The Zero-Emission City Logistics Maturity model

What do inner city SMEs know about planned zero-emission zones

Motloung, Thato; Quak, Hans; Anand, Nilesh; van Duin, Ron

DOI
10.1016/j.trpro.2024.03.027

Publication date
2024

Document Version
Final published version

Published in
Transportation Research Procedia

Citation (APA)
Motloung, T., Quak, H., Anand, N., & van Duin, R. (2024). The Zero-Emission City Logistics Maturity model: What do inner city SMEs know about planned zero-emission zones. *Transportation Research Procedia*, *79*, 194–201. https://doi.org/10.1016/j.trpro.2024.03.027

Available online at www.sciencedirect.com

ScienceDirect

Transportation Research Procedia 79 (2024) 194–201

Transportation Research Procedia

www.elsevier.com/locate/procedia

City Logistics 2023

The Zero-Emission City Logistics Maturity model – What do inner city SMEs know about planned zero-emission zones

Thato Motloung[a]*, Hans Quak[ac], Nilesh Anand[b], Ron van Duin[bd]

[a]*Breda University of Applied Sciences, Monseigneur Hopmansstraat 2, Breda, 4817 JS, The Netherlands*
[b]*Rotterdam University of Applied Sciences, Kralingse Zoom 91,Rotterdam, 3063 ND, The Netherlands*
[c]*TNO, Anna van Buerenplein 1, The Hague, 2595 DA, The Netherlands*
[d]*Delft University of Technology, PO Box 52600 AA, Delft, The Netherlands*

Abstract

This paper delves into the zero-emission city logistics readiness of businesses located in the earmarked Dutch inner cities, which are gearing up towards decreasing the emissions attributable to urban logistics activities. Emission reduction is to be achieved by rolling out mandated zero-emission zones which are to be implemented in 30-40 Dutch cities from the 1st January 2025, with the dates set and municipalities planning towards the banning of diesel-fuelled commercial vehicles. This research seeks to determine the extent of zero-emission operational maturity by use of the zero-emission maturity model by examining the four biggest cities in the southern Dutch Province of Noord Brabant. The research shows a low level of awareness among companies in the cities of Eindhoven, Breda, 's-Hertogenbosch, and Tilburg and calls for better methods of information dissemination, especially among the small to medium businesses who don't consider city logistics as their core business.

Keywords: Zero Emission Zones; Netherlands; SME; City Logistics; Electric Vehicles; Maturity Model.

1. Introduction

Since the issue of 'Our Common Future', popularly known as the Brundtland Report (Brundtland, 1987) and the Vienna Convention (1985), a spotlight has been placed on the impact that pollution has on the environment. Countries were tasked with creating initiatives geared towards becoming more sustainable, this has led to various international treaties on the protection of the environment by limiting greenhouse gas emissions. Numerous countries are pursuing government-steered initiatives to limit global warming to 1.5°C as per the Paris Climate

* Corresponding author. Tel.+31 68 775 21 69 *E-mail address:* motloung@buas.nl

2352-1465
10.1016/j.trpro.2024.03.027

Agreement mandated Net Zero Coalition (United Nations, 2015). This paper delves into one such initiative which is aimed at reducing carbon emissions by 1Mton yearly (TNO, 2021) in the Dutch logistics industry, as the Dutch climate agreement plans to implement zero-emission zones in city centres of the 30 to 40 largest Dutch cities from 2025 (see Klimaatakkoord, 2019). The agreement to implement zero-emission zones follows from a Green Deal where public and private stakeholders agreed to aim for zero emission city logistics by 2025. As a result, the Netherlands will be entering into a transition to phase out traditionally fuelled logistics vehicles within city centres in the plight to decrease emissions and thus slow down the environmental degradation that has ensued as a result of industrialization. This arrangement is further set out in the Implementation Agenda City Logistics (IACL) (Dutch: Uitvoerings agenda Stadslogistiek, UAS) (Rijksoverheid, 2020). The IACL pertains to rolling out zero-emission zones in 30-40 cities in the Netherlands. The IACL outlaws commercial vehicles from entering the declared zero emission zones from the 1st January 2025, with exceptions for newer vehicles (i.e. Euro 5 vans end of 2026, Euro 6 vans end of 2027, and Euro 6 trucks end of 2029, see Rijksoverheid, 2020).

In order to see how companies prepare for these zones, and also if the small to medium businesses (SMEs) are going to be ready in time, this paper delves into the Dutch province of Noord Brabant which is gearing up towards decreasing the emissions which are attributable to urban logistics activity in the largest 4 Noord Brabant municipalities: Breda, 's-Hertogenbosch, Eindhoven and Tilburg (called the B4). Three of these municipalities already have announced that they will be implementing zero-emission zones in 2025, Breda being the exception.

