is also increasingly being directly requested in tenders. However, electric transport still has many practical and financial drawbacks for us.’

Dick Geelen, Director of Procurement & Supply Chain at Unica, in 2018

‘ENGIE aims to be CO₂ neutral by 2030. How do we engage our service engineers in the transition to ZE transport?’

Antonie Langelaan, Environment and Quality Assurance Manager at ENGIE, in 2020



Suppliers of electric vehicles want to know what considerations service organisations make when choosing a vehicle.

‘We want to develop the optimal vehicle for service engineers. This requires bringing together the technology and the people who will use it’

Jorrit Kreek of Urban Arrow, in 2018

‘We are introducing a new electric freight vehicle with a maximum speed of 45 km/h, with the ANWB (Royal Dutch Touring Club ANWB) as a potential customer. Our main question is: how do we match what we have to offer to their requirements?’

Bob Kranenburg of Easy Go Electric, in 2018



Providers of charging infrastructure and logistics hubs want to know how their solutions can be specially adapted for service organisations.

‘Because they fear being caught stranded between appointments with an empty battery, service organisations want to charge as often and as fast as possible. Ideally, they would like to charge all vehicles at the same time at maximum power. This would demand an enormous investment in charging infrastructure. However, this is unnecessary, since not all vehicles need to be fully charged at all times, or at maximum capacity, or simultaneously. With more knowledge

about the logistical considerations of service organisations, we can provide better advice on charging services and develop specific charging solutions.’

Frank Tollenaar, Laadpunt Nederland, in 2018

‘There is no clear answer to the question of whether mobile loading hubs work in service logistics, because every customer has different characteristics and processes. My question is: under what conditions would such a solution work?’

Hans Baars, The Hub Company, in 2018



Providers of fleet management solutions are finding that customer demand is evolving and that they need to adapt to it in order to remain competitive.

‘Not every engineer needs a car for every journey. In order to give our customers the best advice on how to organise their fleets, we need to have knowledge of all of the options available for travelling in a different way, for example by means of sharing concepts, a hub or by decoupling the engineer from his materials.’

Jeroen van der Rijst of Fleetkennis, in 2018

1.5 Goals and methodology of the research project

The central research question is: which logistics concepts, charging strategies and behavioural interventions can be used to realise zero-emission transport for service organisations? With this research, the participants intend to:

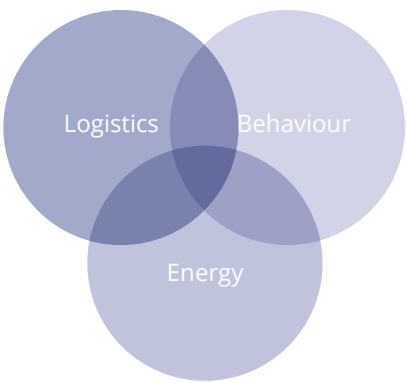
- ▶ strengthen the ability of companies offering services for ZE transport to innovate;
- ▶ support service organisations in their efforts to innovate in the field of zero-emission mobility;
- ▶ connect providers and large service organisations in order to jointly develop multidisciplinary knowledge on the deployment of ZE transport in service logistics.

The professionals participating in the project aim to develop (joint) services for service logistics. To this end, they are in need of more knowledge about:

1. The logistical characteristics of service organisations, on the basis of which these organisations purchase vehicles and schedule trips;
2. The role of service workers in the transition to sustainable urban logistics;
3. Vehicle charging and swapping concepts that facilitate the use of ZE transport in service logistics.

Figure 1.6: Three pillars within the ‘Go Electric’ research project

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The sub-questions of this study are:

1. On the basis of what criteria and considerations do service organisations currently purchase vehicles and plan trips?
2. What updates to the business processes of service organisations are necessary for zero-emission mobility?
3. How can service organisations stimulate the adoption process by their employees (the users of zero-emission transport)?
4. Which charging strategies can facilitate the deployment of zero-emission transport by service organisations?
5. Which new products and services can suppliers develop for service organisations wanting to implement zero-emission transport?

Reading Guide

Chapter 2 deals with the characteristics of service organisations and explores upon what criteria and considerations they currently purchase vehicles and plan trips. Chapter 3 discusses solutions for ZE transport. Then Chapter 4 discusses the sub-questions concerning updating business processes, the adoption process with employees and charging facilities. New products and services offered by providers

are the focus of Chapter 5. In Chapter 6 the conclusions are presented. Between chapters, the practical experiences of service organisations are presented.

Research methodology

The research is organised into four phases: analysis, design, evaluation and validation. The methodology for each phase is outlined in Table 1.1.

Table 1.1: Research methodology per phase

.....

Phase	What	How
Analysis	The goal of this phase was to gain a better understanding of the logistics processes of service organisations, their charging options and the attitudes and commitment level of employees to ZE transport.	▶ Interviews with management, fleet managers, planners and service engineers. ▶ Analysis of quantitative data from planning and fleet management systems.
Design	The aim of this phase was the (joint) development of concepts and interventions for ZE transport. Based on the proposals, the service organisations made a choice that was further evaluated.	▶ Workshops with project partners ▶ Focus groups with service employees
Evaluation	The goal of this phase was to evaluate potential solutions and interventions for ZE transport. This process was conducted by means of practical experiments and experiences.	▶ Practical experiments ▶ Focus groups with service employees
Validation	The aim of this phase was to develop roadmaps and business models to enable the scaling up of zero-emission transport for service logistics.	▶ Workshops with project and network partners.

1.6 Participants

The Urban Technology Research Programme of the Amsterdam University of Applied Sciences (see box) was the lead partner in the ‘Go Electric’ project. Together with HAN

Automotive Research, they formed the research team. In addition, more than 20 parties from the public and private sectors participated in the project by generating, applying and disseminating knowledge (Table 1.2).

Table 1.2: Overview of ‘Go Electric’ project participants

Knowledge institutions	▶ Amsterdam University of Applied Sciences (AUAS) ▶ Arnhem and Nijmegen University of Applied Sciences (HAN)
Industry associations and platforms	▶ Vereniging DOET ▶ Techniek Nederland ▶ Amsterdam Economic Board
Solutions providers	▶ Arval Bedrijfswagens ▶ DOCKR ▶ Easy go Electric ▶ Fietsdiensten.nl ▶ Fleetkennis ▶ Laadpunt Nederland ▶ LogistiekeHubNL ▶ Parcls ▶ Groupe PSA Nederland ▶ Syndesmo ▶ Technische Unie ▶ The Hub Company ▶ Urban Arrow
Service organisations (case partners)	▶ Eigen Haard ▶ ENGIE ▶ Feenstra ▶ Heijmans-Brinck ▶ Hoek ▶ Unica

Urban Technology Research Programme – Amsterdam University of Applied Sciences (AUAS)

The world is witnessing a period of increasing urbanisation. In 2050, 80% of the world's world population will live in cities. This brings with it a whole host of challenges. How do you organise cities so that vital functions are maintained? How do you come up with smart solutions to face challenges such as climate change and decreasing availability of fossil fuels, raw materials and water? The Urban Technology programme is a partner for professional practice and knowledge institutions in the Amsterdam Metropolitan Area and focuses on these challenges. Urban Technology designs and evaluates smart technological solutions that can be applied locally. Within the Urban Technology programme, seven professors work with senior lecturers, lecturer-researchers, PhD students, alumni, and students of the AUAS all work on applied research.



► Unica

Unica is an all-round technical service provider in the Netherlands, dedicated to solving technical problems in and around buildings. With over 2700 employees, Unica is one of the largest technical service providers in the country. Unica's stated aims are to save 10% CO₂ in 2021 compared to 2018 and to have an emission-free vehicle fleet by 2030. For Unica, the target to have an emission-free vehicle fleet is their motive for researching new and emission-free logistics concepts.

During the 'Go Electric' project, two solutions were examined in greater detail. Using trip data from on-board computers, interviews and a focus group with employees, as well as on the basis of models, insights were gained into various logistical, behavioural and charging options.

Cargo bike and hub combination

A student from AUAS investigated the feasibility of the cargo bike + hub combination in their graduation project. The cargo bike + hub solution appeared to be financially attractive compared to the current situation, provided that cargo bike trips in the city are planned separately. Unica intends to experiment with this approach, using its own office in Amsterdam as a hub location. Unica considers the implementation of a moveable hub too complex and

economically uncertain. For Unica engineers, being able to keep their vans and having the option to choose to use a cargo bike are prerequisites for working with a cargo bike hub solution.

The Unica Innovation Center and the management of Unica Amsterdam are enthusiastic about a pilot scheme in which the Amsterdam office will be used as a cargo bike hub. The pilot scheme will start as soon as the impact and risks of the coronavirus are manageable. The idea is as follows: from the office hub, trips within Amsterdam's A10 ring road can be made using electric cargo bikes. As part of the planning process, a 'city centre schedule' will be made for maintenance work that is within cycling distance of the hub. Engineers will then be able to volunteer to take part

in the city centre schedule. This will create a pool of engineers who cycle one or more days per week. 'Go Electric' researchers recorded a video to inform Unica engineers of these developments. They also compiled recommendations for behavioural interventions in preparation for the pilot scheme.

Electric van

The evaluation of the plug-in hybrid electric vehicles (PHEV) shows that without changing how jobs are planned, a considerable portion of Unica's kilometres could already be driven electrically, provided that vehicles are fully recharged after the working day. At the start of 2021, Unica began using a fully electric vehicle in Nijmegen: a Toyota Proace EV. The vehicle is used by an engineer who carries out maintenance work for the City of Nijmegen, the HAN University of Applied Sciences, a number of hospitals and Friesland Campina, among others. The engineer has been provided with a charging

station at home. It is expected that the action radius (WLTP 330km) will be sufficient for the maximum distance the engineer will travel per day (240km). At most customer locations, the engineer can also recharge during the day if necessary.

To ensure that these new solutions can be scaled up within the organisation, it is important that Unica engineers are informed about the use of cargo bikes and electric vehicles, as well as about the purpose of the pilot schemes. It is also important that, in order to fulfil the potential distances that can be covered by electric vehicles, a charging strategy is drawn up for charging: at home, on the road, at Unica premises and/or at customer locations. ◀



Chapter 2

Characteristics of service organisations

The 'Go Electric' project focused on organisations that use vans to provide a specialist service to customers in urban areas. This chapter describes this target group in more detail, paying attention to trends and developments, customers, logistical characteristics and employees.

2



2.1 Specialisations and scope

The profile of service organisations operating in cities is diverse. There are variations in size of organisations, in customer segment and in specialisation. They include services in the areas of:

- ▶ Energy systems
- ▶ Electronic equipment
- ▶ Gas and heating
- ▶ Air conditioning and refrigeration
- ▶ Industrial installation
- ▶ Water and sanitation
- ▶ Telecommunications
- ▶ Facilities in public space
- ▶ Interior cleaning
- ▶ Removals
- ▶ Pest control
- ▶ Building facade maintenance and cleaning
- ▶ Lift maintenance
- ▶ Coffee machine maintenance
- ▶ Climate system maintenance
- ▶ Landscape management
- ▶ Printer maintenance
- ▶ Drainage and sewerage
- ▶ Door and frame maintenance
- ▶ Beer tap maintenance

Based on figures from AUAS, Statistics Netherlands and Connekt/Topsector Logistiek, it is estimated that around 200,000 vans are used by service organisations in the Netherlands. A large proportion of the organisations in the target group of 'Go Electric' are affiliated with the industry sector organisation *Techniek Nederland* (6,300 members). *OnderhoudNL* (MaintenanceNL) (2,000 members) and the *Nederlandse Vereniging voor Service Management* (Dutch Service Management Association)

(250 members) also promote the exchange of knowledge in the sector.

Techniek Nederland is a trade association for technical service providers, installation companies and the technical retail trade. They represent over 6,300 businesses and are one of the largest employers' organisations in the Netherlands.

2.2 The work is changing

In the coming years, there will be a lot of work to do in the technical installation, service and maintenance markets. There are major challenges in the areas of housing construction, the energy transition, the renewal of the physical infrastructure and the construction of safe digital infrastructure (Techniek Nederland, 2020). This calls for technical expertise. Not only is the amount of work increasing, but the character of the work itself is also changing. The focus has shifted from delivering or maintaining a product (such as a security alarm) to fulfilling a need ('security'). Usage rather than possession is becoming increasingly important. No longer is price the most important criterion for clients, but rather customer satisfaction. This calls for a different business model for technology companies, who must transform themselves into service organisations, unburdening their clients of concerns, providing more (proactive) advice, delivering customised solutions and getting paid on the basis of how they perform. This development is called servitisation (CONNECT2025, 2018).

Table 2.1 presents the characteristics of the six case partners involved in the 'Go Electric' project.

Table 2.1: Overview of the six case partners

	Unica	Heijmans (Brinck)	ENGIE	Eigen Haard	Feenstra	Hoek
Type of service provided	Technology in buildings	Construction and infrastructure (measurement)	Energy and technology	Housing	Technology in housing	Landscaping
Area covered in the Netherlands	Nationwide	Nationwide	Nationwide	Amsterdam	Nationwide	Noord-Holland
Number of employees in the Netherlands	2,700	4,600 (150)	6,000	551	1,400	150
Vehicle fleet size	1,700	3,200 (55)	3,450	130	954	100
Number of passenger vehicles	900	2,400 (15)	1,900	90	196	10
Number of freight / commercial vehicles	800	800 (40)	1,550	40	758	90
Number of cargo bikes	0	(6 rented for pilot project)	2	0	4	0
Read more on	Page 22	Page 42	Pag 64	Page 90	Page 110	Page 124

Servitisation is the process by which service provision becomes an increasingly important part of companies' business models: more and more revenue is generated by the provision of services.

The nature of the work is also changing as technical systems grow in their complexity. Devices are equipped with sensors, and the combination of the Internet of Things, 'big data' and the right algorithms provides service organisations with an ability to predict workloads.

2.3 Labour market shortages

In the last ten years, a worrying shortage of technically skilled personnel has arisen. Older personnel (from the so-called baby boomer generation) are retiring in large numbers, meaning that vacancies for technical professions are hard to fill (Employee Insurance Agency (UWV), 2019). Meanwhile, young people are more likely to continue their studies after intermediate vocational education and then end up in other sectors (MBO Keuzegids, 2020). The consequences of this shortage became apparent between 2014 and 2019 when the economy showed an upward trend. The wages of starting installation engineers, welders and plumbers rose by as much as 400 to 600 euros per month in those years (Trouw, 2018) and the number of open vacancies rose to above 70,000 (UWV, 2020). Despite this promising outlook for job opportunities, a corresponding large influx of first-year students has not yet been observed (Techniekpact.nl, 2020). Some businesses are therefore even choosing to employ untrained staff and to train them internally. An example of this is Feenstra, a company which specialises in servicing central heating boilers. Feenstra's engineers-in-training are often young people, people who have switched careers, or re-entrants to the labour market. However, smaller organisations often do not have the capacity to provide training themselves and are therefore reliant on employment agencies, with the high costs that this entails.

Due to the shortages in the labour market, technology companies must invest a substantial amount of time and money into recruiting new staff. In addition, they need to pay extra attention to staff satisfaction to

In 2013, a starter with a diploma in electrical or installation engineering earned between 1,800 and 2,000 euros (gross) per month. Five years later, that gross amount had reached 2,300 to 2,600 euros per month. (Trouw, 2018).

prevent them from leaving for competitors. They can do this, for example, by offering career development opportunities and attractive secondary benefits.

Servitisation, technical innovation and sustainability issues also present challenges for human resources policy. These developments call for all-rounders; staff with social skills and knowledge of both old and new systems. It is therefore important that employees continuously develop their skills and technical knowledge. Employers would therefore be well advised to invest in 'lifelong learning'.

2.4 Sustainable business with sustainable mobility

Technical service providers play a crucial role in helping other sectors to become more sustainable. They are also increasingly formulating sustainability objectives for their own business operations. Heijmans, for example, aims to be CO₂ neutral by 2023. ENGIE has also stated the same objective for 2030. Unica intends to have an emission-free vehicle fleet by 2030 and Eigen Haard wants to become the greenest housing association in the Netherlands.



Vehicle fleets are responsible for a significant proportion of the CO₂ emissions of technical service providers. Heijmans' vehicle fleet accounts for 38% of the company's CO₂ emissions. For ENGIE this percentage stands at 67%, for Feenstra it is 80% and for Unica 92%. It is therefore logical to reconsider mobility policy in order to achieve CO₂ targets. There are already numerous initiatives and ideas aimed at influencing the travel behaviour of employees with passenger cars (which have yellow licence plates in the Netherlands) in order to become more sustainable. Examples include offering a bicycle allowance, travelling by train, restrictive parking policies at the office and tax benefits for low-emission cars (including leased cars). For employees who travel with a commercial van (with what is known as a grey licence plate in the Netherlands), there have been considerably fewer initiatives in recent years. There are various reasons for this:

1. The lack of tax benefits.

Employees are generally not permitted to drive a delivery or freight van (with a grey licence plate) for personal use. In these cases, the employee is not liable for a supplementary tax liability (in the Netherlands) on the extra, 'personal' kilometres driven. This means that there is no financial incentive for an employee

to choose a vehicle with lower emissions – which have lower tax rates attached; an incentive which is present for non-delivery company vehicles.

2. Transporting materials and equipment.

Vans are used to transport materials and equipment. A different way of travelling therefore necessitates a different way of transporting these items. Switching to a bicycle or public transport is therefore less straightforward for employees in a van than for those in a passenger car. In addition, many installation companies are located on industrial estates, which are often not readily accessible by public transport or are not within cycling distance for employees.

3. The unpredictability of trips.

The journeys and activities of an employee in a van are generally less predictable than those of a business traveller in a passenger car. Urgent assignments and unexpected situations at customer's premises make it unclear in advance what distances will be covered and what materials will be needed.

4. Lack of supply of suitable electric vans.

This is lagging behind the availability of electric passenger cars.

2.5 Logistical characteristics

The logistical characteristics of service organisations are determined by the characteristics of the journeys they make and their material flows. These characteristics vary significantly. Not only do they differ per technical service provider, but also per engineer and per working day.

The diversity in these characteristics means that there is no one single, widely applicable solution for emission-free service logistics.

Based on historical trip data from four service organisations (see Table 2.2), logistics characteristics were examined. Interviews with team leaders and planners from the service organisations provided insight into the organisation of material flows. The results are presented in the following paragraphs.

Table 2.2: Overview of service organisations whose trip data was examined

Organisation	Year	Number of vehicles analysed
Eigen Haard	2019	30
ENGIE	2018 and 2019	30 in 2018 and 30 in 2019
Heijmans	2019	57
Unica	2018 and 2019	14 in 2018 and 18 in 2019

A helping hand for formulating and monitoring sustainability targets

The Trias Energetica concept

To bring about a reduction in CO₂ emissions, the 'Trias Energetica' concept can be followed:

- Step 1.** Reduce energy demand;
- Step 2.** Use energy from renewable (sustainable) sources;
- Step 3.** Use finite (fossil) energy sources as efficiently as possible and offset their emissions.

Sustainable Development Goals

In 2015, the United Nations adopted the Sustainable Development Goals as the new global sustainable development agenda for 2030. The seventeen goals can be used as a guide and as inspiration when formulating business objectives.

The CO₂ Performance Ladder, by SKAO Stichting Klimaatvriendelijk Aanbesteden & Ondernemen (Foundation for Climate-Friendly Procurement and Business)

The CO₂ performance ladder is an instrument to help companies and government bodies to reduce CO₂. This CO₂ performance ladder provides business operations guidance within projects. It is a clearly recognised instrument as a reporting tool within organisations and is used in tenders to assess sustainability performance.

BREEAM-NL (Building Research Establishment Environmental Assessment Method)

BREEAM-NL is the Dutch version of BREEAM, an assessment method for determining the sustainability performance of buildings, areas and projects. The method comprises quality marks. For example, there is *BREEAM-NL Nieuwbouw en Renovatie* (New Buildings and Renovations), which is used to determine the sustainability performance of new buildings. Transport (such as the accessibility of the building by public transport) is taken into account. Another quality mark is *BREEAM-NL In-Use*, which assesses existing buildings at three levels: building, management and use. *BREEAM-NL Gebied* (Neighbourhood) and *BREEAM-NL Sloop & Demontage* (Demolition & Dismantling) are also used. More and more clients are demanding a high BREEAM score.

Coalitie Anders Reizen (Travel Different Coalition)

More than 50 large Dutch organisations participate in the Travel Different Coalition to make their business mobility more sustainable. They share the ambition to reduce CO₂ emissions per FTE by 50% in 2030 compared to 2016 (Anders Reizen, 2020). The programme team facilitates knowledge sharing and cooperation and monitors progress. There is also an active 'Young Professionals' group involved in the coalition, which helps to identify new opportunities.

CO₂ Calculation

Dutch organisations can calculate CO₂ emissions on the basis of fuel and electricity consumption and associated conversion factors at www.co2conversiefactoren.nl. Internationally, the SBTi (Science Based Targets Initiative) of the Paris Climate Accord is an applied methodology.

Figure 2.1: The potential of various solutions depends on the trip profile: some examples for illustration.

		Number of stops per day	
		Few	Many
Distance covered per day	Short	Public Transport	Deploy light electric freight vehicle or cargo bike
	long	Recharge at the client's location	Quickly recharge between stops
		Long	Short
		Duration of stops	

Trip characteristics

The trip profile describes the number of stops and the number of kilometres travelled in one day. For each individual trip profile, a different solution for ZE transport could be favourable (see Figure 2.1). For example: when an engineer has many stops within a short distance of each other, it is beneficial to use a small, easy-to-park vehicle. When there are long distances and long stops, charging the vehicle at a client's location can be a solution. Figure 2.1 shows more examples.

Variations in driving distance, number of stops and time spent working

Table 2.3 shows the average and maximum distances per service organisation, the number of stops and the average delivery time. What is striking is that these figures differ greatly. A service engineer from Eigen Haard, for instance, drives an average distance of 81 kilometres per day, with a maximum of 240 kilometres per day. A service engineer from Heijmans drives an average distance of almost 200 kilometres a day, with a maximum of almost 600 kilometres. The number of jobs per day also varies greatly. ENGIE carries out an average of three jobs per day, while Eigen Haard averages 12 jobs per day. The average time spent on the jobs also varies. Eigen

Haard spent an average of half an hour on each job. ENGIE, on the other hand, spent an average of more than 3.5 hours.

There are therefore big differences not only between one service organisation and another, but also between employees and between any given employee's working days. The variation in distances and number of stops per service organisation is graphically represented in a box plot; see Figures 2.2 and 2.3. The box plot shows the lowest value, the first quartile, the median, the third quartile and the highest value. Each quartile represents 25% of the trips. For example, the following applies to Eigen Haard:

- ▶ The minimum number of stops on a day is 0.
- ▶ On 25% of working days, an engineer has between 0 and 8 stops.
- ▶ On 25% of working days, an engineer has between 8 and 12 stops.
- ▶ On 25% of working days, an engineer has between 12 and 15 stops.
- ▶ On 25% of working days, an engineer has between 15 and 29 stops.
- ▶ The maximum distance travelled is 240 kilometres.
- ▶ The maximum number of stops is 29.