The International Council on Clean Transportation (ICCT) defines a zero-emission zone (ZEZ) as 'an area where only zero-emission vehicles (ZEVs), pedestrians, and cyclists are granted unrestricted access while other vehicles are either prohibited from entering or permitted to enter upon payment of a fee' (Cui, et al., 2021). The Dutch ZEZs will only apply to commercial vehicles (all vans and trucks categorized category N: vehicles carrying goods). The Netherlands has the most ambitious target with a widespread rollout of 28 ZEZ declared to date throughout the country.

Larger logistics companies have started making preparations to adhere to the stipulations set by the local governments. However, as there is a multitude of stakeholders in the area of city logistics, attention must be not only given to the ability of large logistics companies to adhere to the policies. There is a question of whether the authorities are doing enough to ensure that these policies are effectively communicated to all who are affected. The channels of communication in use currently are: logistics brokers who conduct door-to-door visitations, websites such as opwegnaarzes.nl, conferences, electric vehicle commercials from OEMs, unions and special interest groups. Closer to the time when policies are rolled out the road traffic service (RDW) disseminates written communication to the owners of all registered vehicles belonging to a class which may be affected by the regulation changes, as they have done with the use prohibition of vehicle classes lower than Euro 6 in certain city centres at the beginning of 2023. The effectiveness of the communication channels is also based on whether the business owner takes the initiative to read the news related to their sector.

This research delves into SMEs located in the city centres earmarked as ZEZs, some of whom do not see themselves as active city logistics contributors. SMEs are in this context defined as businesses which employ less than 250 employees and make an income below 40 million euros per annum as per the Dutch government definition (Kamer van Koophandel, 2021). For the purposes of this study, micro-enterprises which are businesses with less than 10 employees were also included in the definition of small to medium businesses. The objective of this research is to establish the awareness of businesses operating within the announced zero-emission zones around the ZEZ policies and establish the maturity of those aware of the ZEZ rollouts towards zero-emission operation readiness. In order to reach this objective a number of research questions were formulated:

- What city logistics activities are the SMEs engaging in?
- What is the maturity level of these businesses in light of zero-emission city logistics activity?
- Are there characteristics that set businesses with higher maturity levels apart from their peers?

This research is feedback into the development of zero-emission maturity model for small to medium enterprises which stratifies the levels of zero-emission zone readiness of businesses. This model is populated by way of using a tool called the Zero Emission City Logistics (ZECL) QuickScan. The model and tool are discussed in the sections below as well as the results of the scans.

1.1. Research Outline

To establish the zero-emission zone readiness of small to medium enterprises, the development of a maturity model which stratifies the levels of maturity of small to medium businesses was crucial. This model defines six stages of preparation that businesses go through in order to reach zero-emission city logistics operations. A questionnaire called the zero-emission city logistics QuickScan is thus used to provide information on the level in which small to medium businesses in the city centre fall in the maturity model.

2. Zero Emission Maturity Model for SMEs (ZEMM-SME)

The zero-emission maturity model is a 6-step model (see Figure 1) stratifying the 6 stages businesses can fall into on their way to zero-emission logistics operations the lowest level being level 0 -Oblivious and the highest level 5 - Optimized, each level is defined in the list following Figure 1. The model is drawn from the Project Management Maturity Model (Harold Kerzner, 2001), The Capability Maturity Model (Paulk et al., 1991), the Business Process Maturity Models (Rosemann & De Bruin, 2005), as well as the Synchromodality Maturity Model (Alons et al., 2019) which is currently in use to measure the modal shift maturity. The ZEMM-SME is a simplified version of the zero-emission city logistics maturity model which is applied in a broader scope to other sectors involved in city logistics in the Netherlands (Quak & Motloung, 2021).

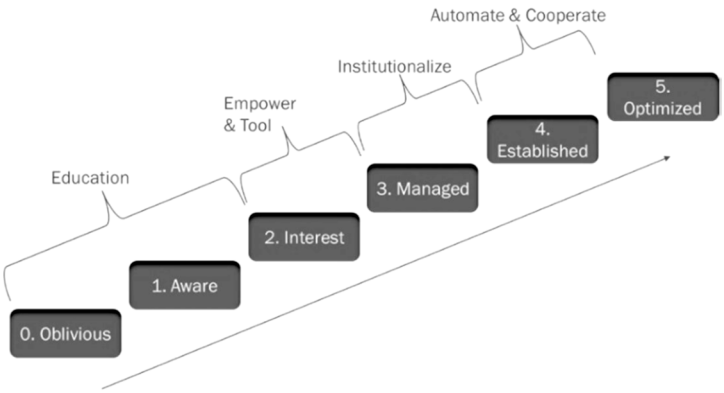

Fig.1: Zero-Emission City Logistics Maturity Model for SMEs

The maturity levels are defined as follows:

- **Level 0**: Oblivious - No knowledge or awareness of ZEZ.
- **Level 1**: Aware - Conversations are had around ZEC, however, these are informal and unstructured. The knowledge of zero emission city logistics is not institutionalized.
- **Level 2**: Interest - The company starts to make solid moves toward ZECL by allocating resources to the formation of ZECL-oriented projects including setting up teams and budgets.
- **Level 3:** Managed - The impacts of ZECL are known and the teams are at work implementing ZECL operations, up to 25% of operations are ZECL oriented. Employees throughout the company are trained on what ZECL is and how to become more sustainable. For companies who do not conduct their own logistics, this is subcontracted to partners who run zero-emission city logistics operations, however, this is not a hard requirement.
- **Level 4:** Established - The initial stages of ZECL implementation have been successfully implemented including pilots and the operations are being ramped up significantly as there is a track record of success (25-75% ZECL). Subcontractors are obligated to conduct logistics in a sustainable zero-emission method.
- **Level 5:** Optimized - 100% ZECL operations, clear metrics which are measured and assessed by both the company and their partners/subcontractors, there is good collaboration and the company is focused on continuous improvement and employing innovative solutions.

2.1. Sampling and Data Collection

Between April and June 2022, 199 small to medium businesses in four cities in Noord Brabant cooperated with students from Breda University of Applied Science in order to establish a view of the maturity level as well as gauge the sentiments of the SME business owners towards ZECL. Nonprobability sampling based on geographical location (the city centres, and foreseen ZEZs) was used and a qualitative questionnaire was employed for the data collection. The businesses were selected randomly by the students and business managers and owners were targeted for these QuickScan interviews. These respondents are often not included in research on ZECL or logistics in which the larger nationally operating logistics service providers, and (own-account) transport operators are usually overrepresented. The small to medium enterprises within the inner cities are often not (well) represented because:

- The targeted SMEs do not consider themselves as role players in urban logistics.
- A low awareness of the zero-emission policies which may lead to potential respondents considering that ZECL does not has anything to do with them and as such incomplete surveys.
- A lack of contact information for the said businesses and a low response rate to emails or other ways they are addressed as they do not consider themselves as target group.

A direct qualitative research method was employed to ensure that there is no miscommunication. Furthermore, as there sometimes exist language barriers among some small to medium business owners in the B4, it was crucial to ensure that these businesses are interviewed in their native language Dutch.

2.2. Zero Emission City Logistics (ZECL) QuickScan

QuickScan, which is a "participatory modelling method that links stakeholder and decision-maker knowledge and preferences" (Verweij, et al., 2016) was employed and executed by twelve students who went into the earmarked zero-emission zones and interviewed the business owners in person using a standard digital questionnaire on the Qualtrics platform (The QuickScan questionnaire) which is available in English and Dutch so as to match the language preferences of the entrepreneurs. In this instance the main stakeholders in consideration are the SMEs conducting business within the designated city centres where zero emission zones are to be implemented, the decision makers are the Dutch governments including municipalities. QuickScan was used to determine the current state of zero-emission initiatives by conducting on-site viewings, taking photographic evidence and hosting interviews with the QuickScan questionnaire, the answers to the questionnaire will determine the level of maturity of the scanned company. The goals of QuickScan for the different stakeholders are:

- **Students**: get an introduction to the practical aspects of sustainability, innovation and change readiness of logistics service providers and businesses (learning objective).
- **Research institutions**: establish the ZEZ readiness of businesses and their needs in terms of support from companies and cities. Inform policymakers of the progress.
- **Businesses**: create awareness and therefore a sense of urgency in preparing for ZEZ to avoid supply chain disruptions when changes are implemented. In addition to this, the feedback from QuickScan will enable companies to establish the next steps they could take to increase their level of zero-emission city logistics maturity.
- **Policy makers**: obtain a clearer view of the readiness of businesses to comply with policy changes as well as establish the need for support from the private sector in terms of infrastructure and general accommodations.