Table 2.3: Service organisation trip data

Distance (kilometer)	Eigen Haard	ENGIE	Heijmans	Unica
Average distance travelled per day (km)	81	99	196	93
Maximum distance travelled in one day (km)	240	522	589	617
Average number of stops per day	12	3	9	5
Maximum number of stops per day	30	13	31	18
Average time spent per job	0:30	3:43	0:50	1:25

To demonstrate the diversity in trip profiles, randomly picked working weeks of two Unica engineers are visualised in Figure 2.4. For each day of the week the number of stops,

the total distance travelled and the number of stops in the city are indicated. The trip profile for the following week could look entirely different.

Figure 2.2: Box plot – number of stops per day

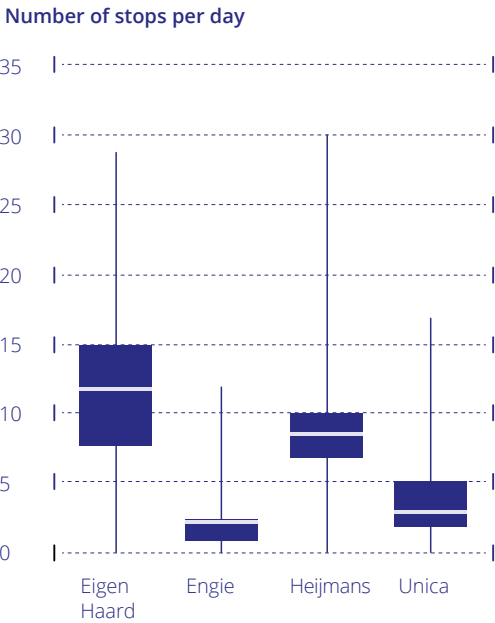


Figure 2.3: Box plot – number of kilometres travelled per day

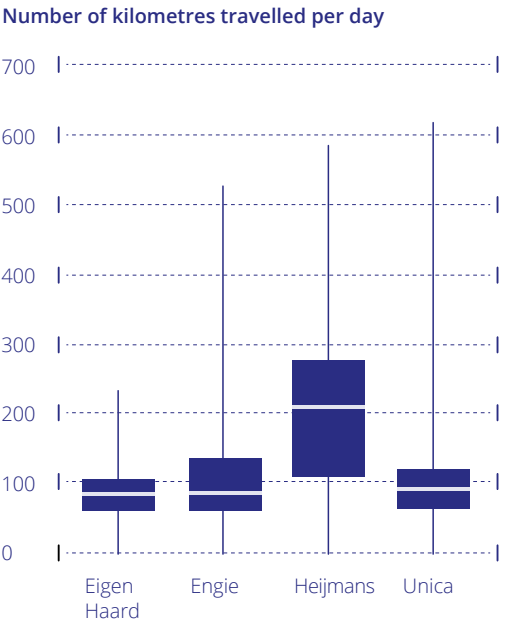
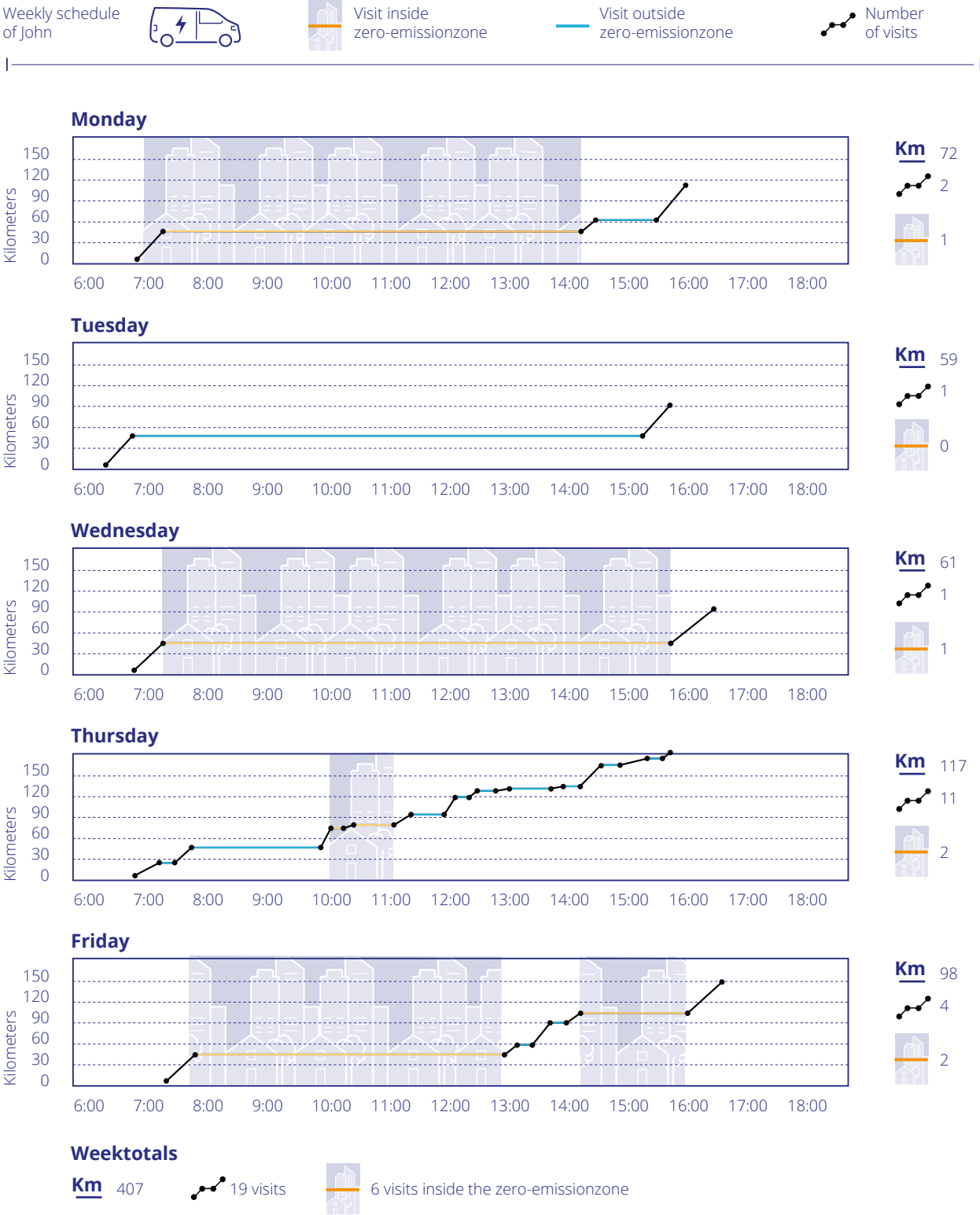
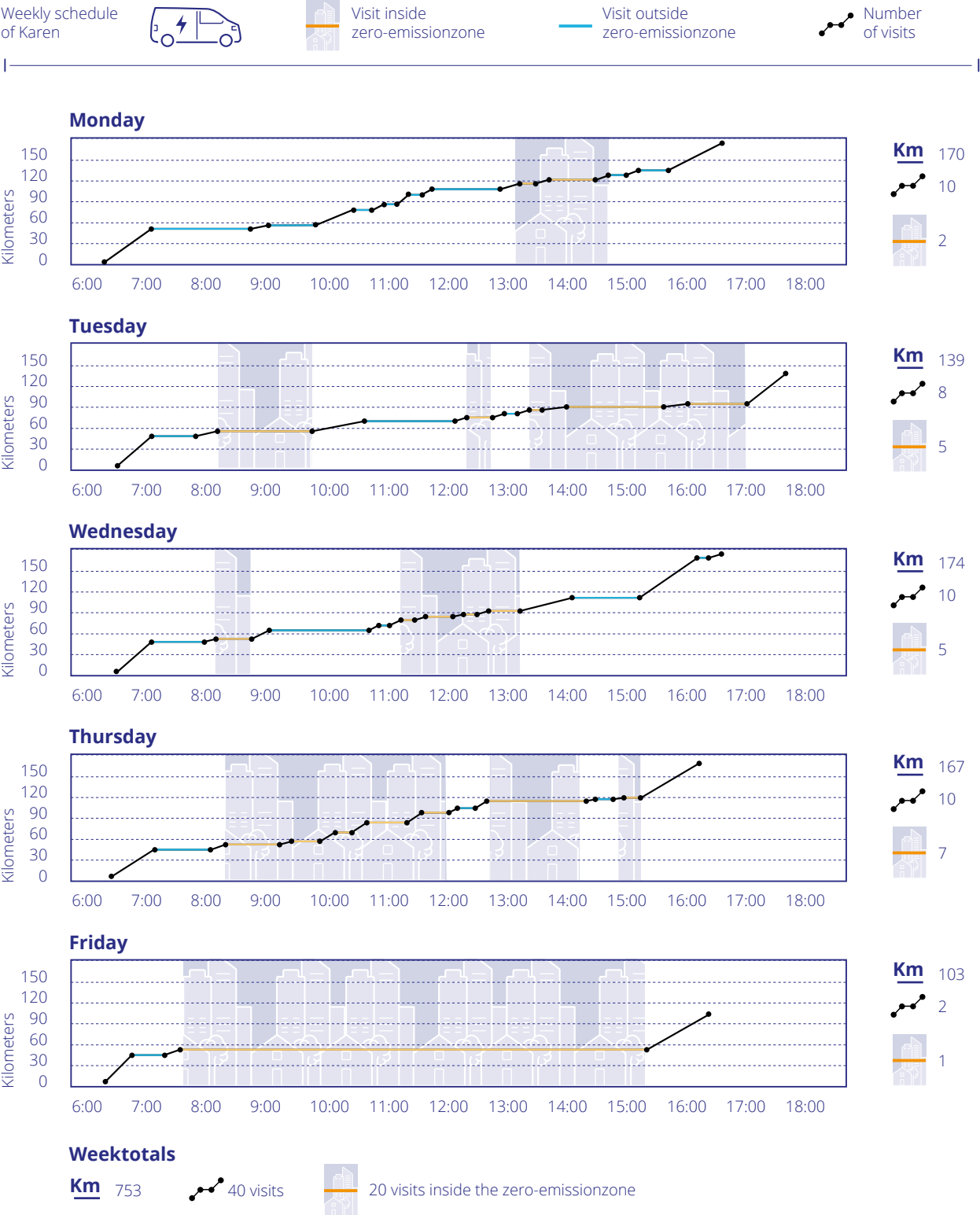


Figure 2.4: Trip profiles showing the working week of two randomly selected Unica engineers



Causes for varying trip profiles and long distances

One cause of the variations in trip profiles with sometimes very long distances is that the work done by service engineers is multi-faceted. They are often deployed for regular maintenance work and projects as well as for breakdowns. This work can sometimes alternate on a given day, or can for instance change on a weekly basis, depending on how the service organisation involved plans its employees' shifts. Not all jobs can be planned efficiently; some jobs are time-sensitive, require a specific specialism or must be carried out by the same staff member every time.

Another cause of these long distances is the shortage of technical staff on the labour market (see paragraph 2.3). As a result, service organisations do not have enough personnel available in all regions of the country. For example, Heijmans deploys personnel from the central Netherlands to the north of the country because of a shortage there. At the same time a number of engineers from the south of the country drive to the central Netherlands to cover that area. To save driving time and costs, engineers are sometimes given the opportunity to sleep in a hotel near the client during the week.

A third cause may be found in the dependence of private individuals on the scheduling and carrying out of service appointments. When smart meters are replaced or maintenance is carried out in homes, it is often important that the resident is present. Inefficiencies arise in the planning process when private individuals are able to cancel the appointment at the last minute or turn out not to be at home ('no-shows').

A fourth cause is a lack of cooperation between service organisations and with their supply chain partners. The exchange of (real-time) information on stocks or the exchange of assignments between organisations is rare.

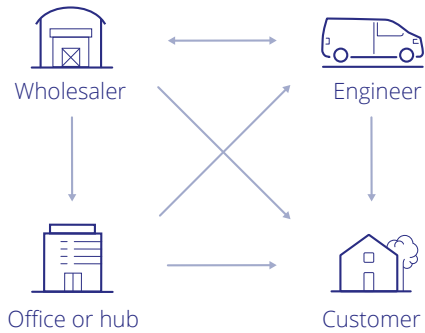
Material flows

If an engineer must always be in the right place at the right time, then so must their materials and tools. The flow of materials can be organised in various ways (see Figure 2.5). A number of practical examples:

- ▶ At Eigen Haard and Unica, materials and equipment are mainly delivered to the organisation's own office. At the beginning or end of the working day, engineers collect the required materials.
- ▶ At ENGIE, goods are mostly delivered to the client's location and in some cases to their own office. In exceptional cases, deliveries are made in the engineer's van or they pick up supplies from a wholesaler. All of this can take place before, during or after working hours.
- ▶ At Heijmans-Brinck, engineers are supplied during the day by a logistics service provider. This happens once, or at most twice, per week. The courier and the engineer communicate to determine the place where they will meet for the delivery. For this purpose, the logistics service provider is given the engineer's schedule. Engineers also sometimes come to the Brinck office in Zeewolde (a 50km drive to the east of Amsterdam) to pick up goods.

The deployment of ZE transport might involve changing the way in which goods reach the customer. This will be discussed in greater depth in Chapter 3.

Figure 2.5: The organisation of the flow of materials can be carried out in various ways.



In interviews with service engineers from Unica, Heijmans-Brinck, ENGIE and Eigen Haard, workers were asked for their opinions on transport and sustainability. The service engineers interviewed, all male, were aged between 29 and 63 and almost all were directly employed. Of the 27 engineers, 20 drove a van with a grey licence plate. The other seven drove a passenger car which they also used for private journeys. The interviewed engineers perform technical service work including the installation, maintenance, replacement or management of technical equipment. The distances they travel and the number of stops they make on a given day can vary greatly (see paragraph 2.5).

2.6 **Employee attitudes**

Behavioural research methodology

- ▶ **Interviews.** In 2019-2020, researchers from AUAS and HAN interviewed 27 service engineers from Unica, Heijmans-Brinck, ENGIE and Eigen Haard. The results are presented in Chapters 2 and 3.
- ▶ **Focus groups.** In 2020, four focus groups were organised, one for each service organisation, with a total of 17 engineers participating. The results are presented in Chapter 3.

Commercial vehicle criteria

From the interviews conducted, it appears that the service engineers considered the following criteria to be the most important when using a commercial vehicle:

- ▶ Loading space suitable for the job (not too big, not too small)
- ▶ Sufficient action radius
- ▶ Comfort
- ▶ Appearance of the vehicle that positively influences the customer's perception (not too luxurious, not too old).

Issues in using the current vehicles

The most frequently mentioned obstacles to the use of current vehicles were the lack of parking facilities (both on-street and in parking garages) and delays caused by traffic congestion. Engineers also found it impractical to only be able to fill up at certain petrol stations (e.g. Shell or Total).



Knowledge and information on electric vehicles

In general, the interviewed engineers knew more about electric cars than about electric vans. Questions were most frequently raised about the action radius, charging speed and cargo space offered by electric vehicles. Several engineers said that a vehicle with an action radius of 500 to 600 kilometres would remove most of their range anxiety.

‘I think electric driving is more stressful because you have to recharge so often.’

Service engineer

Associations with electric driving and motivation to drive an electric vehicle

The engineers had varying opinions about electric driving. Advantages identified included emission-free driving and comfort (driving an automatic car instead of with a manual gearbox). At the same time, engineers were concerned about the environmental impact of the battery, the potentially limited action radius and charging of the electric vehicle.

‘The automatic transmission of an electric car makes it easier to drive in traffic jams.’

Service engineer

Charging facilities

Within the Amsterdam area, the engineers generally did not expect any problems with the charging infrastructure. Outside the city and at home, however, some doubts were expressed. Most engineers said that they had no space on their own property and did not want to claim a public car parking space with a charging station. Engineers who do did have space for a charging station on their own property had questions about the additional costs involved (installation, maintenance and energy costs).

‘Sustainability is good, but not everyone can afford an electric vehicle.’

Service engineer

In general, the engineers were more positive about the development of electric vehicles in their sector. They did note, however, that until now they had not yet noticed much of

it in action and that there was not yet much discussion amongst their colleagues about sustainable transport.

‘Making homes and mobility more sustainable go together well.’

Service engineer

Alternative modes of transport

None of the engineers thought that it was feasible to replace vans with alternative vehicles outside Amsterdam. Within Amsterdam, some engineers did see opportunities for e-cargo bikes, e-scooters, light electric vehicles restricted to 45km/h or even boats, as long as the task and the materials were suitable for the vehicle. Some engineers with experience of using an e-cargo bike questioned the cargo space and the physical effort required to handle the vehicle.

‘I am prepared to use a cargo bike, provided the weather is nice and I get paid more for it’

Service engineer

consideration in contracts. When it does play a role in the tendering process, it often turns out to be difficult to give it concrete form in practice. In 2019, researchers from the ‘Go Electric’ project spoke with board members, fleet managers and team managers of various service organisations about the role of clients and customers in the transition to ZE transport. They shared the following experiences:

- 1. Clients have (so far) made few, if any, firm demands for sustainable transport in tenders.
- 2. Clients do not consider sustainable transport when selecting a supplier.
- 3. Clients are not willing to pay extra for sustainable transport.
- 4. Clients do not verify whether sustainable transport is actually used during the fulfilment of the contract.
- 5. The temporary nature of contracts makes service organisations reluctant to invest in a specific transport concept for a particular client.

2.7 Client attitudes

Service organisations provide their services to various customers including government bodies, utility companies, offices, hospitals, schools, industrial plants, property owners’ associations and private property owners. Sustainable transport is not yet an important



► Heijmans-Brinck

Heijmans is a technical service provider in the Netherlands that is active in real estate, construction and infrastructure for residential, commercial and public works. In 2014, Heijmans acquired Brinck, a company specialising in the installation of water, heat, electricity and gas meters.

In 2019, Heijmans (and therefore also Brinck) adopted a new strategy with sustainability targets covering the themes; energy, materials and space. For energy, the target is for Heijmans to be CO₂ neutral by 2023. Heijmans applies the 'Trias Energetica' concept in order to achieve the desired result. This is a three-step approach: 1) limit energy consumption, 2) use clean/green energy, 3) use energy efficiently. As part of Heijmans' strategy, since 2020 the costs of making its operations carbon-neutral have been made transparent for each business unit and reported as a 'Sustainability' KPI. This is partly why Heijmans is actively pursuing the electrification of its vehicle fleet, which accounts for 38% of the company's CO₂ emissions.

As part of a project carried out for client Liander in the De Pijp neighbourhood in Amsterdam, Brinck has deployed six Urban Arrow cargo bikes for a period of six months from Liander's location on the south-eastern edge of the city. Engineers go to the hub location under their own means, load the necessary materials into a cargo bike and then cycle to the work location in Amsterdam. In addition to this pilot, research has been carried out into the use of PHEVs. By comparing historical trip data from Brinck's diesel vehicles with the characteristics of PHEVs, it was found that 70 to 80% of the distance could be covered electrically, assuming an action radius of 200km and a charging strategy in which the engineer recharges fully at home after the working day.

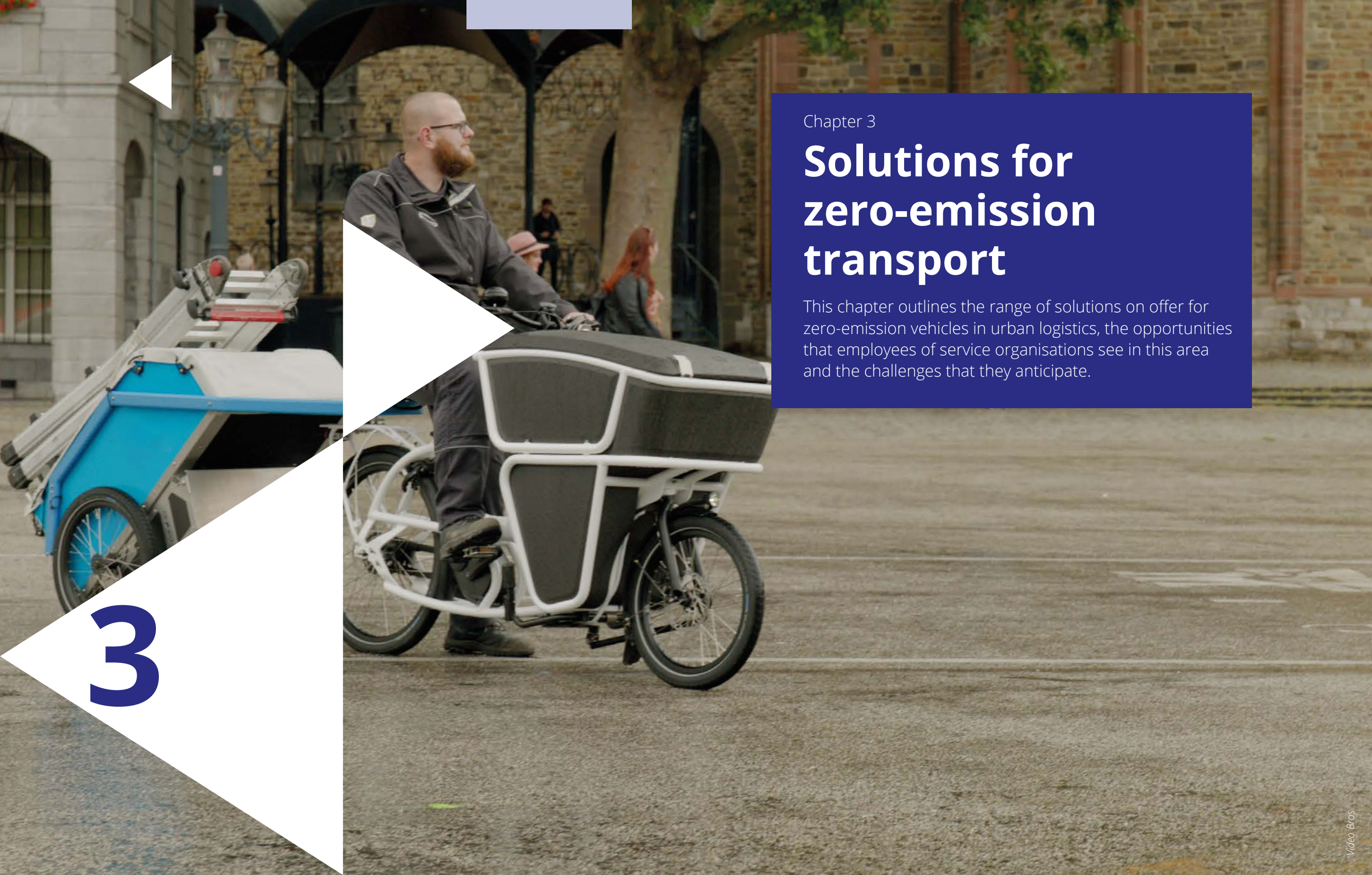
Engineers involved in the pilot scheme indicated, based on their experience, that the cargo bikes triggered positive reactions from customers, that there was ample parking space and that their use was environmentally beneficial. At the same time, the cargo bike does not offer the same loading capacity as a van, meaning that not all the required materials could be carried. Some engineers also found cycling physically taxing. Engineers indicated that they would benefit from an extra hub in the working area from where they could pick up or drop off materials, and where they could also have lunch, take a break and use the toilet.

In addition to coordinating the amount of materials that can be carried by the cargo bikes and the use of an extra hub where breaks can be taken and materials stored, it is also essential that a pilot scheme is well organised. It is advisable to organise sessions

with employees (and any freelancers) involved before the start of the pilot scheme in order to discuss the idea, purpose and method of the chosen solution and to build support. It is also wise to stay informed about how the vehicles are being used during the pilot scheme, for example through a WhatsApp group in which engineers can share their experiences. Finally, it is recommended to evaluate the pilot scheme together with the engineers after its completion, so that suggestions and feedback from those involved can be taken into account.

The experiences of the Brinck pilot scheme prompt us to examine, based on the flexibility that service logistics organisations want to offer from different work locations and schedules, when it is desirable to establish fixed and flexible hubs and when it is possible to make use of flexible vehicle arrangements for scaling up and down vehicle fleets. ◀





Chapter 3

Solutions for zero-emission transport

This chapter outlines the range of solutions on offer for zero-emission vehicles in urban logistics, the opportunities that employees of service organisations see in this area and the challenges that they anticipate.

3

3.1 Electric vans

An electric vehicle (EV) is driven by an electric motor instead of a combustion engine. The engine is powered by batteries installed inside the vehicle which need to be recharged (see paragraph 3.4). An EV has no tail-pipe emissions and is therefore allowed into zero-emission zones. EVs have lower maintenance costs than diesel-powered vehicles (Propfe et al., 2012), the energy costs per kilometre are lower, the vehicles make little noise when driven and they have automatic gearboxes. The cabin and cargo space of an electric van are similar to those of a conventional van (see Table 3.1). Engineers can have lunch in the van and take shelter in bad weather, listen to the radio on the road, and carry their materials and equipment with them. The advantage of an 'automatic' was frequently mentioned by the interviewed engineers as a plus point of electric driving, for example when driving in traffic jams.

One disadvantage of electric vehicles is the limitation of, and uncertainty about, their action radius. People, and also the engineers interviewed, are uncertain about how many of kilometres they can drive on their battery, especially when it is not fully charged. They also have questions about the possibility of recharging in time and in the local vicinity. The term 'range anxiety' arose from this situation. Improvements in battery technology have increased the maximum action radius of electric vans in recent years. The battery pack of the Nissan ENV200 has increased from 24kWh to 40kWh (from 100 to 200km WLTP). The Toyota ProAce is available in 50kWh and 75kWh (230 and 300km WLTP). In practice, action radius is on average 19% lower than the WLTP² value, according to an analysis by Travelcard (2020) and depends on the way the vehicle is used (driving style, whether air conditioning is used, speed) and weather conditions.

Table 3.1: Overview of types of van

			
Name	Small van	Medium van	Large van
Load capacity	4 to 6 m ³	6 to 9 m ³	9 to 13 m ³
Examples	Volkswagen e-Caddy, Renault Kangoo Z.E., Nissan E-NV200	Volkswagen e-Transporter, Mercedes eVito	Volkswagen e-crafter, Mercedes e-sprinter, SAIC Maxus EV80
Net payload	<750 kg	750-1,000 kg	> 1,000 kg

Hydrogen fuel cell technology

Several car manufacturers (including Toyota, Hyundai, Hyzon, Iveco, Mercedes and Renault) are developing electric commercial vehicles that run on hydrogen. For vans in urban logistics, it is expected that battery-electric vehicles will be favoured because of their lower TCO (Total Cost of Ownership). Both the price of the vehicle and the price per kilometre are considerably higher for hydrogen-powered vans than for fully battery-powered technology. The advantages of hydrogen are: less time at the charging station, more certainty in operations because of the higher action radius and better possibilities for storing energy surpluses. However, the availability of hydrogen charging stations is currently still very limited. The success rate of hydrogen applications is much higher for heavy road traffic, for long distances and for maritime shipping. Nevertheless, the technology is also being developed for passenger cars, one reason being that the energy network cannot cope with the growth in electric vans. The European research project FCCP is also experimenting with hydrogen-powered cargo bikes (Interreg NWE, 2021).

So far, little research has been conducted into the impact of load weight on the action radius. Practical experience shows that the action radius decreases significantly when the vehicle is loaded. In 2019, Arval Consulting conducted a test in Derby, UK, in which they first measured the action radius of an unladen E-NV200, then measured with different load percentages (25, 50, 70 and 100% of the maximum load weight). The results are shown in Table 3.2 and Figure 3.1. This test shows that the vehicle consumed 84% more energy when fully laden (700kg) compared to the unladen journey. This represents almost a halving of the action radius.

larger amount of energy per kilometre. One solution is to limit the maximum speed of the vehicle. However, this can lead to negative experiences for employees. In Eigen Haard's pilot project with two electric vans (see case description on page 90) , the vehicles were limited to a maximum speed of 90km/h. The engineers at Eigen Haard were not aware of this limitation, but were able to notice it in practice. They indicated that this was too restrictive and led to unpleasant situations on faster roads, for example when merging in traffic. From experience, they also noted that the action radius quickly decreased when the air conditioning was switched on and that range anxiety increased in unexpected traffic situations, such as traffic diversions.

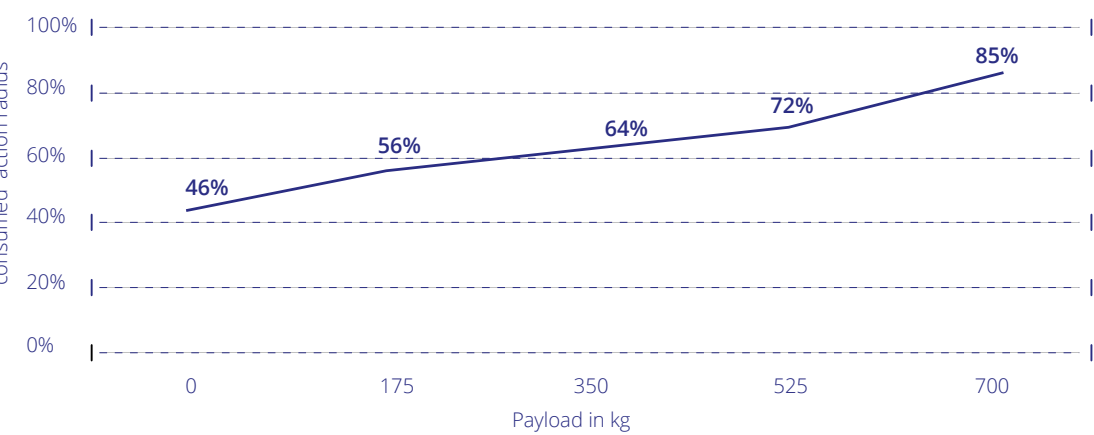
The speed at which the vehicle is driven also has an impact on its action radius. At a high speeds, the vehicle consumes a relatively

² WLTP is the abbreviation of Worldwide Harmonized Light Vehicle Test Procedure, a standard test to measure the consumption of electric vehicles. The WLTP provides insights into the action radius and fuel consumption.

Table 3.2: The impact of payload on action radius (Arval Consulting, 2019)

Action radius according to the manufacturer (km)	Maximum payload according to the manufacturer (kg)	Test route distance	Payload used	Payload (kg)	Action radius at the of the test	Action radius after 54km	Action radius used (km)	% Loss in comparison with action radius at 'start'	Increase in energy consumption compared to unladen
167	700	54	0%	0	109	59	50	46%	0%
			25%	175	109	48	61	56%	23%
			50%	350	111	40	71	64%	42%
			75%	525	109	30	79	72%	58%
			100%	700	108	16	92	85%	84%

Figure 3.1: The effect of load upon action radius (Arval Consulting, 2019)



Range anxiety can be alleviated with a higher battery capacity, but also with sufficient charging possibilities and a clear charging strategy (see section 3.4). In the absence of a reliable charging strategy, with a higher battery capacity, range anxiety gives way to charging anxiety. In order to increase the action radius, a lightweight commercial vehicle can be chosen. In addition, if the service engineer is able to organise their equipment more efficiently, a smaller vehicle model can be sufficient. It is also possible to envisage logistic concepts whereby the materials are transported to the service engineer's workplace by a third party; thus saving the service engineer weight and kilometres.

'If an engineer can't find a spare part (quickly) in the van, because there is no clear view over the cargo space, then the spare part is ordered again. As a result: engineers carry too much in the van than necessary.'

Hans den Otter, fleetmanager Unica

'It is important to properly arrange the contents of the van so that nothing is forgotten and nothing is carried twice. After all, extra weight reduces action radius. Sortimo uses lightweight materials and makes sure that the workflows are optimised.'

Lars Hendrikx, Sortimo commercial vehicle fitting



'The Volkswagen e-Crafter has a spring-loaded seat, that's super!'

Service engineer

'According to the brochure, the Volkswagen e-Crafter should have an action radius of 137km, but I didn't get further than 100km at times. Sometimes it was a close-run thing.'

Service engineer

'The electric van is pleasant to drive in traffic jams, because of its automatic gearbox'

Service engineer

3.2 Plug-in hybrid electric vehicles

‘Compared to an all-electric vehicle, a PHEV is practical; you have all the advantages of electric driving, but you don’t come to a standstill when the battery is flat. That provides flexibility.’
Service engineer

An alternative between the diesel van and the battery-electric van is the plug-in hybrid electric vehicle (PHEV) in petrol format. Because the PHEV can fall back on using fossil fuels, driver range anxiety and charging anxiety are less of a problem than with a full EV, especially within zero-emission zones. At the moment, the Ford Transit is the only available PHEV van that can serve as a solution (see photo). This vehicle has an action radius of 56km WLTP. In practice, the actual action radius will be lower and will depend on the vehicle’s load, among other things.



3.3 Light electric freight vehicles

A light electric freight vehicle (LEFV) is a bicycle, moped or compact vehicle with electric assistance or propulsion, designed for the distribution of goods in public spaces at limited speeds (see Table 3.3). Due to their small size, LEFVs are more manoeuvrable than electric or hybrid vans, occupy less space and can be parked right next to the customer’s door, saving time on parking. On average, an engineer cycling through the city is able to take a 20% shorter route if they had driven a car, since bikes are able to take more direct routes which are less interrupted by one-way roads, parks and squares. Another benefit is the opportunity to save on parking costs. This financial advantage proved decisive enough for Heijmans-Brinck and Feenstra to deploy cargo bikes for jobs in Amsterdam city centre. Another advantage is that no driving licence is required for most LEFVs. This is an advantage given the shortage of technically trained personnel, as employees under the age of 18 and/or without a driving licence can also be hired.

Table 3.3: Types of light electric freight vehicle

 Cargo bike	 Moped	 Compact distribution vehicle
Net load capacity 50 – 350 kg	Net load capacity 100 – 500 kg	Net load capacity 200 – 750 kg
Roadworthy weight: 20 – 170 kg	Roadworthy weight: 50 – 600 kg	Roadworthy weight: 300 – 1,000 kg

‘With 33 hours of work in the city centre, if you can save EUR 7.50 per hour in parking fees, you can lease a cargo bike for a month.’

Feenstra

There are also a number of drawbacks to the use of LEFVs, which can mean that their deployment requires additional measures:

- ▶ LEFVs have a lower capacity to carry materials and equipment. Therefore, it may be necessary to organise material flows differently by, for example, supplying engineers at the customer’s location (see paragraph 5.3.1) or by collaborating on a hub (see paragraph 3.5).
- ▶ LEFVs generally offer little or no protection against rain, cold, heat and solar radiation. Employees should be provided with clothing adapted to weather conditions. For example, rainproof clothing to ensure that the engineer does not arrive soaking wet at the customer’s door. This is an important consideration not only in terms of customer and employee satisfaction, but also in terms of safety (in the case of electrical jobs).
- ▶ LEFVs also generally offer little comfort during lunch breaks. As an alternative to having lunch in their van, it can be arranged for the engineer to have lunch at

the customer’s premises, at a nearby cafe (see the Feenstra case study) or at a hub.

- ▶ LEFVs cannot be driven on faster roads such as motorways/freeways. A transition to a hub location is therefore generally necessary when a journey includes sections outside the city.

In the case of cargo bikes in particular, some physical effort is required from the employee. This could be experienced either as an advantage (in terms of health and vitality) or as a disadvantage. Interviews and focus groups with engineers who have experience with cargo bikes yielded mixed reactions. Some experienced the cargo bike as a restriction of their freedom in cases where they no longer had access to a van. They found cycling difficult, physically exhausting and claimed that they were unable to carry all the necessary items. On the other hand, they said they could get to their jobs in Amsterdam quickly and that the action radius of the cargo bike is more than sufficient. Engineers also heard positive reactions from customers and colleagues about the use of the cargo bike. One employee of the ANWB (Royal Dutch Touring Club) in Nijmegen who rides a cargo bike for the Wegenwacht (auto breakdown service) is indeed very proud and enthusiastic about the use of a cargo bike in his work, and also encourages his colleagues to use them.

3.4 Charging options

The battery capacity of light electric freight vehicles is limited, as they can generally be charged from a wall socket. These vehicles often travel only short distances, so a fully charged battery or carrying an extra one is sufficient.

Charging infrastructure is a necessity for electric and hybrid vehicles. This charging infrastructure may consist of public, semi-public and private charging facilities, with or without guaranteed availability. Charging stations may have different charging speeds (see Table 3.4) as well as different and varying energy prices. As a result, there are plenty of ways in which the charging strategies can be devised. NKL Nederland (The Netherlands Knowledge Platform for Charging Infrastructure) outlined various charging options and charging scenarios in their *Handreiking Logistiek Laden* (Charging Guidelines for Logistics) (2020).



German company Swobbee supplies battery swapping stations for LEFVs in public spaces

Table 3.5 outlines options for charging during and after working hours. For each option, concrete questions arose during the ‘Go Electric’ project.

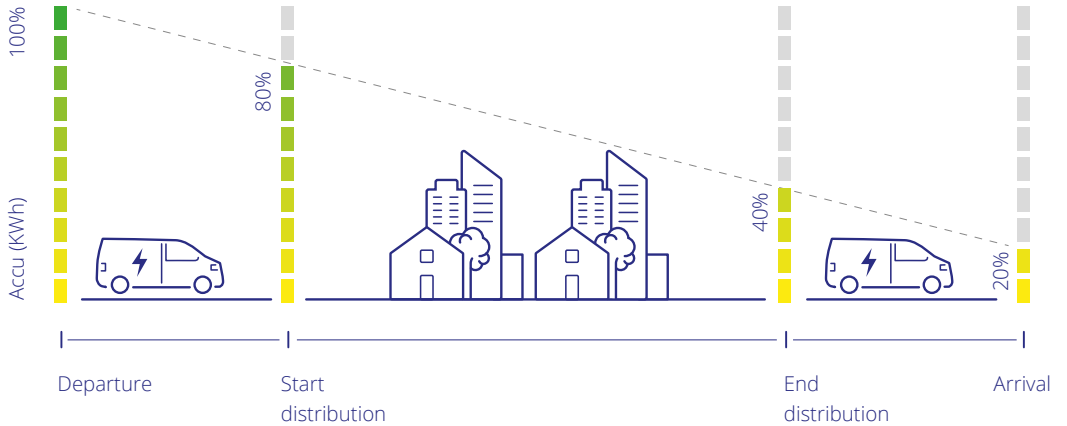
Table 3.4: Approximate charging times (NKL, 2020)

How long does it take to charge an electric van with a battery capacity of 80 kWh from 20% to 80%?					
	Home charging	Regular charging	Fast charger	Fast charger	Ultra-fast
Charging capacity kW	11	22	50	150	350
Charging time 80 kWh	260 min	130 min	60 min*	20 min*	8 min*

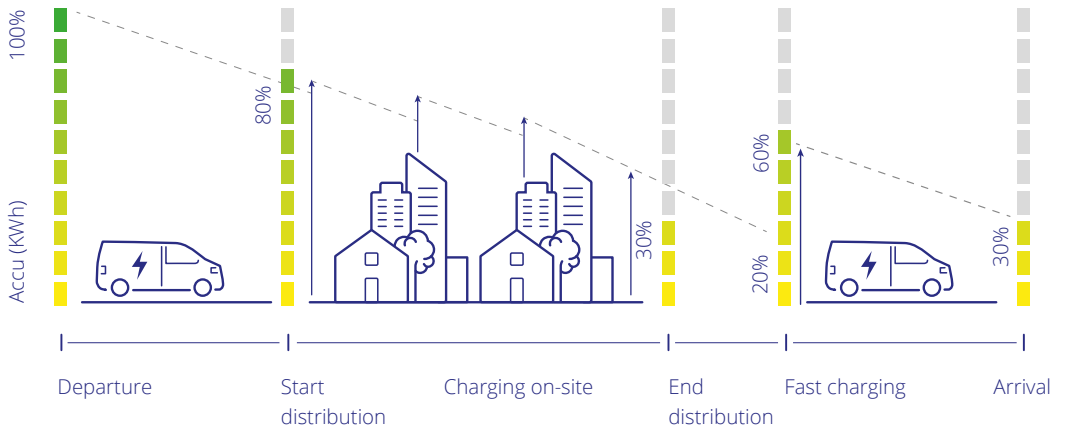
* Assumption: the vehicle is capable of handling faster charging speeds.

Table 3.5: Charging strategies and options (based on Topsector Logistiek, 2019)

Charging after working hours		Questions
At the engineer's home	On private property	Who facilitates the charging station and pays for the energy?
	In public space	Is there a space available nearby?
Business premises	Own premises	Is there always space available?
	External location	Does the electricity grid have sufficient capacity?



Charging during working hours		Questions
Customer location	Customer premises	What does the customer think? Are there any spaces available? Who pays for the energy? For a car park: can the van get in?
	In public space	Is there a space available nearby?
En route	Fast charging station	Is there a guaranteed space? Is there a fast charging station on the route?



Charging after working hours means attaching the vehicle to a charger after the working day is over in order to start the next working day with a full battery. For situations in which a full battery is sufficient for the day's travel, and charging at the site is guaranteed, this charging strategy is sufficient. However, practical experience has shown that charging after working hours poses a number of short and long-term challenges. When engineers do not have a private parking space at home, they are dependent on public charging stations. There may not be enough space on the organisation's premises to charge the entire fleet simultaneously. There is also the question of whether the local electricity grid can cope with the energy demand. In addition, when the vans are charged at the depot, engineers must commute to work. In addition, security on the premises must also be ensured.

Charging during working hours involves charging during or between jobs. Guaranteed charging at the customer's premises is a solution, especially for routes with few stops, which often means relatively long stopping times at the customer's premises. Engineers note that their customers increasingly have charging stations at their disposal, but that these are often reserved for their own employees or customers, so that it is not always clear whether the engineer is allowed to charge there. Fast chargers are a good option for recharging between stops, for example during lunch, but these are not always on the route. This may mean that a detour has to be made. Short charging sessions with a low charging capacity have little impact: the battery does not charge very much, which

may be disproportionate to the time the engineer spends connected to the charger. Moreover, engineers report extra pressure and irritation when they have to consider charging several times during the day, when they have to find a charging spot near the customer (which is not occupied) or when they have to park at a charging station located far from the customer.

'I stop for an average of 30 minutes at a house to do a job, so recharging doesn't really do much good.'
Service engineer

A challenge in service logistics, compared to parcel distribution for example, is the unpredictability and variation of daily trip lengths and customer locations (see Chapter 2). As a result, the charging requirements and the availability of charging facilities are also uncertain. A charging strategy which dynamically makes use of the various possibilities, integrated in the schedule and providing convenience to the engineer, is necessary to scale up emission-free service logistics.

3.5 **The hub as a supply and/or transfer point**

The limited action radius, speed and charging capacity of (light) electric vehicles do not make them suitable as a one-for-one replacement for a conventional van. Hubs offer a solution for deploying (light) electric vehicles in cities. A hub is a storage location at which service personnel can



switch between different modes of transport and where, if required, materials can also be stored and loaded. Materials can be transported from the hub to the customer location by the engineer themselves or by a 'last-mile' courier. Cooperation with a last-mile courier provides a solution for large materials that cannot be transported in the engineer's vehicle, as well as for follow-up and emergency deliveries.

3.5.1 Hub locations

Which locations lend themselves to the use of a (light) electric vehicle? Should employees set off directly from home, or should they first travel to a location in the city and then switch over there? Eight options (see Figure 3.2) were presented to service organisations in spring 2020 via an online

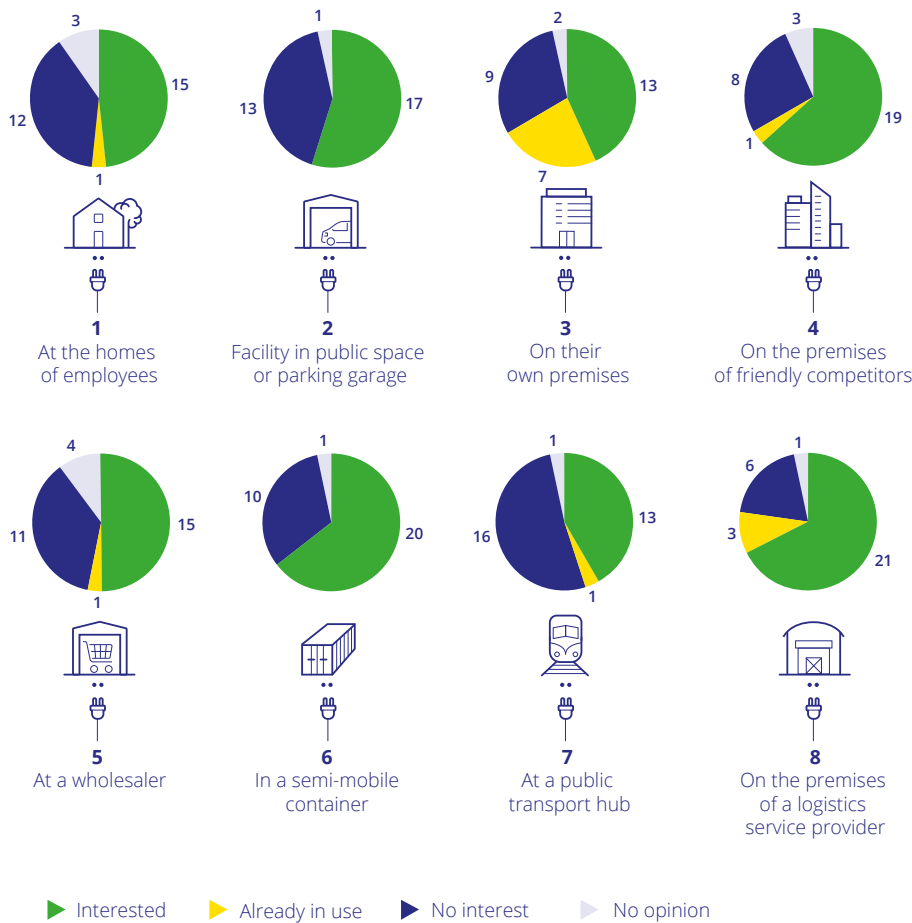
questionnaire. Figure 3.3 shows the results of 31 respondents. The most interest was expressed for the depot of a logistics service provider. A mobile hub and the premises of friendly competitors also scored highly. Taking the results of the questionnaire as a basis, a group of research partners then came together to develop the ideas into a concrete pilot project. You can read more about this in the Feenstra case study (see p.110) and in Chapters 4 and 5.

3.5.2 Size and catchment area of a hub

Logistic hubs in and around the city can offer the opportunity to switch vehicles and store materials. Based on their size, different hubs can be categorised: large, medium and small. The map shown in Figure 3.4 shows various hub locations in Amsterdam.

Figure 3.2: Questionnaire results (n=31)

From which locations does your organisation intend to deploy zero-emission vehicles or bicycles (in the future)?