The QuickScan questionnaire itself comprises six sections, namely:

1. Company characteristics: with questions pertaining to the business name, location, supply chain position, city logistics segment, FTE and whether it is part of a franchise.
2. Fleet data: dealing with the number of vehicles in the business fleet, the types of vehicles, whether the business has electric vehicles as well as the proportion of the types of vehicles in the fleet.
3. Volumes: pertaining to the loading units of the goods received by the shop and volumes daily, over and above this, how many weekly deliveries are received by the business and the types of vehicles these deliveries are conducted in.
4. Awareness: comprising 20 true or false questions used to gauge the knowledge of certain concepts and activities related to ZECL, this awareness section is the fundamental section needed to allocate businesses to a certain maturity level.

5. Interest: asking businesses whether they would like assistance with developing their zero-emission strategy to support growth in maturity level over time.
6. City logistics information dissemination: asking the respondent to rank the city logistics information that they would like to receive by priority.

Students had a single opportunity to survey the business representatives as such, QuickScan was posed to ask a broad range of questions to adequately stratify business maturity and provide data on the current state of businesses planning towards sustainable last-mile transportation. The next section delves into the results of the foray into the state of small to medium-enterprise zero-emission last-mile logistics readiness.

3. Results

This chapter details the results of the QuickScans aimed at determining the types of city logistics activities the businesses are involved in, the maturity of their zero-emission activities as well as the characteristics that businesses measuring in the higher levels of maturity share. The students scanned a total of 223 inner-city businesses, with a distribution of 61 in Tilburg, 60 in Breda, 41 in Eindhoven, and 37 completed scans in 's-Hertogenbosch, the remaining 24 were found to fall out of the range of businesses of interest for this study or were incomplete, leaving 199 QuickScan results, which are presented in the remainder of this paper.

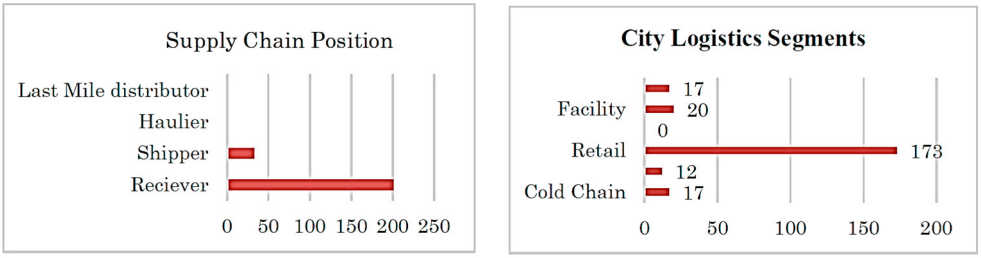

Fig. 2. (a) Respondent supply chain position and (b) City logistics segment

Most scanned businesses fell into the retail segment (see Figure 2). Further segmentation also indicated that some retailers are businesses which fall into the HORECA-label (n=61), which comprises hotels, restaurants, and catering establishments. The types of businesses which were scanned were predominantly receivers, some of which ship to the customer from their stores, hence opting for more than one supply chain position due to ownership of their own supply chain.

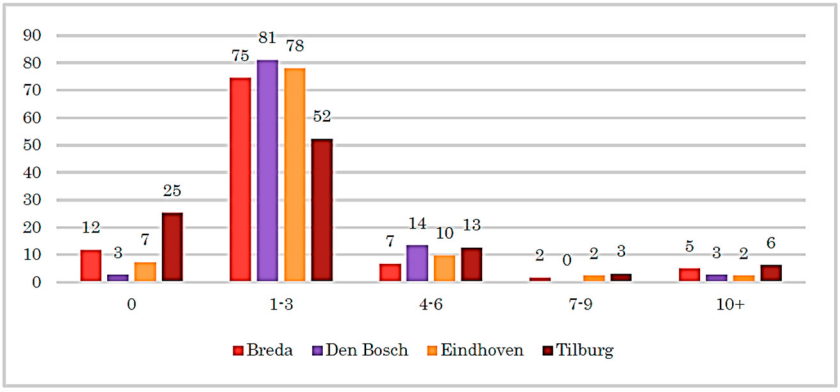

Fig. 3. Proportion of vehicles used in city logistics operations per city

To determine the relevance of the zero-emission logistics policies to these businesses, they were asked about the vehicles used for their city logistics operations, to which 70% responded to using between 1-3 vehicles for their

deliveries; in 's-Hertogenbosch (also known as Den Bosch, see also figure 3) indicating the highest proportion, followed by Eindhoven, Tilburg indicates a slight deviation with 25% of surveyed businesses indicating that they do not use their own transportation. The preferred vehicle type for the city logistics operations of scanned businesses are vans; with 137 businesses indicating that they make use of vans for their city logistics activities, followed by box trucks, used by 63 SMEs. Businesses with low goods volumes make use of passenger cars (n=16) as well as cargo bikes (n=11) for their deliveries and ten businesses have their stock delivered using large trucks with trailers (n=10).