Mobile charging container for electrical equipment from Dura Vermeer

► Large volumes on the edge of the city

There is more space available on the outskirts of the city than in the inner city. This offers opportunities for larger hubs, such as distribution centres. Here, freight trucks can deliver large volumes of goods in roll cages and on pallets and smaller vans and freight trucks can take over the remaining transport to the city. The hubs are located at a distance of up to approximately 10 kilometres from the city centre. One example is SLS; a business which operates a service-logistics location in Amsterdam-Zuidoost (south-east). Other examples are Hulshoff (10,000m²), B. Smart City Hub (24,000m²) and the Amsterdam Logistics CityHub (220,000m²; for which construction starts in 2021). Wholesalers such as Solar, Technische Unie, Stihl and Wasco can also fulfil this role. Technische Unie operates three electric freight trucks from its own transshipment point in Westpoort, on the western edge of Amsterdam, to the city centre.

► Medium-sized, located in or near to the city

Medium-sized hubs can be located on the outskirts of cities. Deliveries are made by small freight trucks, vans or by cargo bikes

with trailers, e-bikes or small van, within a radius of 5 kilometres. For example, MyPup has four medium-sized city hubs (of 400m²) in the Netherlands at which they receive parcels and distribute them to parcel lockers at organisations in the city. Cycle logistics operators such as Tring Tring and Cycloon also have medium-sized hubs (125m² and 400m² respectively). Sometimes these kinds of operators also rent space in a large hub ('hub in hub' concept). These medium-sized locations could serve as pick-up and transfer points for service engineers. Mobian and DOCKR have devised a concept for this purpose (see box).

► Small micro-hubs at neighbourhood level

Finally, there is the option of small hubs in the city. These could be pick-up points in local neighbourhoods, such as Parcls or Homerr (<100m²). From here, materials can be collected on foot, by bike or by a small van within a radius of about one kilometre.

Figure 3.4: Various hub locations in Amsterdam

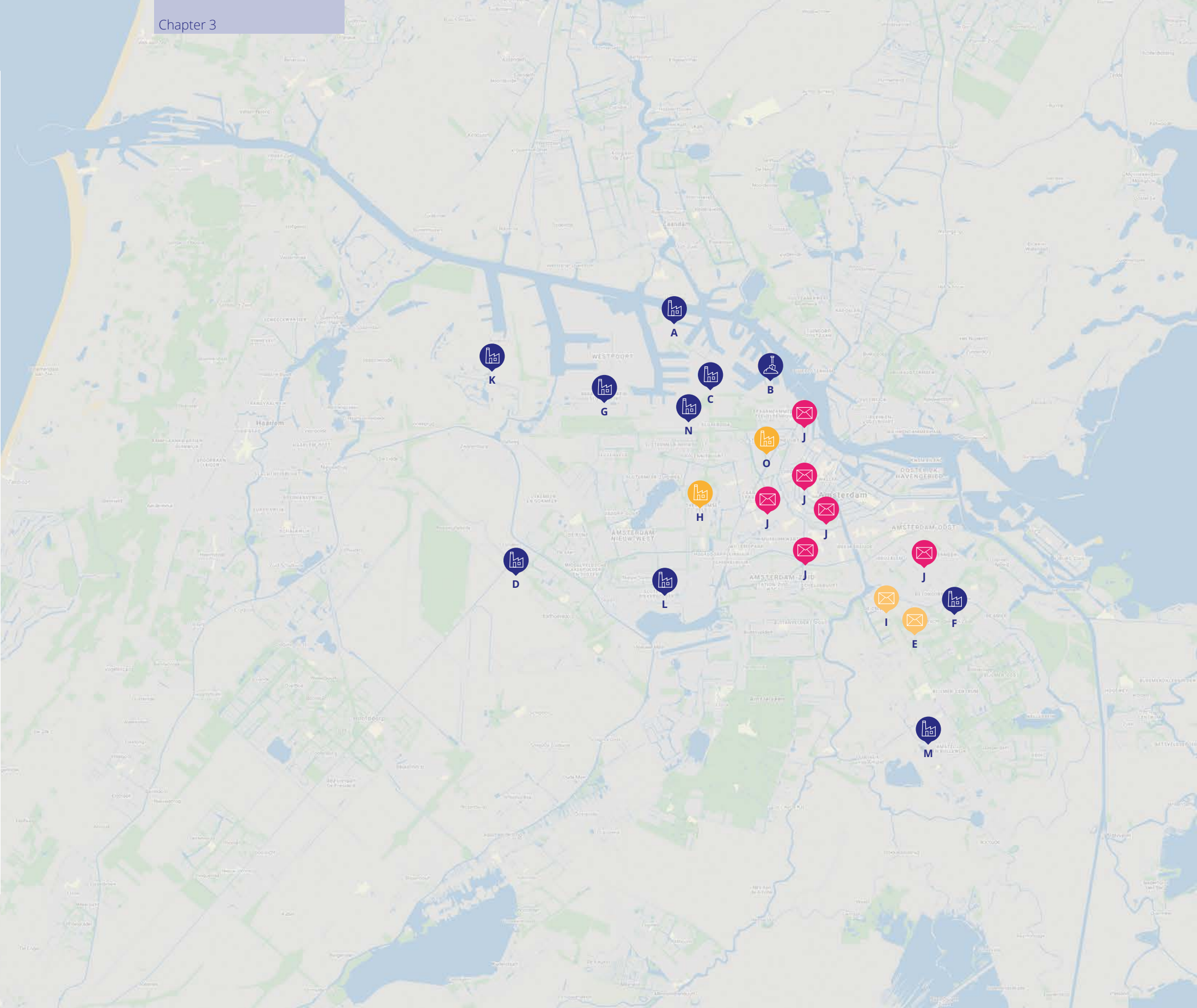
- A. Amsterdam Logistic Cityhub
- B. Bouwhub Amsterdam
- C. City Hub
- D. City Logistics Innovation Campus
- E. Cycloon Post & Fietskoeriers
- F. Deudekom
- G. Hulshoff
- H. Mobian
- I. MyPup
- J. Parcls
- K. Peeters Vervoercentrale
- L. Smart City Hub
- M. Special Logistic Services
- N. Technische Unie
- O. Tring Tring

Function

- Construction
- Parcel
- Diverse

Estimated delivery area

- Small hub (1km)
- Medium hub (5km)
- Large hub (10km)



This article was published in November 2020 on the website of Topsector Logistiek (Topsector Logistiek, 6th November 2020).

Park + Ride with e-cargo bike for service logistics

Amsterdam is the first city with a new service especially for engineers, installers, construction workers and other handymen in the city who are facing ever-increasing parking costs. The solution is simple. Reserve a parking space and cargo bike, park the bus on the outskirts of town, load the things you need into the cargo bike, get on and whistle happily all the way to your customer. It halves parking costs, and eliminates both long searches for a parking space and a lot of annoyance. A welcome side effect: it reduces the number of vans in the city.

The idea was conceived by MOBIAN and DOCKR. MOBIAN supplies reservation software for parking spaces and DOCKR offers a subscription-based service for cargo bikes. *‘The idea works on two levels,’* begins Laurens Bushoff of MOBIAN. *‘We reduce the costs for the engineers, installers and handymen who need to be in Amsterdam.’* Willem Boverhof of DOCKR adds: *‘And on the other hand we are helping the city in its ambition to make Amsterdam a cleaner place by reducing the number of vans in the city.’*



Mobian and DOCKR's Park+Ride service for service workers



3.6 Preventing trips

The above paragraphs describe logistical and transport solutions. But it is also possible to envisage measures that prevent a trip from having to be made in the first place. When journeys are shorter and more predictable, the opportunities for zero-emission transport increase. It is worth examining how service organisations might improve collaboration with the many self-employed workers they have in their network; engineers drive long distances and encounter many colleagues from competitors on the way. Couldn't this be done more intelligently by somehow exchanging jobs?

There are also opportunities to make journeys more predictable through better version management using BIM data for the maintenance of buildings and installations, the use of IoT, tele-maintenance, interactive electronic documentation, performance-

based service logistics (paying for performance) and a smart network of local inventory hubs in collaboration with wholesalers or colleagues. And maybe it's treason to say it, but can't we make the customers a little more self-reliant?

‘Sensor technology and IoT mean that more and more devices can be maintained remotely or by the customer themselves. On the other hand, devices and systems are becoming more and more complex, which means that the help of external specialists is more frequently required. Think of cars: you used to be able to change a light bulb yourself, but now you can't do that anymore either’

Laurens de Vrijer, Techniek Nederland



► Engie

ENGIE is one of the largest energy suppliers in the Netherlands and is a current market leader in technical services in the areas of sustainable urban development, smart buildings, sustainable generation of energy, supply of geothermal heat and solutions for electric vehicles. ENGIE has set itself the goal of becoming emission-free by 2030. In addition, the company has the ambition to become the market leader in the field of 'zero-carbon transition as a service'.

Student teams from the Amsterdam University of Applied Sciences studied the applicability of the electric cargo bike among service engineers. In 2020, ENGIE started to deploy electric cargo bikes for service engineers on the grounds of Maastricht University. The students investigated the question of what internal and external factors should be taken into account during the introduction of electric cargo bikes in campus and utility areas. They focused their research on the campus area of the University of Twente.

Interviews with engineers working in and around the campus area highlighted important internal and external factors that should be taken into account during the introduction of cargo bikes. One of the engineers interviewed during the study is

already using an electric cargo bike on the campus of Maastricht University.

Internal factors

The most important internal factor that emerged from the survey is doubts among engineers about the volume of a cargo bike. The engineers anticipated that the volume offered would be too small for them to do their work. They would not want to have to cycle back to a logistics hub to get the right part if they had forgotten to put it in the cargo bike. This is closely related to the second internal factor that emerged from the study, namely that some engineers do not have the experience to estimate what items they need to bring to a job, with extra kilometres of cycling as the inevitable result. The third internal factor is that the engineers indicated that they would like to

be more involved in the transition to electric cargo bikes. They felt they had no say in the changes the company was implementing to become CO₂ neutral in the future.

External factors

The most important external factor influencing the switch from the van to the cargo bike was weather conditions. The engineers indicated that they did not like the idea of cycling in bad weather. In addition, they felt they were treated less favourably in their working environment when they had to cycle in bad weather instead of driving their car.

The students' recommendations to ENGIE are as follows:

- ▶ **Involve engineers in research projects and in the preparation of a pilot scheme.** This would give them a better understanding of why they themselves are so important in the switch from vans to cargo bikes.
- ▶ **In the initial stages of implementation, keep hold of the vans.** In order to smooth the transition to cargo bikes, it is advisable not to get rid of the vans straight away. This way, engineers can first choose which means of transport to use and have time to experience the advantages of the cargo bike.
- ▶ **Start using electric cargo bikes in the spring.** When weather conditions are more favourable, the engineers will first experience the advantages of the cargo bike, which will help them, in time, to use it in less favourable weather conditions as well. ◀



Peter Debie



Approaches to zero-emission service logistics

This chapter addresses the adaptations that are necessary in the business operations and processes of service organisations in order to implement zero-emission transport. The engineers, simultaneously the drivers of the vehicles, play a key role in this. An important question is how employees of service organisations can be encouraged to embrace these innovations. We also discuss the decisions that need to be made in order to develop an effective charging strategy. Lastly, in this chapter we consider the implications of zero-emission transport for service logistics planning and control, for supporting ICT, and for financing options. The aim of this chapter is to provide service organisations with the necessary tools to shape their zero-emission transport plans.

4.1 Challenges, aspirations and constraints

The six case studies and partners workshops held in 2020 revealed the challenges, constraints and aspirations for the introduction of zero-emission transport in service logistics. By means of a gap analysis, the service organisations indicated where they wanted their company to be in 2025 and what was needed in order to get there from their current situation (see Table 4.1).

This is important information for the development of solutions by providers (see Chapter 5). Interestingly, most of the challenges were not related to the means of transport itself, but to the business choices that are associated with them. We also observed differences between the service organisations. Since 2020, zero-emission transport has received more attention, but there is also a tendency towards delay by some organisations; after all, there is still a long way to go to 2025 and 2030.

Table 4.1: Gap analysis results

	Current situation The path towards zero-emission service logistics	Desired situation Zero-emission service logistics
Supply of materials	► There are fears that with less loading space or with a different logistical concept, engineers will not be able to get the necessary materials to the right place on time. ► Return flows (e.g. organic waste, old parts) are often forgotten about when designing new logistics concepts.	► The ability to predict what materials will be needed is high enough to ensure that the right materials and tools are available at the right location at the right time and that no excess supplies are carried. ► Return flows are well integrated.
Planning	► Most planning systems are based on the use of a generic type of vehicle and do not distinguish between inner-city and non-urban trips. ► The charging of electric vehicles is not integrated into schedules.	► Planning takes into account different transport options and the (real-time) action radius. ► Real-time data on the action radius, charging options and availability of supplies is integrated into service planning systems.
Personnel	► The terms and conditions of employment are not compatible with the deployment of alternative modes of transport. ► Due to the shortage of suitable engineers, service organisations are reluctant to make changes that could lead to lower staff satisfaction. ► There is not always permission (from the employee representation council) to view staff location data in real time (for privacy reasons).	► There is communication with engineers about the new ways of working and the implications for their job satisfaction. ► The consequences for the terms of employment and personnel policy are clear. For instance, a different contract for personnel on bicycles or agreements about being able to view personnel location data in real time.

	Current situation The path towards zero-emission service logistics	Desired situation Zero-emission service logistics
Hub locations	► The availability of hubs is patchy. ► There is uncertainty about who is most able to manage hub locations: the client, contractors, third parties or municipalities? ► There is uncertainty about the availability of parking locations and vehicles in sharing concepts.	► It is possible to make a well-informed decision about which hubs are suitable for the organisation's activities and charging needs (vehicles and equipment). ► The management of a hub or network of hubs is well organised in terms of findability, availability, and clarity around services and costs.
Charging infrastructure	► It is not yet clear where the engineers will actually charge, which makes it difficult to make the right investment choices regarding charging infrastructure. ► Practical issues (meter box, land, premises) are encountered when installing charging infrastructure, resulting in high installation costs. ► There is a shortage of suitable engineers to install charging infrastructure. ► Electricity grid operators cannot quickly scale up energy capacity. ► The price of charging en route is unpredictable.	► The charging strategy (whether at home, en route, at the customer's premises or via fast charger) has been determined and is part of the overall plan. ► Engineers have access to reliable information about charging options and locations. ► There is sufficient charging speed and electricity supply capacity. ► Charging costs and energy prices are transparent and predictable. ► There is an investment plan for shared charging infrastructure. ► A proper site survey is carried out in advance to reduce installation costs. ► Actual charging behaviour can be monitored.
Vehicle procurement and maintenance	► Contracts are not flexible; vehicle fleets cannot be scaled up or down quickly. ► Maintenance is carried out during working hours.	► Flexible contract options are available: purchase, all-in lease or short-term rental. Including or excluding maintenance on location and/or en route. ► The action radius and loading capacity of the vehicle are in line with the work engineers carry out. ► Maintenance is carried out at a location and time to suit work activities (en route or close to home or the office).

4.2 Business challenges

From the list of constraints, it is clear that the path leading to ZE service logistics does not begin with the choice of transport mode. The composition of any given vehicle fleet is the result of decisions made regarding the customers and activities of the service organisation, the personnel and how they are organised logistically. This means that service organisations must first carefully examine their activities: which customers do they intend to serve and with what expertise? Which service and market segments are being targeted and what service agreements are being made with customers? Which employees are required and available in which areas? From which locations is the supply of materials organised, and by whom?

The corporate issues involved in the roadmap to zero-emission can be divided into long-term (strategic), medium-term (tactical) and day-to-day (operational). The issues relate to A) customers and activities, B) personnel, C) logistics and D) the vehicle fleet and charging infrastructure. See Table 4.2.

Given the necessity to phase out not just some, but all diesel vehicles within 5 to 10 years, it is vital to work through these decisions. Any organisation that thinks that they can simply replace diesel vehicles one for one should go back to drawing board: what kind of service organisation do we want to be, for whom, with whom, and where?

A. Customers and Activities

The size, location and requirements of the client and end-customer all influence the extent to which ZE service logistics is necessary, desirable and possible. Is the customer large and located in a lively, car-free city centre? Or is it maintenance at many different customer addresses, spread across the city? Or is it situated in an industrial area? Does the client value efficient, clean logistics? Do they offer charging points and storage capacity? The characteristics of the client, end-customer and service activities then determine how steps B to D are implemented.

Collaboration with clients and friendly competitors can be an attractive option in busy areas, where transport and parking costs are high. One example can be found in Amsterdam Zuidas, the business district located on the southern edge of the city centre. The area is straddled by a motorway/ freeway, has a busy train and metro interchange and contains a high concentration of offices, homes, bars and restaurants. A total of 55 organisations – including ENGIE – have joined forces to form the Green Business Club (GBC) Zuidas. Members of the GBC work together on sustainable innovations for the area. ENGIE provides technical maintenance for some of the large buildings in Zuidas, including WTC and ABN AMRO. Gate research from 2018 (carried out by AUAS and others on behalf of GBC Zuidas) shows that there is a high frequency and diversity of deliveries. By consolidating packages and facilities deliveries (such as cleaning products or technical materials), the number of actual deliveries to the buildings could, in theory, be halved. Consolidating deliveries for technical maintenance at these office buildings can reduce the number of actual deliveries by 3 to 8%.

Table 4.2: Business challenges influencing zero-emission service logistics

	A Customers and activities	B Personnel and behaviour	C Logistics and planning	D Fleet and charging infrastructure
Strategic More than a year	▶ The selection of service and market segments and service agreements ▶ Cooperation with colleagues and clients in service provision ▶ Sustainability targets	▶ HRM policy and use of freelancers (national or regional focus)	▶ The van as a supply point ▶ The locations of hubs and supply points ▶ Whether or not to outsource service logistics ▶ Service planning strategy ▶ Real-time data provision	▶ Definition of vehicle options ▶ Type of contract with partners in fleet management ▶ Vehicle charging strategy and locations (home, office, hub) ▶ Subsidy choices (working together in consortia)
Tactical 1-12 months	▶ Coordination with colleagues ▶ Sustainable transport in tenders	▶ Personnel planning for engineers ▶ Behavioural interventions (educational, motivational) ▶ Recruitment, selection and deployment of external engineers	▶ Level of stock in the vehicle, at the hub, or at the customer's premises ▶ Agreements with suppliers about materials ▶ Assigning engineers and customers (regions, cities, districts)	▶ Fleet management: Deployment of vehicles and vehicle mix based on a balance of service requirements and cost. ▶ Which vehicles need to be replaced first and what should they be replaced with? ▶ Maintenance plan ▶ Applying for subsidies
Operational Less than a month	▶ Monitoring Service Level Agreements	▶ Daily management of engineers	▶ Scheduling of orders for the vehicle, hub or supplies at the customer's premises ▶ Handling returns	▶ Daily deployment of vehicles (and parking reservations if required) ▶ Charging the vehicle (on location, en route or at home) ▶ Vehicle maintenance

In practice, the consolidation of deliveries is a complicated task because of the variety of stakeholders with divergent interests and a lack of insight into logistical costs. Interviews with ENGIE employees, city logistics service provider Hulshoff and Zuidas facilities managers have shown that:

- ▶ The parties see social and operational benefits of consolidation: less traffic congestion and better planning.
- ▶ The correct distribution of costs in the chain is a necessity, but is a complex task when no contractual agreements have been made between the service organisation and the client.
- ▶ The organisations are prepared to enter into discussions with each other in order to identify solutions, including the question of who is responsible for managing the process.

B. Personnel and behaviour

The adoption of zero-emission vehicles by employees is an important factor in their successful implementation. Just as plans can be adapted to the action radius of an electric vehicle, the involvement and

expertise of engineers also demands special attention. This section describes how service organisations can stimulate the adoption of new vehicles among engineers at strategic, tactical and operational levels. It is important to take new, hired and existing staff into account when thinking about this adoption process.

HR policy

Due to a shortage of technically trained personnel, it is a challenge for service organisations to carry out all of the work they need to do. Engineers must therefore be deployed in the most optimal way. This makes it all the more important to facilitate the switch to alternative modes of transport (time is precious) and to ensure that new engineers perceive their modes of transport as attractive. At the strategic level, HR policy plays an important role in making agreements about the use of these alternative means of transport with new staff, including those yet to be recruited. As one of the case partners said during a workshop: “It is important to keep staff happy in this tight labour market”. For

instance, the employment contract could include the standard use of the cargo bike by new engineers. This can be a solution when hiring staff who do not have a driving licence. The employment contract can also be adjusted when engineers use a cargo bike, for example by arranging a lunch allowance which engineers can use at local cafés, or by extending the travel allowance so that the engineer is paid for the time spent travelling to and from the cargo bike. In addition, in the case of the cargo bike, other perks can be offered, such as a clothing package to protect the engineer from the effects of weather conditions such as heat or rain. Another option is for organisations to outsource work to self-employed people that already use zero-emission transport, in order to get started faster and inspire their own employees.

Behavioural interventions

On a tactical level, efforts can be made to change behaviour within an organisation to encourage engineers to use new, Behavioural interventions For case partner Unica, following an analysis of the current behaviour of their employees, recommendations were drawn up for behavioural interventions. The Behaviour Change Wheel (Michie, Atkins, & West, 2018) was used to design and analyse the survey. The Behaviour Change Wheel is a generic behavioural model that distinguishes between behaviour, behavioural determinants and intervention functions. This model is used in research to select target behaviours, analyse existing behaviours and - via examination of behavioural determinants - ultimately design behavioural interventions to achieve a new target behaviour. The key to the Behavioural

Change Wheel is the COM-B model, which states that behaviour stems from three behavioural factors: capacity, motivation and opportunity. These three behavioural factors each consist of two different components, also called sub-factors. The capacity factor consists of the two sub-factors psychological capacity (such as knowledge) and physical capacity (such as skills). The motivation factor consists of the sub-factors automatic motivation (such as habits and impulses) and reflective motivation (such as planning and evaluating). The opportunity factor consists of the two sub-factors physical opportunity (such as infrastructure) and social opportunity (such as social norms). Next, through an analysis of current behaviour, nine different intervention functions can be chosen to influence the behavioural factors and to stimulate the target group to adopt new target behaviours. These intervention functions were used to formulate behavioural recommendations, giving the service organisations the tools they need to respond to the knowledge, attitude and expectations of their own engineers. An overview of the COM-B model and the nine different intervention functions can be found in Figure 4.1.

Using the Behavioural Change Wheel, recommendations were made to stimulate engineers to try out a cargo bike as a means of transport for one working day. The results for the recommendations were obtained from a focus group of engineers from a case partner and a brief literature review on the use of electric cargo bikes in commercial service provision. Factors determining the general use of bicycles were also investigated. It was concluded from this study that any behavioural interventions

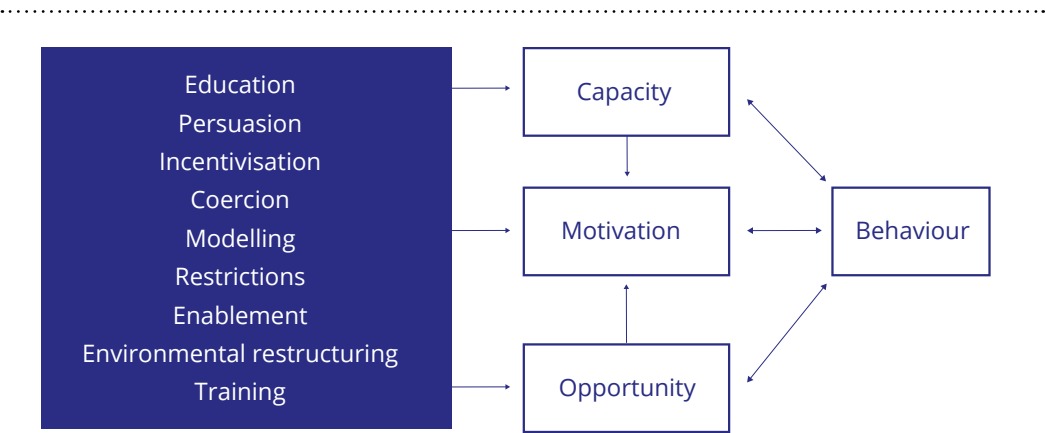
Table 4.3: Results gate research Green Business Club Zuidas

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Measurement period: one working week in the spring of 2018					
	Number of deliveries in one working week	Number of different suppliers	Number of deliveries for technical maintenance	Number of unique suppliers for technical maintenance	Deliveries potentially suitable ³ for consolidation
WTC-Building	372	222	16 (4%)	12 (5%)	200 (54%)
ABN AMRO	238	106	21 (9%)	12 (11%)	134 (56%)

³ Food, flowers, waste and regular mail are not directly suitable. GBC Zuidas wants to bundle supplies for flowers and fruit by working with local preferred suppliers. Coordinating delivery days is another option to reduce the number of deliveries.

Figure 4.1: The behavioural change model



should focus on employees' awareness of using the cargo bike (*psychological capacity*), the reasons for and benefits of using cargo bikes (*reflective motivation*), and the social norms within the group of engineers (*social opportunity*). The recommendations for behavioural intervention therefore focused on three intervention functions: *education, persuasion and (social) environmental restructuring*.

► *Education* is principally concerned with increasing psychological capacity and thus knowledge. When announcing the pilot project, ensure that engineers are informed that the service organisation has taken into account the preconditions that are necessary to promote the effective use of the cargo bike. These preconditions can be identified during a focus group. Also provide information on the use of the cargo bike, such where the bike can be ridden and parked.

► *Persuasion* relates in particular to reflective motivation and concerns the service organisation's arguments for using the cargo bike. This may increase the motivation of the engineers to try out a cargo bike. In communications with employees, the service organisation can explain why they want to use the cargo bike (e.g. to increase sustainability) and why they are first running a pilot project and giving engineers the opportunity to try it out. An interesting outcome of the interviews was that several service engineers saw a relationship between their work and sustainability: in their view, the substitution of old technology for newer and more sustainable systems contributes directly to making buildings and homes in the Netherlands more sustainable. Service organisations looking to increase the intrinsic motivation of employees to switch to a different mode of transport should be more active in researching and identifying such positive associations, so that the experiences of engineers and organisational sustainability ambitions correspond more closely.

► *Restructuring of the environment*. When applied to the social sphere, this factor concerns social opportunities and aims to normalise the process of trying out a cargo bike. In order to achieve this, it is important that employees feel free to try out a cargo bike without experiencing negative reactions from colleagues. For example, ask an engineer who is willing to try out the bicycle (because they are already sympathetic to it) to share their experiences with their fellow engineers from the service organisation. This has the advantage of making cargo bike use more accessible for engineers who would like to try one out, but are reluctant to be the first to do so. It also gives other engineers the opportunity to ask questions of the first engineer, which may help them to overcome any doubts they may have.

Guidance during pilot projects

On an operational level, it is important that engineers are carefully supervised during a pilot project with new vehicles. This is where recommendations made at a tactical level can be translated into practice. This means, for example, that engineers receive information in good time, but also that the social component is important at this point. By giving engineers the opportunity to share their experiences with the organisation in the interim, it is possible to make adjustments to the pilot project if necessary. This has a positive effect on the use of the vehicle. For the participating engineers, the possibility of reflection and intervention is also a sign that their practical experience is actually taken into account in the evaluation of the pilot project. It can also be valuable for engineers to share their experiences with other engineers, provided that this is

well facilitated by the organisation and that the points for attention put forward by the engineers are taken seriously. Experience from organisations such as ANWB (p.130) shows that the enthusiasm of engineers who already ride a cargo bike also motivates other engineers to try it out.

Influencing and monitoring driving behaviour

The driving style and route choice of the driver determine the practical action radius - as well as the acceptance by fellow road users - of a means of transport. There are various ways to influence efficient, safe and conscientious driving behaviour. These include speed restrictors, gamification apps that give the user feedback and the SafeDrivePod (Fleetkennis, 2019). Positive side effects of good driving are: lower energy and maintenance costs, a positive image for the organisation and fewer traffic fines. Charging behaviour can also be monitored to positively influence the action radius. Laadpunt Nederland, for example, recommends keeping the battery charge level (or 'state of charge') at between 20 and 80%, as this is better for the battery and therefore the action radius. The monitoring of driving behaviour is relevant to the use of electric vans as well as light electric freight vehicles and bicycles.

C. Logistics and planning
Hubs and supply locations

An important topic when it comes to strategic and tactical matters is the use of hubs and supply points. All service organisations face similar choices: should the engineer drive directly from their home to work, or should they go to a supply depot to pick up materials? Should they also switch to another (light) electric vehicle at that point? How can engineers get hold of the materials they need – including larger items – when e-cargo bikes are used?

Any hubs or extra vehicles would entail extra costs, which would have to be recouped. This could be done by carrying out more jobs per day, reducing parking costs or not offering a van to an engineer who commutes to the hub independently.

Supplies in the van

During the 'Go Electric' project, no data was collected on supplies kept in vehicles (volume and weight). Surprisingly, most service organisations have no active policy regarding stock kept in their vehicles. Despite this, the cargo space and load weight of a vehicle is an important consideration. The loading capacity of electric vans is between 700 and 1,000kg, including passengers. Service organisations should carefully consider the supplies and fittings in their vehicles. Much of the stock kept in vehicles is 'dead' stock, often left behind from previous jobs. This should be regularly and rigorously de-cluttered; less is more. The vehicle of the future will be smart. RFID on packaging may prove useful for frequent stocktaking of supplies kept in vehicles.

Service planning should take both the action radius of and current stock levels of vehicles into account to a greater extent. Proper preparation is crucial. It may be that in the future, a device in need of maintenance will automatically indicate what is required via remote diagnostics. When determining what supplies should be kept in a vehicle, it is necessary to take into account not only the level of service and the value of the stock, but also weight. If there are several vans carrying supplies in a city, this should be considered as part of a virtual city or regional inventory. Alternatively, supplies and parts located on the outskirts of the city (at logistics operators or wholesalers) can be delivered to engineers just-in-time. To a large extent, this can be done using cargo bikes (see paragraph 5.3.1). Smaller packaging units and lighter packaging materials are also suitable for delivery. Finally, a vehicle's interior must be designed with lightweight materials and efficient organisation systems.



Planning and ICT

Long recharging times and a short action radius requires different tactical and operational service and transport planning. Electric vehicles can be equipped with on-board computers that monitor the vehicle performance, location, battery and driving behaviour. With up-to-date traffic information, appropriate plans can be made for the reliable deployment of both vehicle and engineer. Current transport management systems (TMS) are not yet suitable; they do not take action radius or battery charging into account and cannot provide dynamic operational planning. One interesting topic is that of how service organisations can put their customers in charge of efficient planning, for example, when installing smart meters, heat pumps, solar panels or periodic maintenance of boilers. For instance, some service organisations enable their customers to schedule an appointment themselves on the basis of available 'time slots' that fit well within a schedule.

City logistics planning for cargo bikes

When using cargo bikes, a different approach to the way engineers' trips are allocated is required. A cost-benefit analysis carried out for Unica shows that deploying cargo bikes is unlikely to result in a favourable business case if planning methods stay the same and vans are retained. The travel time savings that can be achieved with cargo bikes due to shorter cycle routes (approx. -20%) are cancelled out by the time needed to switch between transport modes at the hub. The biggest gain is in the reduction of parking costs, but in Unica's case this gain was cancelled out by higher costs for the lease/purchase and maintenance of



the cargo bikes. See Figure 4.2 and Table 4.4. Heijmans-Brinck did realise a positive business case by saving so much on parking costs that they recouped the lease costs. This was because the stop density of the cargo bike was much higher in this case: the engineers on cargo bikes typically made stops within a short distance of the hub and did not switch means of transport in between. When this scenario was applied to Unica it also resulted in a positive business case. See Figure 4.3 and Table 4.5. Since the engineer cycles faster between customers, the reduction in travel time also offers the potential to increase turnover by serving more customers per day.

Concept 1: Planning unchanged, van retained

In this concept, no changes are made to planning methods and all engineers keep their van. At the hub, they can switch from van to cargo bike.

Figure 4.2: Logistics Concept 1

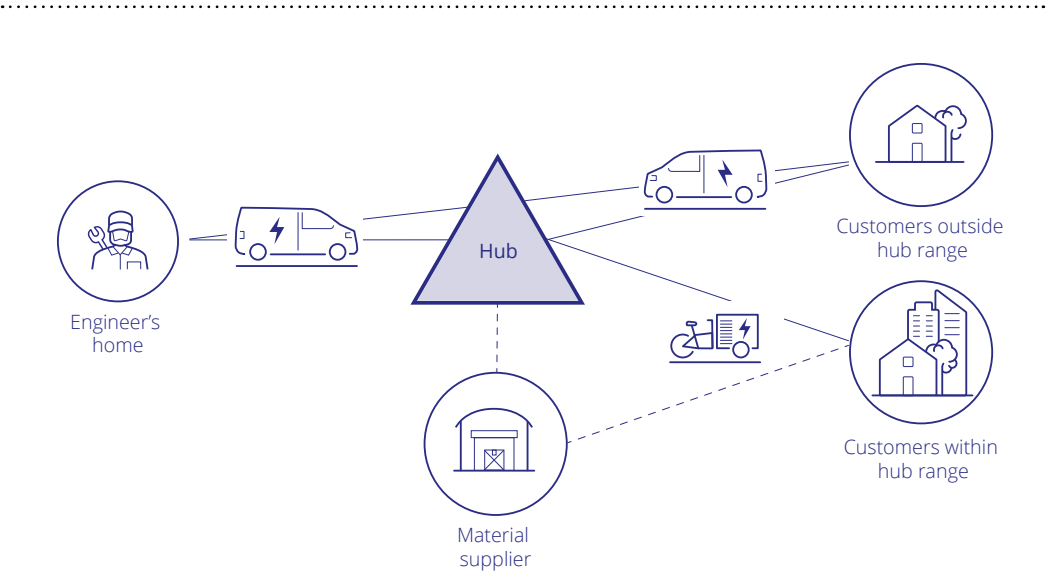


Table 4.4: Costs and benefits per month for the average engineer in concept 1

Costs		Benefits	
Hub location / layout	Dependent on location	Reduction in fuel costs	€ 10
Cargo bike incl. maintenance	€ 400	Reduction in parking costs	€ 150
Switch between bike and car	≈ travel time gains	Reduction in urban journey times	≈ bike-van switch
Extra supplier costs	€ 70	Reduction in CO ₂ offset costs	< € 1
€ 470 + hub costs		€ 160	

Concept 2: Urban-only schedule plus travel allowance

In this concept, a schedule is drawn up which only includes jobs within the city. The engineer taking these trips does not receive a lease car but rather a travel allowance. From the hub, the engineer travels by cargo bike.

Figure 4.3: Logistics Concept 2

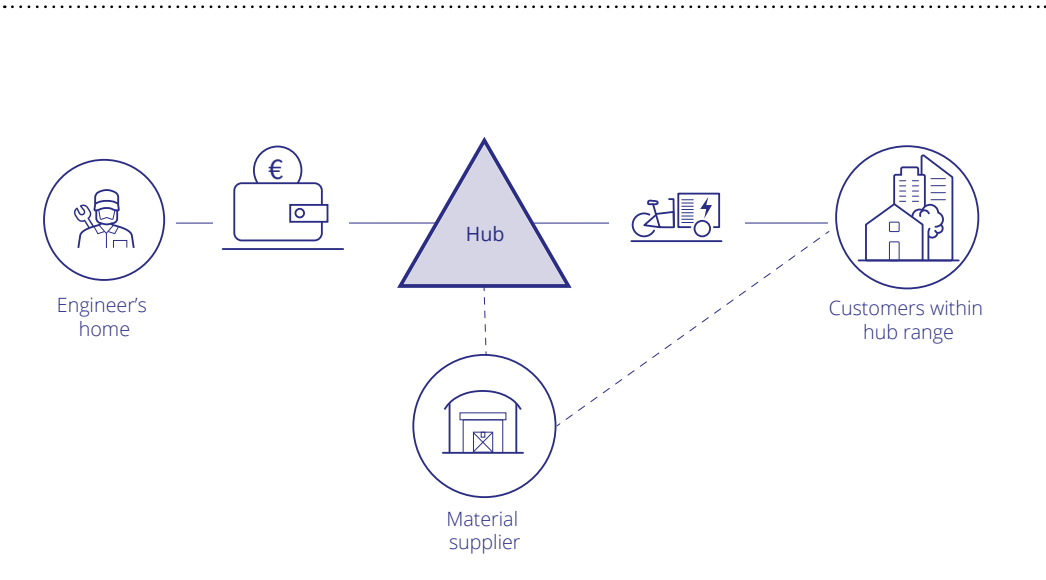


Table 4.5 Costs and benefits per month for an average engineer in concept 2

Costs		Benefits	
Hub location / layout	Dependent on location	Reduction in fuel costs	€ 70
Cargo bike	€ 400	Reduction in vehicle lease costs	€ 400
Extra supplier costs	€ 70	Reduction in urban journey times	€ 200
Travel allowance	€ 90	Reduction in parking costs	€ 400
Implications for planning	?	Reduction in CO ₂ offset costs	€ 10
		Increased turnover	?
€ 560 + hub and planning costs		€ 1080 + turnover increase	

D. Fleet and charging infrastructure

Fleet managers make decisions about their vehicle fleets and charging infrastructure. In Chapter 3 the various options for vehicles and charging facilities were discussed. At a strategic level, questions are raised about vehicle options, contract arrangements with partners, charging strategy and subsidies.

Vehicle mix

A strategic question for service organisations is whether they should give employees a regular vehicle of their own, or whether a more flexible model of vehicle use, possibly including sharing, would be preferable. Lease contracts run for three to five years. It is critical for service organisations that vehicle availability can be guaranteed. With the deployment of vehicles comes the tactical question of how maintenance should be organised. Where should it take place, for example close to the home of the engineer or close to the depot? During or after working hours? In the case of cargo bikes, an on-site mechanic or cooperation with a local cargo bike dealer are just two of the options.

At a tactical level, fleet managers determine the composition and deployment of their vehicle fleets based on the balance between the volume and location of work, service requirements and costs. They also arrange for the bringing in and removal of vehicles from their fleet, financing and subsidy applications, and arrange maintenance. At the level of daily, operational service planning, the deployment of vehicles (and where necessary the reservation of parking space), charging and maintenance are important.

Charging strategy

In order to successfully deploy zero-emission vehicles, service organisations need to

think about a charging strategy that aligns with their trip planning and which offers convenience to employees. Before investing in charging stations, upgrading the electricity grid or vehicles with an extra-long action radius, the right trade-offs need to be made. Using a model and based on trip data, various charging scenarios were analysed for Unica, Heijmans-Brinck, ENGIE and Eigen Haard (see Figure 4.4). What percentage of all kilometres can the vehicles in the fleet drive electrically under the current trip plan? It is clear that charging after working hours is essential. Charging at a customer's premises or at a fast charger during working hours significantly increases the action radius. Follow-up questions include which scenarios, or combination of scenarios, could be implemented in practice, where the vehicle should be parked after working hours and what the energy prices are per location.

Smart charging

For business premises where it will be necessary to charge many vehicles, a comprehensive approach to generating, balancing and distributing energy is needed to match energy demand with supply. The availability of electricity will become a location criterion, but in-house energy generation (solar or wind) will also be a component in the development of logistics premises. Service organisations will need to carefully consider the energy services they require, initially and during upscaling, such as charging points, charging speed, smart charging and charging stations. Charging infrastructure policies are not yet concrete on a local level. In combination with the advent of service-logistics hubs, cooperation seems sensible; as a service organisation in a hub on the outskirts of the city, which of your counterparts do you want to cooperate with?



Buying electricity

Diesel can be bought at any pump for a similar price per litre. Electricity is different. This immediately creates a disparity: charging on your own premises versus recharging at a commercial terminal. Prices at charging points vary widely. Calculations by Breikers (see 4.3) show that energy costs on an organisation's own premises are 74% lower than those in public locations. In order to stimulate the growth of electric vehicles, it is important to have an open and transparent market. This not only strengthens the position of the consumer, but also provides a level playing field for suppliers. The law demands that consumers are clearly informed of the price of a product or service. However, customers

are often uncertain of where they stand when charging their electric vehicle. Charging prices are not always readily accessible and sometimes there is no overview provided afterwards. In addition, differences in prices between locations and charging passes raise questions about price transparency. It is up to the relevant providers to jointly establish price transparency. Service organisations must follow the developments in this field closely. It is possible that prices will fall and become transparent and predictable.

Figure 4.4: Charging scenarios

		Data 2018 (14 vehicles) and 2019 (18 vehicles)	Share of electric kilometres Calculated on all kilometres driven by the vehicles in the fleet							
Does charging take place during the working day?	Yes, 15 minutes at a fast charger	42%	42%	42%	42%	75%	90%	96%	98%	
	Yes, at half of the stops	43%	58%	69%	73%	73%	92%	98%	99%	
	Yes, at a quarter of the stops	44%	32%	39%	42%	62%	86%	97%	99%	
	No, that is never possible	0%	0%	0%	0%	47%	78%	94%	97%	
Does charging take place after the working day?		No				Yes				
What is the action radius with a full battery		50km	100km	200km	300km	50km	100km	200km	300km	

		Data 2018 (57 vehicles)	Share of electric kilometres Calculated on all kilometres driven by the vehicles in the fleet							
Does charging take place during the working day?	Yes, 15 minutes at a fast charger	21%	21%	21%	21%	43%	61%	87%	95%	
	Yes, at half of the stops	28%	35%	38%	39%	47%	69%	92%	98%	
	Yes, at a quarter of the stops	16%	19%	20%	20%	38%	58%	86%	96%	
	No, that is never possible	0%	0%	0%	0%	24%	45%	78%	93%	
Does charging take place after the working day?		No				Yes				
What is the action radius with a full battery		50km	100km	200km	300km	50km	100km	200km	300km	

		Data 2018 (30 vehicles) and 2019 (30 vehicles)	Share of electric kilometres Calculated on all kilometres driven by the vehicles in the fleet							
Does charging take place during the working day?	Yes, 15 minutes at a fast charger	60%	60%	60%	60%	42%	88%	99%	100%	
	Yes, at half of the stops	32%	49%	65%	68%	65%	88%	99%	100%	
	Yes, at a quarter of the stops	17%	28%	40%	43%	57%	81%	98%	100%	
	No, that is never possible	0%	0%	0%	0%	47%	74%	97%	99%	
Does charging take place after the working day?		No				Yes				
What is the action radius with a full battery		50km	100km	200km	300km	50km	100km	200km	300km	

		Data 2019 (30 vehicles)	Share of electric kilometres Calculated on all kilometres driven by the vehicles in the fleet							
Does charging take place during the working day?	Yes, 15 minutes at a fast charger	50%	50%	50%	50%	88%	99%	100%	100%	
	Yes, at half of the stops	66%	73%	77%	78%	90%	99%	100%	100%	
	Yes, at a quarter of the stops	35%	39%	42%	43%	77%	97%	100%	100%	
	No, that is never possible	0%	0%	0%	0%	57%	90%	100%	100%	
Does charging take place after the working day?		No				Yes				
What is the action radius with a full battery		50km	100km	200km	300km	50km	100km	200km	300km	

Calculating the optimal modal mix and hub locations

Using data analysis of the trips made by one of the service organisations, a graduate student from the Vrije Universiteit created a model in CPLEX and Rstudio. This model allows service organisations to choose a vehicle from various pre-designated hub locations. The balance between modalities is based on the following variables:

- ▶ Time spent working at the customer premises: number of stops and stopping time
- ▶ Maximum length of a working day
- ▶ Average speed of the vehicle
- ▶ Battery capacity of the vehicle
- ▶ Charging speed of the vehicle
- ▶ Electricity consumption per kilometre
- ▶ Fixed costs for using the vehicle (lease costs and recharging the battery)
- ▶ Fuel cost per kilometre
- ▶ Salary cost per minute

By using trip data from Heijmans-Brinck, 2,000 different working days were simulated for each different hub location. Table 4.7 shows the results in percentages. It is assumed that an engineer has only one type of vehicle at their disposal per day and cannot switch in between jobs. It is also assumed that engineers only visit customers in the Amsterdam region.

The table is meant to be interpreted as follows. From De Pijp in Amsterdam, it is most economical to use the cargo bike on 54% of all working days. On 4% of working days the cargo bike's battery will need recharging. In the other 46%, the van is financially more advantageous or necessary to be able to carry out all planned jobs within the maximum working time. The latter may occur when there are long distances between customers on a working day. This model can help service organisations with the tactical planning of engineers and vehicles.

Table 4.6: Results of the Vrije Universiteit model

	Hub location in Amsterdam			
Number of routes which are chosen for deployment of:	Hemweg	De Pijp	Vijzelstraat	Spaklerweg
Cargo bike	50%	54%	55%	46%
Van	50%	46%	45%	54%
Battery recharging	2%	4%	4%	3%

Ten tips for setting up and running a pilot project:

1. Choose a top-down approach; ensure management commitment and ensure that the pilot project lines up with the strategic vision of the organisation.
2. Aim for the circumstances in the pilot project to resemble the actual future situation as much as possible.
3. Involve HR and engineers from the start. Think about adoption by engineers, working conditions such as commuting allowance, weatherproof clothing and coffee and lunch facilities.
4. Make material flows transparent: keep track of what is currently being transported and what is really necessary.
5. Adjust plans where possible or desirable, but keep tip 2 in mind.
6. Determine and evaluate the new method of working (the hub locations, vehicles, charging infrastructure, material flows, etc.) on the basis of trip analysis, financial figures and experiences of engineers.
7. Meet frequently with stakeholders (vehicle suppliers, hub operators, suppliers, engineers) to learn quickly and make adjustments. Use a communication tool (such as WhatsApp) to get daily feedback from engineers.
8. Think about a communication strategy (internal and external); exposure can contribute to a sense of pride among stakeholders and higher customer satisfaction.
9. Involve engineers in sharing their experiences with colleagues.
10. Organise maintenance and replacement transport in case of breakdowns.

4.3 Financing

Subsidies

Beginning in the spring of 2021, Dutch businesses can apply for a subsidy of up to 5,000 euros for the purchase or lease of an emission-free van (Staatscourant/ Government Gazette, 9 February 2021). This subsidy comes in anticipation of the requirement to be completely emission-free by 2030; giving early adopters a helping hand. Light electric vehicles are not mentioned in the provisional subsidy scheme, despite them often being an excellent option in the city.

Because the price of a van depends on its size and battery pack, the subsidy covers 10% of the new purchase price, up to a maximum of €5,000 per vehicle. In combination with the subsidy, businesses can make use of various fiscal incentives that make the purchase of an electric van attractive, such as the environmental investment deduction. The scheme is based on vehicle ownership, not on sharing.

In addition, local and national subsidies are available for, among other things, the development of new vehicles or service-logistics concepts. These include offerings from organisations such as Dinalog, Topsector Logistiek, municipalities and knowledge institutions. Schemes are also on offer from government bodies, an example being the Climate Technologies and Innovations Demonstration Scheme (DKTI - *Demonstratieregeling Klimaat Technologieën en Innovaties*), which is made available by

RVO. The City of Rotterdam also subsidises initiatives promoting efficient logistics (Logistiek010,2021).

Total Cost of Ownership (TCO)

Breikers has developed a model⁴ to calculate the TCO of small, medium and large electric vans. Figure 4.5 shows three different examples of one-to-one replacement for (a) Nissan NV200, (b) Peugeot Expert Long, and (c) Fiat Ducato. The model was used to analyse costs over the entire life cycle of a diesel vehicle, an electric variant which only uses public charging infrastructure, and an electric variant which only uses on-site charging infrastructure. The following assumptions were made:

- ▶ 20,000 kilometres are driven per year.
- ▶ A term of 5 years was assumed.
- ▶ For the current vehicle, diesel vehicles from the year 2016 were assumed.
- ▶ The vehicles have a maximum load capacity of 1,000kg and do not require a tow bar.
- ▶ Tax benefits are included in the depreciation costs.
- ▶ The residual value is 20% of the purchase price, for both diesel and electric vehicles.
- ▶ The Amsterdam subsidy scheme for emission-free company cars of 20% of the purchase price (with a maximum of €8,000) and €5,000 for the lower weight category of van were taken into account.
- ▶ The investment costs for charging infrastructure were not included.
- ▶ The Dutch electricity mix is used for charging.

⁴ Although the TCO tool used has been compiled with care, the possibility of errors cannot be ruled out. All amounts and figures mentioned, although based on current sources, are indicative. Therefore, no liability can be accepted for the results and outcomes presented.

Figure 4.5: Breikers model results



The results of the model show that the TCO of the diesel vehicle and the electric variant (public charging) do not differ much for the Nissan (1% increase) and increase slightly for the Fiat Ducato (8%). For the Peugeot, the TCO of EV (public charging) is 14% lower than the diesel TCO, due to the relatively high subsidy available for this vehicle.

When choosing a charging strategy in which charging takes place on an organisation's own premises, greater benefits can be obtained. The energy costs of on-site charging are (in the model) 74% lower than with public charging. As a result, using on-site charging facilities reduces the TCO in the three examples by approximately 15% compared to a public charging station. These comparisons show that whether the TCO is higher or lower than for a conventional vehicle depends upon the charging strategy adopted.



► Eigen Haard

Housing corporation Eigen Haard (600 FTE) rents out, maintains and repairs 57,000 homes, shop premises and parking facilities in the Amsterdam metropolitan region. Eigen Haard has its own fleet of 130 vehicles, 40 of which are vans. With support from mobility consultancy Syndesmo, Eigen Haard is working on a new mobility policy that aligns with its own sustainability ambitions, the future emission-free environmental zone and the challenges of urban parking.

In 2020, Eigen Haard ran a six-month experiment to test two different electric vans: the Volkswagen e-Crafter and the Maxus EV80 (from Chinese manufacturer SAIC). During the pilot scheme, four engineers drove the electric vans from the regional office at Sloterdijk, on the western edge of Amsterdam, where the vehicles were also charged.

In order to evaluate the pilot scheme and investigate the possibilities for scaling up the use of electric vans, interviews and a focus

group were held with the four engineers who had gained experience with the Volkswagen e-Crafter and the Maxus EV80. A student team from AUAS conducted additional research into the supply of electric vans, charging options and Eigen Haard's criteria.

Engineers' experiences

The interviews demonstrated that the engineers had mixed feelings about the pilot project with the two models of electric vans:

Negative experiences	Positive experiences
▶ Both vehicles in the pilot scheme were too large, which made them difficult to park in Amsterdam. ▶ The action radius was not sufficient, which caused stress. ▶ De maximum speed was too limiting. ▶ It was difficult in practice to find a useable charging point close enough to jobs at rental properties, and the time taken per job was typically too short to be able to charge properly.	▶ The vehicles were associated with sustainability. ▶ The vehicles did not cause much noise pollution. ▶ One of the vehicles was considered comfortable. ▶ A number of customers made positive comments about the electric vehicles.



Eigen Haard

A focus group involving the four engineers indicated the need for a clear charging strategy, as according to them there is little time during the working day to recharge intermittently. They would also prefer a smaller vehicle with a greater action radius and recommended that other colleagues also try out the electric vehicles, so that a larger group of engineers can gain electric driving experience.

Solutions for the transition to ZE mobility
For Eigen Haard, an important factor in choosing an electric vehicle is that there is enough space for materials. Marthin van Greuningen, Day-to-Day Maintenance Manager, explains:

‘Our engineers come to our depot every day to refill their supplies. This way, they always carry all the supplies with them in the vehicle’.

To facilitate the transition to an emission-free vehicle fleet, the student team came up with three possible solutions:

- 1. An alternative to commuting to work in order to limit distances driven.**
Engineers who live a long way from work do not take a vehicle home, but leave it at Eigen Haard's depot after work. They receive financial compensation for commuting.
- 2. Fast chargers on Eigen Haard premises for interim recharging.** Eigen Haard's two depots are fitted with four or five fast chargers. When the engineers make their daily visit to the depot to collect materials, the vans are recharged within 30 minutes. There would need to be a clear schedule for who comes at what time, so that space for recharging could be guaranteed.
- 3. Less supplies in vehicles to reduce weight.** Due to the negative effect of the weight of loads on the action radius, reducing the amount of supplies in the vehicle is recommended. By cooperating with city hubs or wholesalers who supply just-in-time it is possible to prevent engineers from running out of supplies. ◀



5

Chapter 5

New products and services for zero-emission transport

This chapter focuses on the development of products and services for zero-emission transport in service logistics. It builds on the lessons learned from the case studies and in workshops held with project partners. Chapter 4 addressed the challenges faced by service organisations in making the transition to a ZE fleet. In this chapter, we discuss the opportunities and challenges for new products and services using the Business Model Canvas, the scalability checklist and initiatives in practice, the next generation of engineers and the role of municipalities.

5.1 **Business model for cooperation**

Suppliers operating on the zero-emission transport market offer a variety of products and services, each with its own value proposition and business model. In order to support and unburden service organisations in their transitions to zero-emission transport, various suppliers must work together. The BMC can be used to gain insight into how suppliers in the market could mutually reinforce each other.

The BMC consists of four components (see Figure 5.1) and nine building blocks (see Figure 5.2). Firstly, the customer approach and the value proposition are determined. Next, the infrastructure needed to deliver the value is identified. Then the costs of this infrastructure and the costs the customer is prepared to pay are examined to assess the financial viability of the business model.

The BMC was used in workshops with organisations to develop a business model for 'hubs for service logistics with cargo bikes'. The organisations were 1) providers that could contribute to the business model and 2) service organisations that would like to make use of it (potential customers). The results show that the providers rely on each other to make a valuable enough proposition to service organisations. Ideally, a service organisation should be able to deal with a single point of contact. The contact organisation would then facilitate the necessary cooperation which enables the activities, resources and financial transactions between partners and customers. The idea is that a network of hubs would emerge from which organisations - depending on their area of

operation, modalities and activities - could choose the most suitable location(s) for them (see an example for Utrecht in Figure 5.3).



Figure 5.1: Business Model Canvas components

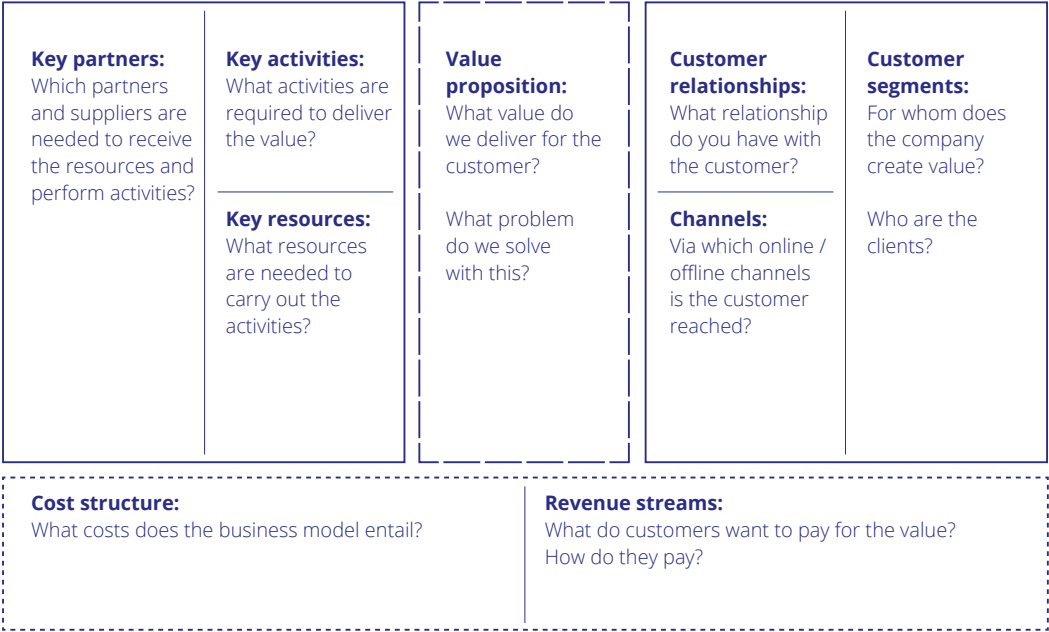
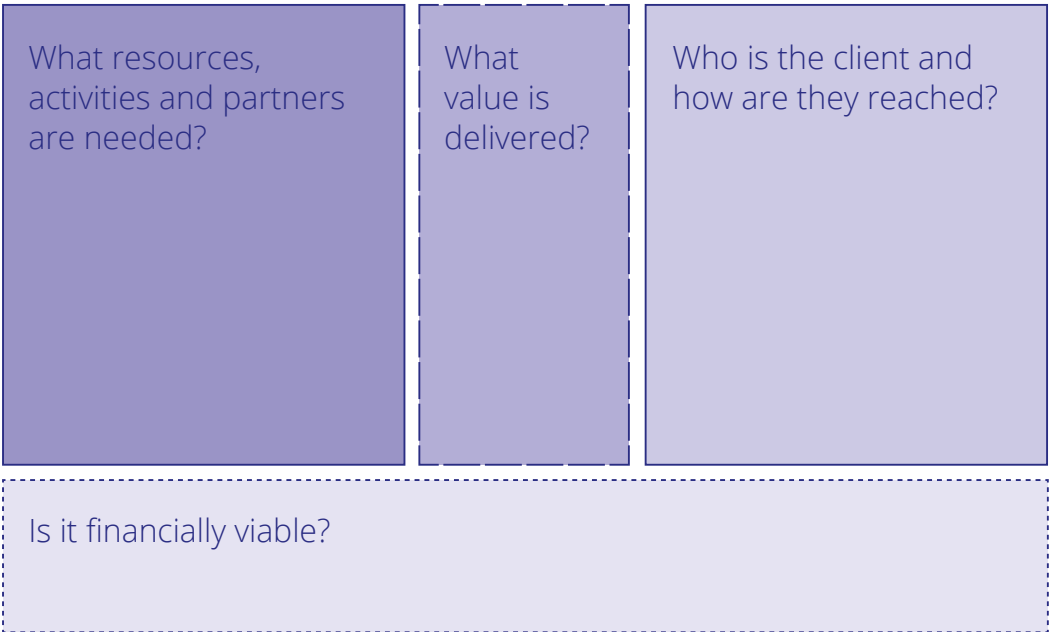


Figure 5.2: Example: Business model for a network of hubs and the deployment of cargo bikes

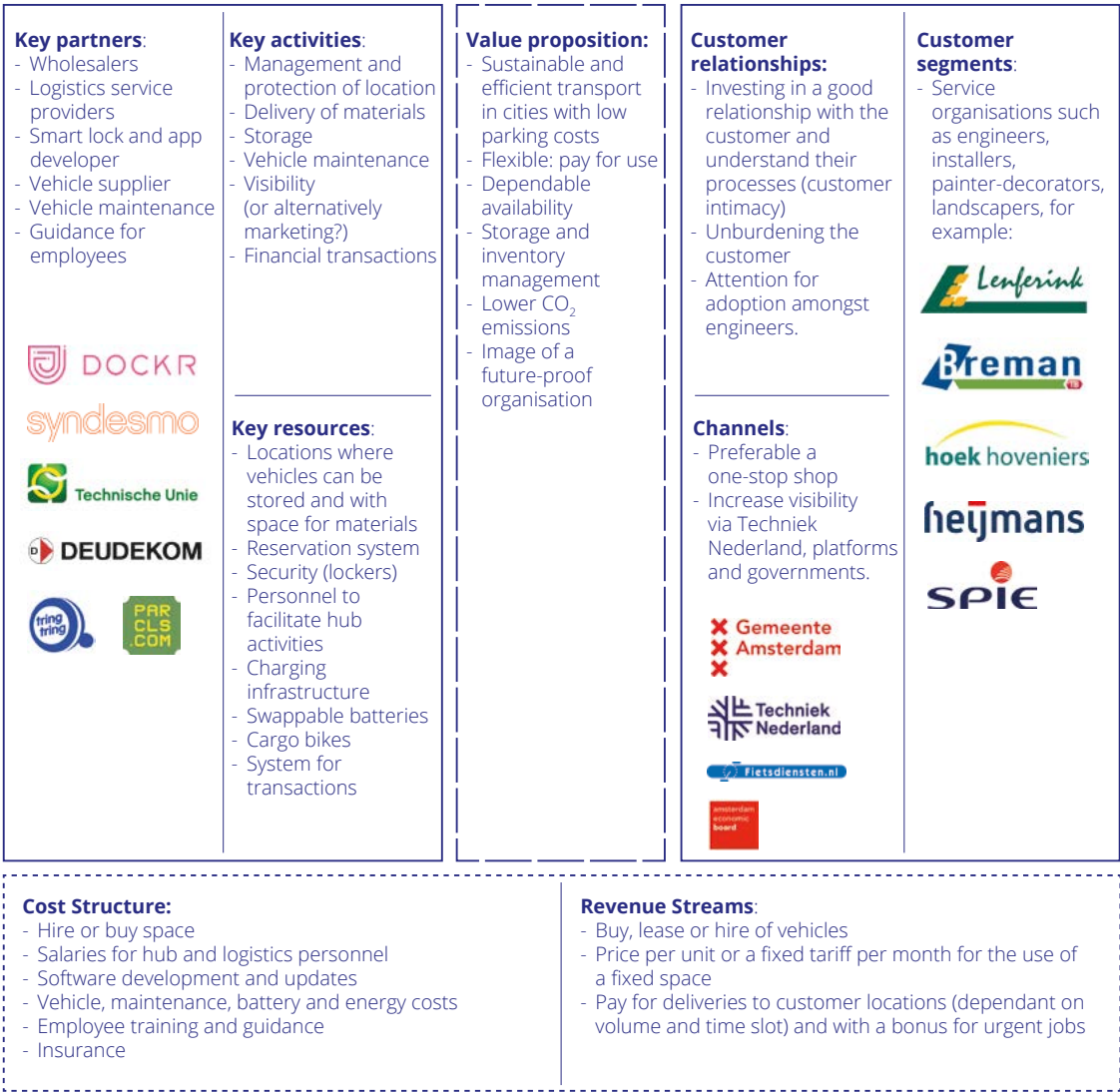
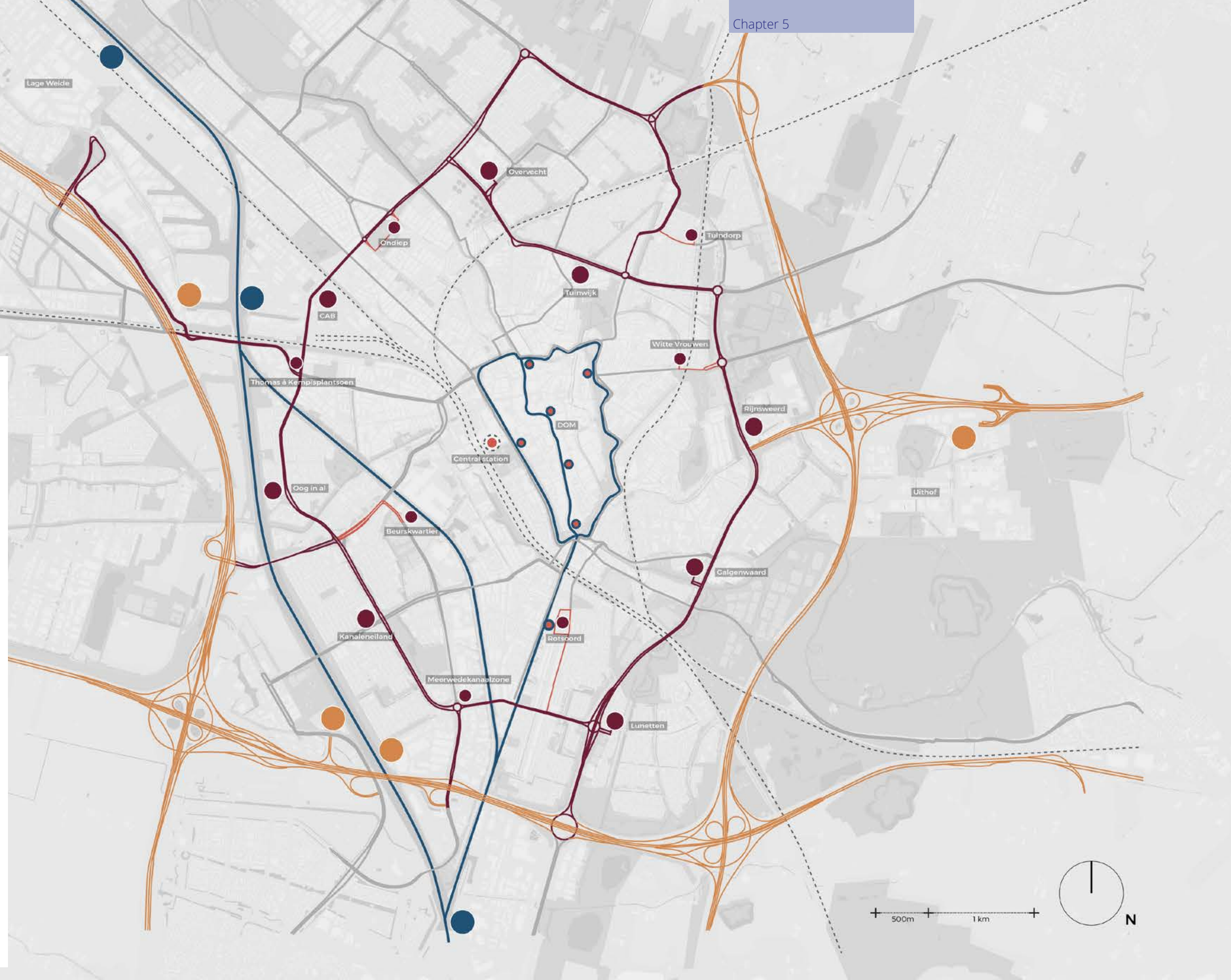


Figure 5.3: A potential network of hubs
(Van Bakel, 2021)

Hub locations, Utrecht

- Construction hub (Large size)
- Theme Hub (Large size)
- City Hub big
- City Hub (small)
- NS Hub (large)
- Stint Hub (large)
- Highway trucks > 47m³
- Ring road Trucks up to 47m³
- Road Vans up to 22m³
- Possible water route
- Train track



5.2 Scalability of solutions

In order to grow successfully as a provider of zero-emission transport solutions, a scalable business model is necessary. The checklist in Figure 5.4 shows a set of questions that can be used to test whether or not a business model is scalable (AUAS, 2018). The researchers and practice partners

applied this checklist to two combinations of solutions:
1. Logistics hubs with cargo bikes
2. Electric vans with charging infrastructure

The results are shown in Table 5.1. The pluses (+) contribute to scalability whilst the minuses (-) stand in the way of scaling up.

Figure 5.4: Checklist for scalability of solutions

User Orientation ▶ How big or how urgent is the problem? ▶ Is the solution easy to understand and to adapt? ▶ Are there already customers using it
Network Effect ▶ Can many people be reached quickly and can they provide positive reviews about the solution?
Technology and Infrastructure ▶ To what extent is the solution dependent on own personnel? ▶ To what extent are production and delivery of physical materials necessary and scalable?
Costs and Benefits Structure ▶ How large is the necessary investment and how quickly would this be recouped? ▶ Is financing easy to find?
Adaptability to law and regulations ▶ To what extent are there any legal barriers which delay scaling up?

Table 5.1: Scalability results

	 Logistics hubs with cargo bikes	 Electric vans with charging infrastructure
User Orientation	⊖ As long as cities and neighbourhoods are accessible to vans, there is no real problem. ⊖ There are still very few service organisations that use cargo bikes and hubs. ⊖ The solution requires changes in work processes, logistics and behaviour.	⊖ There is a tendency to procrastinate: 2025 and 2030 are still a long way off. ⊕ Reducing CO₂ footprint is becoming increasingly important ⊕ There are already customers: the share of EVs is growing. ⊕ Zero-emission receives more attention since 2020.
Network Effect	⊖ Organisations that are already active with cargo bikes and hubs are often small and insufficiently united to be able to reach a large group. ⊕ There is growing media attention for urban mobility.	⊕ Companies, especially competitors, make each other enthusiastic. ⊕ Government programmes such as EcoStars contribute to a wider reach.
Technology and Infrastructure	⊖ The scarcity of space in cities makes it difficult to scale up hub locations. ⊖ Scaling up cycling depends on the production and supply of materials and on overcoming 'teething troubles'.	⊖ There is a shortage of personnel to install charging infrastructure. ⊖ Installation of charging stations often involves practical problems. ⊖ There are long lead times for EVs. ⊖ Electricity grid operators cannot increase capacity quickly.
Costs and Benefits Structure	⊖ It is not clear who is going to make the investment in logistics hubs. ⊖ There are numerous small cargo bike manufacturers on the market, and so far few large-scale investments have been made. ⊕ If smart use can be made of existing locations (logistics hubs, pick-up points or parking places), the investment required is not particularly large.	⊖ SMEs cannot afford to make the necessary investment. ⊖ The investment in charging stations is uncertain if companies expect to relocate. ⊖ Energy prices are unpredictable. ⊕ Large companies can make the investment. ⊕ The value of a property can increase when there are charging points.
Adaptability to law and regulations	⊖ Ideally, employment contracts should be amended. This is a slow process, which is an obstacle to scaling up. ⊕ New type approval regulations are due to be introduced for cargo bikes. This may be a short-term barrier to scaling up, but in the long term it may contribute to greater safety and acceptance.	⊖ Mistrust regarding subsidy policies and regulations stands in the way of scaling-up. ⊕ Manufacturers must meet CO₂ targets ⊕ Subsidies stimulate the uptake of EVs.

5.3 Practical examples of new initiatives

Over the course of the 'Go Electric' project, a number of plans were made to accelerate the use of zero-emission transport in service organisations and other sectors. Here we will highlight three such plans: 1) a partnership between a wholesaler and cycle logistics operators, 2) an industry association for sustainable urban logistics, 3) a physical location for exhibitions and innovation.

5.3.1 Delivery to customers by cycle logistics operators

Technische Unie (2,000 employees) is a wholesaler for installation specialists. They supply more than one million products from 700 suppliers of electrical engineering, lighting, telecommunications, installation materials, sanitation, heating and air conditioning technology. Technische Unie has 37 branches, 2 distribution centres and 22 transshipment hubs. Customers can also choose to have their goods delivered. This is done on pallets (large goods) and green containers (small goods), and if required with express delivery. In addition, Technische Unie offers services to completely take over the logistics flows on construction projects. Technische Unie aims to be the greenest electrotechnical wholesaler and therefore participates in discussions around urban logistics solutions.

In 2020 Technische Unie entered into a partnership with cycle logistics operator Tour de Ville in Tilburg and soon after with their counterparts Cyclo in Rotterdam. The cycle logistics operators deliver the goods to the installer's workplace, allowing installers to travel directly to their jobs without having to visit the wholesaler, saving time

and emissions. The concept is now being expanded throughout the Netherlands with local cycle logistics operators.

Throughout the Netherlands, cargo bikes are used to deliver a wide range of products and services such as parcels, flowers and food. An overview per city can be found on www.fietsdiensten.nl/fietskoeriers-en-bezorgdiensten

Jos Sluijsmans, Fietsdiensten.nl

5.3.2 The Duurzame Stadslogistiek (Sustainable City Logistics) Industry Association

A group of partners involved in the 'Go Electric' project has taken the initiative to establish *Duurzame Logistiek*; an industry association for sustainable urban logistics. In recent years, the number of city hub operators, cycle logistics operators, specialist last-mile delivery operators and sustainable logistics platforms has grown. New partnerships and cross fertilisations between these parties are emerging, not only in practice, but also at round table sessions, in research projects and through initiatives



such as the Green Deal ZES, local Green Deals and ZES25. However, there is still no formal trade organisation that unites these parties, with the result that they are insufficiently represented in the bodies that discuss, for example, subsidies and permits for emission-free transport in cities and subsidy programmes. Willem Boverhof, who works at DOCKR and is one of the initiators of the industry association, explains: "The Ministry of Infrastructure and Water Management is preparing a subsidy scheme for emission-free commercial vehicles for 2021-2025. It's great to speed up sustainable logistics, but there is no mention of other sustainable alternatives, such as consolidated sustainable logistics in the city via hubs or using cargo bikes". There are more topics that an industry association for sustainable urban logistics could discuss. Public space in the city is being reassessed; what is the correct place for the cargo bike in our streets? Will all city logistics companies be required to obtain a NIWO permit⁵? Why does one municipality issue local permits and subsidies for sustainable logistics when others do not? What charging infrastructure will be installed in public spaces for urban logistics?

An industry association for sustainable urban logistics offers the potential to:

- ▶ allow urban logistics companies to further join forces by stimulating cooperation among members;
- ▶ promote the collective interests of the group by advising politicians and the government on behalf of the sector;
- ▶ further professionalise the sector through knowledge exchange;
- ▶ showcase the potential of the sector more widely by briefing the media.

In short, the purpose of the association is: representation of interests, communication, stimulation and professionalisation. The initiators, Willem Boverhof (DOCKR), Hans Lingeman (Parcls), Richard Hoving (Amsterdam Economic Board) and Jochem Beunderman (Vereniging DOET), have stated that the association will be officially established in December 2020. During this phase, there are a number of questions to which they, in cooperation with Tospector Logistiek and Connekt, want to find answers: Does the industry association fit under an existing umbrella or would an independent organisation be preferable?

- ▶ In what form can the association best be established?
- ▶ What is needed in order to set up a financially viable association?

5.3.3 Cargo Bike Expertise & Innovation Centre (CargoBEIC)

In 2020, for the first time in nine years, the International Cargo Bike Festival (ICBF) was not able to take place due to the coronavirus crisis. The ICBF is an annual event at which the professional cargo bike community meets to inform and inspire one another. Following the cancellation of the 2020 event, the organisation is now planning to set up permanent physical and digital cargo bike exhibitions. The aim is to perpetuate the movement, connection and energy created by the ICBF throughout the whole year. CargoBEIC will be a permanent exhibition for cargo bike manufacturers at IPKW, an industrial zone in the Dutch city of Arnhem. With three main functions, CargoBEIC will meet various needs of both cargo bike

⁵ The NIWO (*Nationale en Internationale Wegvervoer Organisatie - National and International Road transport Organisation*, the Dutch licence provider for companies involved in road transport) grants permits to transport companies engaged in road freight transport in the Netherlands. The permit is required when using vehicles with a loading capacity of more than 500 kilograms (NIWO, 2021).

manufacturers and logistics service providers in general:

- **Exhibition area and test track:** CargoBEIC offers manufacturers the opportunity to exhibit, present and have their products tested by potential customers. In addition, the set-up of CargoBEIC will offer organisations and government bodies interested in the use of cargo bikes the opportunity to view and try out products, possibly by appointment.
- **Knowledge centre:** CargoBEIC will function as a place and organisation in which knowledge and research on cargo bikes - and their use - will be brought together and shared: for instance, technical expertise on vehicles, regulations, urban distribution and logistical processes. This knowledge will be made available via online and offline events. The HAN Academy of Engineering & Automotive and the Mobility Innovation Centre (MIC) are partners in the project. Also located at IPKW, the proposed site, are many innovative organisations who are open to collaboration. CargoBEIC will also function as a test centre. HAN Academy of Engineering & Automotive is already an experienced test centre for vehicles which fall 'between the bicycle and car'; LEVs and cargo bikes;
- **Virtual exhibition:** Online access to a virtual exhibition will offer organisations the opportunity to present themselves to a worldwide audience without limitations in time and space. Visitors from all over the world will be able to find out what the market has to offer, unconstrained by borders and travel distances.

The CargoBEIC initiative has been developed by Jos Sluijsmans (Director of Fietsdiensten.nl and ICBF) in collaboration with Lentekracht (Koen Vrielink and Bram Lamberts). The concept builds on the needs of a growing industry of cargo bike manufacturers and on developments in the logistics sector, which is increasingly looking for innovative solutions as a result of societal developments including an increase in online shopping, more congested cities, and tighter environmental legislation. The aim of the Cargo Bike Expertise & Innovation Centre is to bring these needs together in order to stimulate the use of cargo bikes and help the industry as a whole to flourish. For more information see www.cargobikefestival.com.

5.4 Addressing the next generation of engineers

In order to gain insight into the extent to which the younger generation of engineers is concerned with sustainability issues, a questionnaire was sent out to vocational students studying to be service and maintenance engineers at ROC Nova College in Beverwijk (20km north west of Amsterdam). It was not easy to reach this target group. The corona crisis made it impossible to distribute the questionnaires physically. The online questionnaire was therefore sent to various course directors. However, there appeared to be little interest in distributing and completing the questionnaire. In the end, six engineers from the Nova College in Beverwijk responded to the questionnaire. Whilst the group is too small to draw any conclusions, it does provide an indication of the attitudes in this group towards sustainable transport.

Results of the online questionnaire

The first question asked about the suitability of different types of vehicles for the engineers' work. Based on their input, these vehicles were given an average rating (see Table 5.2).

It is striking that the younger generation remains attached to the conventional way of doing the job of an installation technician. The bigger the vehicle, the better, or so it seems. For example, all respondents indicated that they did not expect to be able to carry out their work adequately using a cargo bike. The explanation for this is that the engineers rely on supplies they carry with them. One of the respondents stated:

'The diversity is increasing. We will be supporting a wider range of technologies, so you will probably need more tools to be able to do your job properly. I now drive a Kangoo. We carry a 'lean' in-vehicle stock and it is already almost impossible to carry everything.'

Service Engineer in training

Table 5.2: Results of the online questionnaire for ROC students (n=6) - Question 1

Question 1. To what extent do you think you will be able to work with these vehicles in 3 to 5 years time?	Rating
Large van	8,8
Medium van	7,7
Sharing system (app)	6,5
Small van	5,7
Passenger car	4,7
Moped	3,3
Bicycle	2,3
Public transport	2,3
Cargo bike	2,0

Table 5.3: Results of the online questionnaire for ROC students (n=6) - Question 2

Question 2. To what extent do you think you will be able to carry out your work in a vehicle with this propulsion system in 3 to 5 years' time?	Rating	Percentage answering 'Not sure'
Fossil	8,5	20%
Electric	6,8	0%
Hydrogen	6,7	40%
Hybrid	8,0	0%
Compressed Natural Gas (CNG)	6,5	20%
Green gas	6,0	20%
Biofuels	6,0	60%
LPG	7,3	40%

The second question asked about the suitability of different vehicle propulsion systems. These were also given a rating (see Table 5.3).

Interestingly, the engineers in training expect, on average, that all of the different propulsion systems perform adequately for the job in hand. Also surprising is the fact that some of the engineers are not yet familiar with some of the less common types of propulsion systems.

- Recommendations for providers**
Providers of zero-emission transport solutions can communicate developments in ZE transport by actively cooperating with vocational training institutes through:
- ▶ Work placements
 - ▶ Guest lectures
 - ▶ Test runs where the future generation of vehicles can be tried out
 - ▶ Company visits

5.5 The role of local government

Local government plays a role in five zero-emission focus areas.

- 1. Regulation and enforcement:** Zero-emission zones (in addition to delivery time windows and weight restrictions) are an important aspect of regulation. With the introduction of zero-emission zones in the period 2025-2030, Dutch municipalities will be able to regulate vehicle emissions within certain parts of their area. In 2021, detailed regulations will be issued to the 30 to 40 municipalities that are establishing zero-emission zones as part of the Dutch climate agreement. Municipalities are also looking into intelligent access control to their city, privileges for extended window times, rules for loading and unloading bays and rules for the number of parking spaces built during construction and renovation projects.

- 2. Facilitation:** For zero-emission transport, it is crucial to have a charging infrastructure in place in residential areas, inner cities and elsewhere. Key questions include: who is responsible and who will pay for the charging infrastructure? The City of Amsterdam, for example, states: 'Charging should take place as much as possible on private and semi-public property'. For service organisations, this means that they must provide their own charging infrastructure and ensure that engineers have access to the public charging stations that the city provides in the public space. This local policy is now coming into effect.
- 3. Stimulation:** In Chapter 4, attention was drawn to the subsidies available in the Netherlands at national and municipal levels. These include purchase subsidies for electric vehicles. More definitive national and local schemes will be announced in 2021.
- 4. Coordinate:** By providing data on traffic, loading and unloading points and charging infrastructure, municipalities can help service organisations to drive more intelligently in the city and to find the right charging point.
- 5. Experimentation:** Municipalities can consider giving priority in tenders to service organisations with clean fleets or electrifying their own fleet of service vehicles. By discussing this with contractors, municipalities can learn about vehicles, logistics concepts and the role of behaviour.





► Feenstra

Feenstra is one of the largest energy service organisations in the Netherlands, serving more than 800,000 households. Feenstra installs, maintains and repairs products for heating, ventilation, security and solar panels. The company also gives advice on CO₂-neutral living and on how to save energy. Feenstra is also examining its own business operations and the CO₂ emissions associated with them. About 80% of the CO₂ Feenstra emits comes from its vehicle fleet.

Congestion in cities, high parking costs and traffic diversions have also prompted Feenstra to look into the mobility of their engineers. Since 2018, Feenstra has included electric vans in its fleet and in 2020 they started using cargo bikes. Engineers are up to three times faster by bike than by car and can more easily park right outside their customers' doors. However, this approach does require a new approach to trip planning and the supply of materials.

Within the 'Go Electric' project, Feenstra has worked with researchers, students and partners to investigate the suitability of electric cargo bikes, hub locations, and changes in planning and staffing.

Vehicle choice

In conjunction with DOCKR, Feenstra organised several test days during which their engineers could try out various vehicles and received training on their use. Firstly at Feenstra's premises and then in Amsterdam city centre. Feenstra actively involved their staff in the selection of vehicles. This proved to have a positive effect on the staff's motivation to work with the vehicles.



Vehicle training at Feenstra's premises and testing in Amsterdam city centre

Hub location

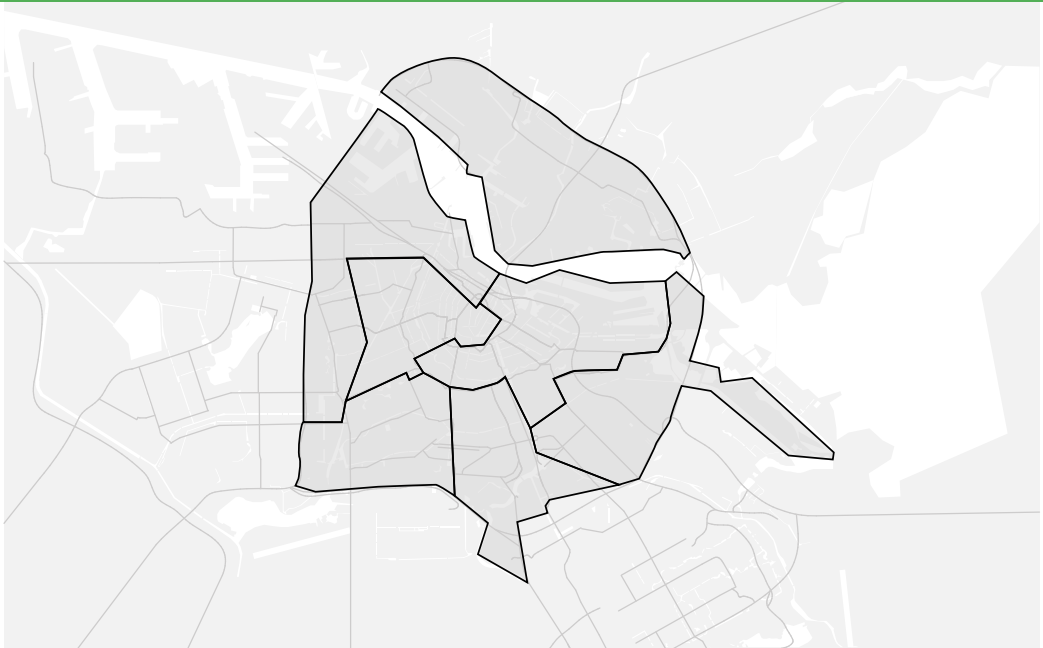
Working together with Deudekom, Feenstra opened a hub location in Duivendrecht - on the southern edge of Amsterdam - in 2020. Here, engineers can park their vans and transfer to cargo bikes. Suppliers also deliver materials to this location. On the Deudekom site, storage containers have been set up in which materials are stored and where the cargo bikes are also parked. Batteries are charged in the container and engineers can get a cup of coffee and even a shower in the Deudekom canteen.

Workforce adaptations

Feenstra has taken various measures to increase the acceptance of cargo bikes by their engineers. For example, they receive a monthly lunch allowance and are provided with rainproof clothing. In addition, young engineers without a driving licence are trained on cargo bikes from their first day in the job.

City centre planning

Compared to a van, cargo bikes have a limited action radius and limited loading space. To deploy cargo bikes as efficiently as possible, it is therefore desirable to limit the work area of engineers using them. This can be done in two ways:



City Districts Amsterdam

- 1. By clustering customer assignments geographically, to prevent engineers from having to cover long distances.
- 2. By clustering technically comparable customer orders, to prevent engineers from having to use many different types of tools and materials.

additional hub location in the north or west of Amsterdam. This would bring both financial and environmental benefits by reducing distances travelled and increasing the use of cargo bikes. ◀

A student team from AUAS divided Feenstra's customer base within Amsterdam's A10 ring road into eight sub-areas. The duration of a working day, the time needed for a job and the distance between stops was taken into account. On the basis of the parking rates and the location of each area, they then advised on which areas should be served by cargo bikes from Deudekom's hub in Duivendrecht. They also advised Feenstra to establish an



6

Chapter 6

Conclusions and recommendations

The final chapter will provide a conclusion of the findings per sub-question. Lastly, the 'Go Electric' partners have drawn up recommendations for four stakeholder groups, with the aim of accelerating the transition towards ZE-service logistics.

6.1 Conclusions

Service organisations account for a quarter of all vans in Dutch cities. When carrying out maintenance, repair and service work, the right engineer needs to be at the right place at the right time, together with the right materials for the job.

It is common for each service engineer to have their own van and to drive from job to job with a large variety of parts and tools, before taking the vehicle home in the evening. This situation can and must change if the ambitions of the Dutch climate agreement are to be achieved and if customers in car-free areas are to continue to be served efficiently. For this purpose, 'Op Weg naar ZES' (On the way to ZES), a national implementation agenda for the Netherlands has been drawn up.

A small reduction in CO₂ emissions can be achieved with existing vehicles (by driving more efficiently) and by replacing them with modern diesel vehicles. Between 2025 and 2030, access to mainly inner-city areas for fossil fuel powered vehicles will be gradually restricted in 30 to 40 Dutch municipalities. Whilst the one-to-one replacement of fossil fuel powered vehicles by electric models would reduce exhaust emissions, it would have no effect on traffic density and the amount of space required by parked vehicles. Such positive impacts can be observed where light electric vehicles and cargo bikes are used. With innovative zero-emission service logistics concepts, both the number of trips and the number of vehicles can be reduced.

The zero-emission transport market is growing. More and more vehicles, hub locations and charging solutions are on

offer. But in addition to the supply of vehicles and infrastructure, innovation is needed to successfully put them into practice. The 'Go Electric' project tackled the question of which combination of services is needed to support service organisations in the transition to zero-emission urban logistics. The central research question was: *which logistics concepts, charging strategies and behavioural interventions can be used to realise zero-emission transport for service organisations?*

Between 2019 and 2021 a total of 38 interviews were conducted, 12 workshops and focus groups were held and 6 case studies were evaluated. In total, 40 organisations, 9 researchers and 50 students contributed. This chapter presents conclusions for each sub-question as well as key recommendations for each stakeholder group. In doing so, we offer service organisations a toolbox for integrating the transition to zero-emission logistics into their business operations.

I. What are the current criteria and considerations by which service organisations assemble their fleets and schedule trips?

Vehicle fleets account for a substantial part (30 to >90%) of the CO₂ footprint of service organisations. Initiatives aimed at reducing this are mainly focused on passenger vehicles in the fleet. The primary considerations and criteria for the composition of a vehicle fleet are:

1. The ability to meet the requirements of the client/customer: 'customer is king'.



- Customers are keen to be relieved of the burden of managing equipment and technical systems. It is still rare for sustainable mobility to be a factor upon which a client chooses their supplier, and it is even less common for them to be prepared to pay extra for it. Service agreements with customers have a major impact on trip planning.
2. The operational costs for the organisation and financial consequences for employees. For as long as clients do not specifically ask for 'sustainable transport' and cities are accessible to diesel vehicles, investments in ZE transport will have to pay for themselves in lower operational costs (e.g. lower energy or parking costs).
3. The supply of vehicles with sufficient comfort, safety, action radius, loading capacity, and acceptance by employees. Service engineers often travel from home directly to the customer, and their working area is variable and large. The average daily distance travelled by a service engineer

- is between 80 and 200 kilometres for the service organisations surveyed. There can be large variations per working day, with peaks of 300 or even more than 500 kilometres.
4. The sense of urgency and the financial resources to invest in ZE mobility, in anticipation of the introduction of zero-emission zones and internal targets for CO₂ reduction.
5. Material logistics and material flows. The loading space of the means of transport and the supplies carried need to be adapted to the work to be carried out and the working environment. Engineers do not want to be caught out on a job without the supplies they need. At the same time, they also want a vehicle that is easy to manoeuvre and park.

II. What updates to the business processes of service organisations are necessary for zero-emission mobility?

The road to zero-emission service logistics does not begin with the means of transport. A service engineer's means of transport is a result of strategic, tactical and operational choices that are made about:

A. Customers and activities.

The size, location and requirements of clients and end-customers all influence the extent to which new service logistics concepts can be realised. Cooperation with clients and friendly competitors is more appropriate in busy, low-traffic areas than on an easily accessible industrial estate. Together with large clients (such as educational institutions, government bodies or offices), efforts can be made to consolidate all technical maintenance deliveries into a single trip. Or, taking it a step further, to consolidate them together with deliveries of parcels, cleaning and office supplies. Practical examples show that assigning control and sharing logistics costs between supplier, client and carrier in this type of concept is complex. Clients can also play a role in zero-emission service logistics by providing charging infrastructure and storage capacity for tools and materials (e.g. lockers or containers into which deliveries can be made) and by including sustainable transport in their procurement criteria.

B. Personnel and behaviour.

The shortage of technically trained personnel on the labour market is both a motivator and a challenge for zero-emission service logistics. A motivator because service logistics solutions can increase the efficient deployment of employees. A challenge because employee satisfaction is important for service organisations. Employee adoption is an important factor in the successful implementation of zero-emission mobility. By outsourcing work to freelancers who already work with electric vehicles or cargo bikes, it is possible to reduce hesitancy and uncertainty among the organisation's own employees. Adjustments in recruitment and selection policies, mobility policies, and operational management of engineers can further stimulate adoption.

C. Logistics and planning

The strategic choices that service organisations make about the use of hub locations, supply locations and the outsourcing of logistics all influence the extent to which zero-emission transport can be realised. By cooperating with small, medium-sized and large hub operators, a network of transshipment locations can be established. On a tactical level, agreements can be made with suppliers for just-in-time supply, for example, so that engineers can travel by bicycle or on public transport. Engineers can also be assigned to customers which are located in zero-emission areas. From the case studies it appears that planning on the basis of neighbourhoods or city centres offers potential for profitable deployment of cargo bikes. Plans should also take into account the time needed for charging, the real-time action radius and real-time stock levels. Current transport management systems often lack this

functionality. By minimising supplies kept in vehicles and by organising them more efficiently, it is possible to use smaller vehicles, which has a positive effect on the action radius of zero-emission vehicles. New technologies using artificial intelligence and IoT sensors should lead to more predictability (or even the prevention) of breakdowns and maintenance work; and by extension, more efficient planning of service logistics. This in turn simplifies the deployment of zero-emission vehicles.

D. Vehicle fleets and charging infrastructure

In the future, one strategic choice on offer to service organisations will be to no longer offer engineers a fixed vehicle, but instead to make use of flexible lease contracts and shared vehicles. Depending on work locations, parking and charging options, a suitable and available vehicle could then be selected for each employee on a daily, weekly or monthly basis. Reliable availability of vehicles is important here. In the case of zero-emission vehicles, availability also means that they need to be provided with sufficient energy.

III. Which charging strategies can facilitate the deployment of zero-emission transport by service organisations?

Charging light electric freight vehicles does not present any major challenges. Electric cargo bikes often have an exchangeable battery. This is not the case with electric vans. In previous years, electric vans typically had

an action radius of around 100 kilometres. For more recent models, the action radius is 200-300 kilometres. When vehicles are heavily loaded, air-conditioned or driven on faster roads such as motorways/freeways, their action radius quickly decreases. Recharging during the working day is challenging, given the varied and unpredictable driving characteristics of service engineers. There are several reasons for this:

- Uncertainty about whether and where a parking space with a charging facility is available leads to stress for service engineers.
- The time spent on a job is often too short to allow for significant recharging. Longer stop times are generally associated with limited daily distance, making recharging unnecessary.
- Making a detour or having to wait for a fast charger is costly and often not feasible in terms of time due to staff shortages.
- The price of energy is often not transparent and there are questions about how charging is handled financially (does the organisation, the engineer or the customer pay?).

With an action radius of around 200 kilometres for newer vans, and with more materials being delivered directly to the customer, it is only necessary to fully charge vans after the working day is over. The question is: where should this take place? If it is at the organisation's own premises, an investment in 'smart charging' or in expanding the site's energy capacity may be required. Such an investment does add value to a property. If the vehicle is to be charged at the service engineer's home, there are also questions about investments and energy costs. Using public charging infrastructure in the neighbourhood is accompanied by

uncertainty about availability and significantly higher energy prices. A third option is to charge vehicles at an external (hub) location and to outsource the coordination of charging to a third party. The financial advantages of electric driving lie mainly in savings on fuel costs and maintenance. This becomes apparent when the vehicle is driven long distances. With sharing concepts, such savings can also be pursued. It is important that service organisations think carefully about their charging strategy, seek advice, and carry out a proper assessment of their intended charging locations to avoid unnecessary high costs.

IV. How can service organisations stimulate the adoption process by their employees (the users of zero-emission transport)?

For many service engineers, the introduction of zero-emission mobility will require changes to the way they work. The exact impact differs between service organisations and possibly even between employees. Typical changes may include scheduling, travel movements, and engineers suddenly having no sheltered break area and being more exposed to the weather when switching to a cargo bike. In discussions with engineers, during one-on-one interviews and focus groups, many of them were sceptical about these changes. They raised a number of practical objections, including the limited action radius and cargo space of an electric vehicle, the uncertain availability of charging infrastructure and the cost of charging, as well as a reduction in their comfort level.

In order to stimulate the adoption of new emission-free transport concepts by service organisation engineers, the following recommendations are made:

1. Engineers would like more information from their employers about the introduction of new emission-free transport concepts and want to be involved in their employers' strategic decisions. In order to create support among engineers involved, it is important to proactively involve them at an early stage in the transition. This can be done, for example, by organising information or feedback sessions in which their questions can be answered and in which they are given the opportunity to express their opinions. During these information or feedback sessions, service organisations can clarify their reasons for making these strategic decisions and explain the benefits of electric vehicles. Going zero-emission is not a choice, rather a necessity in order to be able to provide continuity and guarantee the survival of the organisation; after all, the competition is switching over as well.
2. Positive examples and practical experiences can lead to greater acceptance of change. One way of stimulating the introduction of a new transport concept is through a low-threshold, well-organised and closely monitored pilot project. Monitoring and communication are important: engineers should be given the opportunity to share both their positive and negative experiences with their employer, so that the envisaged transition to electric vehicles is well targeted to organisation-specific activities.
3. Engineers are often familiar with sustainability issues and some even see sustainability as an integral part of their work. This rationale can be productively

used by employers to develop new strategies (including transport strategies) and introduce them to employees. It is important that engineers are able to recognise themselves and their work in this vision.

4. In addition to behavioural interventions, service organisations can adjust their employment contracts and employee benefits so that switching to an electric vehicle, especially a cargo bike, becomes attractive to engineers. This can be achieved by increasing travel or lunch allowances, or by offering protective clothing.

VI. Which new products and services can suppliers develop for service organisations wanting to implement zero-emission transport?

Based on their importance in urban logistics, service organisations are an interesting market for providers of zero-emission transport solutions. During the 'Go Electric' project, we have collaborated with various providers:

- Vehicle providers offering flexible leasing contracts.
- Importers and developers of light electric freight vehicles offering customised solutions for service logistics.
- Installers of charging infrastructure who can carry out a thorough site inspection and offer advice on the appropriate charging strategy.
- Consultants in fleet management and behavioural change taking the transition to

zero-emission transport out of the hands of their clients.

- Hub operators who offering storage, parking facilities, charging infrastructure and last-mile logistics.
- Software developers designing planning software for zero-emission service logistics.

As long as cities and neighbourhoods remain accessible to fossil fuel powered vans, service organisations will continue to feel no urgency in tackling this issue. However, with the advent of zero-emission zones and car-free areas, this is set to change. It has also been observed that large organisations are stimulating each other and that efforts to reduce their CO₂ footprint are gaining importance. Large organisations are able to invest in this. A plumber or installer from an SME does not have access to such resources. The question is whether national and municipal subsidy programmes can fill this gap or whether something more is needed. Consideration could be given to Experience Centres, where the sector (young and old, small and large) can become acquainted with zero-emission vehicles and logistics concepts. Allowing service engineers (and future generations of service engineers) and their managers to try out the new technology and provide them with information can help accelerate adoption. Finally, providers in the urban logistics market could unite as a sector: by joining forces and interests, offering joint services, and frequently exchanging knowledge, they can professionalise further. In this way, they can also strengthen their common position in their dealings with government. The result is that the government will take their ideas into account when regulating, enforcing, facilitating, stimulating, coordinating and experimenting with zero-emission transport.

6.2 Recommendations

The ‘Go Electric’ project partners have drawn up the following recommendations for four stakeholder groups.

Service organisations	▶ Do not wait until 2025. Start preparing for zero-emission zones now. ▶ Make a top-down plan for the coming years, including the strategic, tactical and operational decisions which need to be made in the areas of customers, activities, personnel, behaviours, logistical planning, vehicle fleets and charging infrastructure. ▶ When deciding on solutions, distinguish between typical work zones, such as: city centre, residential area, campus / industrial area. ▶ The road to zero-emission service logistics does not start with the vehicle. All business processes must be scrutinised, and employee mobility and the transport of materials are often two separate streams. ▶ Be open to change. Move towards a new mindset in which cooperation with supply chain partners and friendly competitors is the norm. Enter into agreements on consolidating deliveries. ▶ Transport less weight. Be discerning about what needs to be carried in a service engineer's vehicle. Use a light and efficient vehicle. Where possible, opt for a smaller model. ▶ Set up pilot projects to learn about the changes needed in business processes and staff behaviour. ▶ Listen to employees and involve them in the plans (bottom-up). Offer ample space for both the enthusiastic and critical opinions of employees. Work on acceptance; even if the first 10 engineers are willing, getting the next 100 on board is often more challenging. ▶ Train employees prior to the deployment of new modalities and logistical solutions. ▶ Think about trends in service technology such as IoT, IETD and remote diagnostics.
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Clients of service organisations	▶ Include sustainability criteria in your procurement. Focus the criteria on the objective (such as 'zero-emission') and do not specify the solution. ▶ Encourage and facilitate cooperation in the supply chain. Formulate requirements and commitments in the contract. ▶ Consider your own responsibility in sustainable transport and efficient logistics. Cluster assignments. Choose service organisations with branches and employees in the area.
Providers of ZE transport solutions	▶ Combine forces with those in the industry who have similar interests. ▶ In designing offerings, deal separately with the flows of materials, information and personnel. ▶ Provide charging infrastructure at employees' homes or in their neighbourhoods. ▶ Recruit personnel for the installation of charging infrastructure. ▶ Develop new planning concepts. ▶ Focus on organised layouts of both vehicles and hub facilities. ▶ Offer (potential) customers a test period in which to get used to new systems. ▶ Counter the tendency to hesitate by organising a community. ▶ Share knowledge and work together with municipalities, via round table sessions and pilot projects. ▶ Give honest information about characteristics such as action radius, charging speed and charging capacity by means of trusted intervals.
Government bodies	▶ Practice what you preach: see our recommendations for clients of service organisations. ▶ Provide infrastructure for charging and safe usage of roads or cycle lanes for LEFVs. ▶ Work together with providers of ZE solutions (e.g. through round table sessions, research and pilot projects). ▶ Provide information about charging and hub locations.



► Hoek

Hoek is a leading gardening and landscaping business with branches in Voorhout and Ursem (each around 25km to the south and north, respectively, of Amsterdam). Hoek carries out special projects in the areas of tree care, sport & recreation, landscape development, public greenery, gardening, landscaping and healthcare environments. These activities are performed from outside the ring road to the centre of Amsterdam.

With their 'Amsterdam autoluw' (car-free) agenda, the City of Amsterdam has decided to remove 10,000 parking spaces. At the moment, with the current number of parking spaces, Hoek's gardeners already struggle to find a parking space, meaning they often have to park three streets away or risk a fine for parking on the pavement. This is a problem that threatens to become more widespread. In addition, Amsterdam will soon become a zero-emission zone, which means that Hoek will have to use zero-emission vehicles in the city.

Student teams from the Amsterdam University of Applied Sciences investigated emission-free alternatives for Hoek's current means of transport. In addition, research was carried out into a new method

of planning jobs with the aim of reducing transport movements.

By working with gardeners who are active in Amsterdam and conducting interviews with foremen, the students were able to identify a number of important factors. These factors were used to draw up criteria that any new vehicle must meet. In addition, the research provided clear insights into the requirements a planning tool for allocating tasks must meet.

Alternative means of transport

In the search for an alternative means of transport, particular attention was paid both to a vehicle's action radius and the possibility of parking it. In addition, the vehicles were assessed for their load capacity, cost, attractiveness to employees and any increase in work pressure due to using a slower means of transport.

The student team investigated three different combinations of vehicles. A logistics hub was also recommended alongside the three combinations. The combinations consist of:

1. An Urban Arrow Cargo XL (cargo bike) in combination with a last mile logistics provider.
2. An Urban Arrow Cargo XL (cargo bike) in combination with a Goupil G4 (LEFV).
3. An e-bike in combination with a Goupil G4 (LEFV). In this case, all gardeners would live in Amsterdam and travel to their jobs by e-bike. A courier delivers mobile boxes with tools with a Goupil G4 (LEFV) to their work location.

The combination of an Urban Arrow Cargo XL with a last mile logistics provider was found to be the most feasible. In this combination, gardeners would use an e-cargo bike to get around whilst carrying the necessary tools. If it turns out that the gardener lacked tools or was unable to take them with them on the e-cargo bike, the last mile logistics provider would be deployed to bring them to the location.

New planning methods

Data from Hoek's present situation shows that the battery of light electric vehicles is not sufficient in every case to be able to travel around all day without recharging. In a follow-up study, a student team researched a new method of planning jobs that would make routes shorter. At the moment, Hoek plans by project: each landscaping team has its own projects. Teams sometimes encounter each other en route, meaning that unnecessary kilometres are being driven.

Initially, it was investigated whether jobs could be planned on an area basis, with each team being given a fixed area in which to work. Due to a current lack of data, it was not possible to determine these areas.

Next, the requirements for a job planning tool for Hoek were investigated, as Hoek does not currently have one. The aim of the planning tool would be to plan jobs in such a way as to reduce transport movements. ◀



► Heijting Tuinen

Landscape gardener
Johanneke Heijting cycles around Nijmegen on her special gardening bike. She designs gardens, creates planting plans and carries out a lot of garden maintenance.

What kind of bike do you use?

It consists of two parts: the bike and the trailer. At the front, there is a box with space for two 36V batteries. There is also a long loading rack and a bicycle trailer hitch. The trailer was designed based on the things that are carried every day. The box measures about 160 by 60 centimetres and can carry a lot. An example of a full load is as follows: a folding ladder (the Little Giant Ladder System by Wienesse) and a smaller ladder, a spade, pitchfork, garden rake, grass rake and a broom. Furthermore, two branch cutters, then the Stihl cordless tools (usually a chainsaw, hedge trimmer and long hedge trimmer with telescopic handle). Finally, a bag full of hand tools, buckets and large bags for collecting bulky green waste. If necessary, you can also use straps to place materials on top of the box. An incidental advantage is that this arrangement stands out and so acts as a business card.

Wouldn't you rather use a van or car?

No, I'm used to doing everything by bike or public transport. You become more and more resourceful when it comes to transporting things around. The only thing I sometimes miss in bad weather is a dry place to have lunch. And if you have a lot of pruning waste or you're going to the garden centre, there's no getting away from hiring a van.

Can anyone just ride off with a trailer like this, or is a little training needed?

No, not at all. Anyone can just take it out on the road. The cycling itself is easy, but you have to get used to it, because you are bigger and more cumbersome than on a normal bike. Sometimes, there are moments when you have to jostle for space in order to manoeuvre through the traffic properly and safely. For example, when you want to get into the left-hand lane and you have to pull out in front of cars.

Back to the trailer. Would you recommend it to other gardeners?

Yes, I would! It's big enough. I can fit everything in there. And the maintenance isn't too bad either: it's made of plywood and the most important thing is that it has to stay dry. ◀

► Jeroen Bosch Schilders

Jeroen Bosch Schilders carries out interior and exterior painting for both shops and homes in the Amstelveen region and beyond.

costs. Bosch Schilders started working this way in 2016 and it took about two months for the painters to get used to it. Thanks to WhatsApp and video calling, we can communicate efficiently among ourselves. ◀

What prompted you to reorganise your logistics?

High parking costs and parking congestion in Amsterdam were the reason for my company to start working in a different way. In the city it sometimes happens that you have to work at Herengracht number 2 but can only find a parking space at number 800. That costs a lot of time and money.

What did you come up with to solve that?

I have all the paint and materials delivered in my van, which I use to drive to the various clients where my painters are working. The painters themselves travel by public transport, bicycle or other means. They bring their own sandpaper, brushes and sealant sprayer in their backpacks. The rest of the materials are delivered by me to the work site. The painters can let me know what they need via WhatsApp until 10 o'clock in the morning and it will be delivered on site the same day.

How does that work out in practice?

Currently, 32 painters work this way, which has resulted in a decrease in overhead

► ANWB Wegenwacht

ANWB Wegenwacht is the largest provider of roadside assistance in the Netherlands. On 7 July 2020, the ANWB deployed a cargo bike for roadside assistance in Nijmegen – a first for the city. How did this come about? We asked Jan van Raaij, who has been an ANWB roadside patrolman for over 30 years.

How did it all come about?

The ANWB has been using cargo bikes for about five years in the four major cities of Amsterdam, Rotterdam, The Hague and Utrecht. When I saw that, I thought: we can do that in Nijmegen too. Mobility in cities is a big problem; it is becoming increasingly difficult to get into them with a car. I said, guys, I'd like to have a roadside assistance bike like that too. Why don't we do that?

And when it gets cold, will you be back in a vehicle again?

Yes, the standard season for bicycle and motorbike patrols is from 1st May to 1st November. After that, they are taken off the road due to weather conditions. Everyone on cargo bike or motorbike duty also has a patrol vehicle.

So you have a bike and a car. Are they kept at home or some other place?

I live close to the depot, so I'm lucky enough to be able to ride there on my own bike. Three of my colleagues live outside the city. They come to the depot in their patrol vehicles and switch over to the cargo bike.

And so you are on your bike all day. You don't swap over halfway through the day?

If the weather conditions allow, I'm on my bike all day. Once in a while it can be so bad that we are told to get off the bike and take the van, but if it rains a bit we just keep on riding. There's a reason we have rainwear, right?

When the bicycle was brought in, were there any changes to the area you had to cover?

The cargo bike is only used in the city of Nijmegen, simply put; within the built-up area.

Does the control room decide which jobs you get and where other colleagues will be?

In principle, the computer selects and does not check whether we are on a bike. If we do find that I can't do a job because I'm on my cargo bike, I'll let them know.

And the action radius of the cargo bike? How long does a battery last?

It's a challenge for us to ride on one battery for a whole day. We do carry a spare



ANWB

battery for emergencies. As a rule, I ride in eco mode. You have eco, tour, sport and turbo modes. If you have to get going with a heavily loaded cargo bike, or if you have a headwind or have to get going and speed up, then you set it to tour, sport or turbo. And when I get up to speed, I switch to eco.

And the maintenance and repairs to the cargo bike, do you do that yourself as well?

No, because it's a company bike. If we had to do that ourselves, we would not be ready to work, and you couldn't work your shift. We have the maintenance of the bike done at Busybike (a local cargo bike specialist). We checked where the local Urban Arrow

service centre was, and he's the dealer here. It's going really well. We are techies and we know at a certain point when something is wrong. The cargo bike is always heavily loaded and is used every day. Some parts suffer more, for example, I recently replaced the brake pads myself because I could see that they were really worn out.

Do you have any tips for service providers who also want to use a cargo bike?

Buy a decent cargo bike, make sure you buy something good. Inflate the tyres, simple things like that. Take a bike with sufficient battery capacity and a strong motor.

**Do you ever miss anything?**

You'll come across something from time to time, but if there's an item you notice you're missing more than once, you can always take it with you the next time.

Do you find it easier to get to places by bike than by car?

Yes, especially in modern residential areas, on one-way streets and dead ends. The latter are usually not applicable to bicycles. Then you have bollards at the end, and I can get past them on my bike.

The ANWB uses diesel vans, but are there plans to switch to electric?

There are already some electric cars. I was recently given a new patrol vehicle that runs on natural gas, and that's all in the interests of the environment. We are always looking for ways to contribute: what are the options and is it workable? With electric cars, the question is whether they will last a full day. It can't just stop working halfway through the day. And there's the cost issue, of course. But it is all being looked at. At Schiphol Airport, for example, we now have an electric car. It mainly deals with breakdowns at the airport itself, in the car parks.

And do people react positively to the cargo bike?

Yes, every day; today as well. People stand in the street, a dead-end street, looking out for a van. They do that nine out of ten times. And then I ring my bell 'ding ding' and they turn around: 'On your bike?' Yes, on my bike.

Sometimes they get a bit suspicious. Is this going to work?

The other day, I had a gentleman with an old fire engine that he had converted into a camper van. He had no more brake pressure and I saw him wondering: on his bike? But I solved it. That's a great feeling. ◀

► The Hub Company

Hans Baars is the founder of The Hub Company. He participated in the 'Go Electric' project in 2019, but withdrew in 2020 when it appeared that there was no demand for his product idea. In this interview, he tells us more about his experience.

How did you come up with the idea of a mobile hub?

In 2017, I came up with the idea of a mobile hub for emission-free urban logistics. The emergence of the (electric) cargo bike and light electric freight vehicles (LEFV) has changed urban logistics considerably. Because light electric vehicles have a limited action radius and less loading capacity than conventional vans, a different infrastructure is required. This is especially true for service engineers, who have to carry quite a few things with them, such as tools and spare parts.

By using LEFVs in combination with a small hub, it's possible to create a fully-fledged alternative to the conventional van. The LEFV takes care of the transport, the hub takes care of the tool storage, the storage of the LEFV and the storage of materials and parts. With solar panels on the roof, charging can even be

taken care of using green power. The hub fits perfectly on a parking space and can therefore be used anywhere. I approached Walther and Susanne to ask whether they saw any potential for this concept. They then invited me to participate as a consortium partner in the two-year 'Go Electric' research project.

What were your expectations of the collaboration with potential customers, friendly competitors and knowledge institutions in the 'Go Electric' project?

When I was asked to participate in the project, I thought it was fantastic. It also confirmed to me that more people could see the added value of the concept. Because there are also partners in the field, I had the impression that a concrete business case could be developed. The expectation was that I would be able to translate the concept into a working model that the sector could familiarise itself with and that, after testing in a pilot, would provide a viable alternative for service engineers.

What have you learnt?

I had a great time working on the project. I met a lot of new people. We went to trade fairs together. We held workshops and made pitches. We thought together about possible alternative emission-free solutions. Thinking in terms of concepts, that suits me. It was great to be involved in.



Why did you withdraw from the research project halfway through?

If your concept is not adopted and, for whatever reason, is not put into practice, it will always remain just a concept. It can still be a wonderful concept, which works on paper, pays off and can even be profitable. But I came to realise more and more (and not only in 'Gas on Electric') that no business was willing to test it in practice. I asked myself a lot of questions about why it hadn't worked after all. Was it not a good idea after all? Was it the timing? Too expensive? Too obscure? Corona? Is the industry not ready for it yet? You tell me. At the end of the day you can keep on pushing hard, but if things don't start moving, it's better to focus on other things and wait

until there is demand from the market. It's a shame, of course, that the energy I put in didn't translate into orders straight away. But that is quite common with new concepts, I think.

Have you stopped completely?

Zero-emission urban logistics calls for a new type of infrastructure. There is still a lot to be done, which is why I think there will be opportunities in the future. I would like to help build this new infrastructure. So if anyone reads this and is keen to take those steps, I would be glad to connect with them. ◀

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Participating organisations and students

The Go Electric consortium was made up of 23 organisations. In total, 40 organisations from the public and private sectors and 50 students participated in the project. The Amsterdam University of Applied Sciences would like to thank all of those involved for their contributions and cooperation. Below is an overview of the consortium partners, those involved and the student assignments. The Go Electric research project was co-funded by Taskforce for Applied Research SIA, part of the Netherlands Organisation for Scientific Research (NWO).

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Government	City of Amsterdam

Student overview

Commissioned by	Type of assign-ment and course	Assignment / Title	Student Name	Year
Unica, Districon, Lectorate of City Logistics	Minor, AUAS Minor Data Science	Emission-free transport for service logistics in cities	Student team	2018-2019
ENGIE, Heijmans, Lectorate of City Logistics	Minor, AUAS Minor Data Science	Dashboard aanvullen met ENGIE en Heijmans	Qëndrim Salihu, Miryam Ahami, Arzu Uzun, Wanitchanun Thirakritsakul	2019-2020
ENGIE, Lectorate of City Logistics	Year 4 Sprint Assignment, AUAS Logistics	ENGIE data analysis	Student team	2019-2020
Heijmans, Lectorate of City Logistics	Year 4 Sprint Assignment, AUAS Logistics	Heijmans data analysis	Student team	2019-2020
Unica, Lectorate of City Logistics	Year 4 Sprint Assignment, AUAS Logistics	Unica data analysis	Student team	2019-2020
Unica, The Hub Company, Urban Arrow	Thesis assignment, AUAS Logistics	To what extent is the concept of a mobile hub with electric cargo bikes feasible for Unica?	Vincent Bensink	2019-2020
Arval	Thesis assignment, AUAS Logistics	De TCO of a commercial electric van.	Daniël Bassie	2019-2020

Opdrachtgever	Soort Opdracht en studie	Opdracht/ Titel	Studentnaam	Jaar
Lectorate of City Logistics	Thesis assignment, Transport& Supply Chain Management VU Amsterdam	The influence of Zero Emission Zones on Service Engineers	Tirza Englebert	2019-2020
Eigen Haard, Lectorate of City Logistics	Year 4 Sprint Assignment, AUAS Logistics	Eigen Haard emission-free	Robert Wiersma, Martijn Bogaards, Floris Drost, Robin de Boer	2020-2021
Eigen Haard, Lectorate of City Logistics	Year 4 Sprint Assignment, AUAS Logistics	Transition to an electric vehicle fleet	Rogier Boon, Marten Tolsma, Wesley Griffioen, Daan Joris, Jurgen vd Hazel	2020-2021
ENGIE, Green Business Club, Lectorate of City Logistics	Year 4 Sprint Assignment, AUAS Logistics	Use of a central hub - Amsterdam Zuidas – advantages and disadvantages	Tim Grooten, Iman El-Kabary, Sybren Greuter, Jonah Savonije, Danique van Tienderen	2020-2021
ENGIE, Lectorate of City Logistics	Year 4 Sprint Assignment, AUAS Logistics	The first steps towards the e-cargo bike	Stef Nijssen, Anniek Denneman, Demy Worst, Pelle Beerse, Yanick van der Ende	2020-2021
Feenstra, Lectorate of City Logistics	Year 4 Sprint Assignment, AUAS Logistics	Recommendation report for Feenstra	Luuk van Schaik, Leon Rademaker, Mark de Vries, Jens Ursem, Tristan Fonck	2020-2021
Hoek, Lectorate of City Logistics	Year 4 Sprint Assignment, AUAS Logistics	Recommendation report for Hoek Hoveniers	Martijn Moes, Daan Dellevoet, Toon Basejou	2020-2021



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