The results of QuickScan revealed that out of the total of scanned enterprises, 31% (n=60) fell into the awareness level, leaving 137 businesses in the oblivious level (see Figure 4). A total of 68.3% of businesses fall into the oblivious stage and therefore are not eligible for higher levels of maturity however, in the remaining 5 levels of zero emission city logistics maturity, a company which falls into stage 3 is also eligible to be in stage 2 as well as stage 1, this applies to companies which fall into stage 1-5, a company which falls into a high maturity is also counted in the lower levels with the exception of level 0.

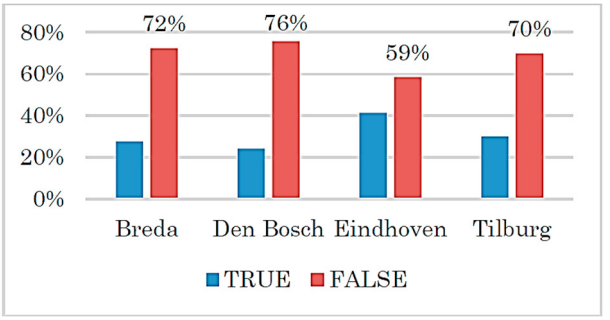

Fig. 4. Proportion of respondents aware of ZEZ plans

With 60 businesses in level 1 as shown in Figure 5, only 22 (11%) of these progress to level 2 which is the interested stage. These businesses are piloting and some are in ownership of zero-emission vehicles. The highest level in which SMEs were to be found is level 3 - Managed, these SMEs make up 5% of the total scanned businesses and are SMEs who actually do not conduct their own logistics, some making use of large logistics service providers who are actively operating electric vehicles, however, the use of electric vans is purely up to the contracted LSP as they do not have ZE vehicle use as part of their service level agreement.

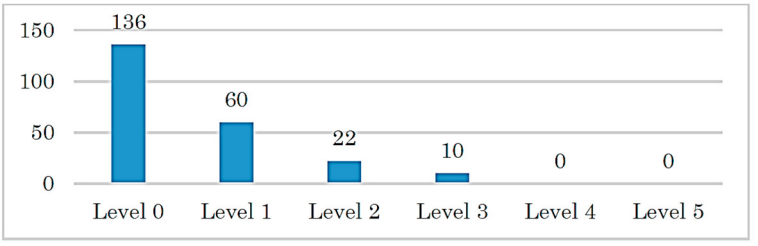

Fig. 5. Maturity Levels Brabant 4 Municipalities

In response to questions gauging zero-emission awareness of the businesses, 33 businesses indicated that they knew the impacts of zero-emission operations, while 26 of these 33 responded to knowing about the zero-emission zones. Of the group that does not know the impacts that zero-emission zones could have on their business (166), 34 indicated that they are aware that zero-emission zones will be rolled out. When asked whether the respondents would consider to use a hub on the city outskirts (in order to satisfy the ZEZ-requirements) 32% of the scanned businesses responded positively, when comparing this rate across municipalities, 37% (n=22) of Tilburg respondents were open to the concept of using a city hub, the lowest being the municipality of Eindhoven which is 10% lower with 27% (n=11) of the businesses saying they would opt for city hubs. The level of interest in exploring how they could prepare their

operations to function with lower emissions was low with only 11% (n=22) of scanned businesses indicating that they would like to learn how they could alter their city logistics operations to decrease emissions.

4. Discussion

Developing an understanding of the maturity of businesses towards zero emission zone readiness involves delving into what city logistics activities are the SMEs, engaging in their maturity level considering ZECL activity and whether there are characteristics shared by businesses falling into a particular maturity level.

The scanned companies all functioned in retail with a few shipping from their store, those that did so belong to the HORECA industry which has home delivery of food items as part of their service offering, this was done using cargo bikes. Most of these businesses use vans to conduct day-to-day business, most having ownership of between 1-3 vehicles. An interesting finding is that some of these small businesses use their own private vehicles, which will not be restricted to access zero emission zones in 2025 (as these are registered as passenger vehicles, category M), therefore they may be allowed to use their (fossil-fuelled) vehicles for city logistics activities unrestricted, which may encourage other small businesses to do the same. This might cause unwanted traffic as the capacity of commercial vans is often larger than private vehicles thus potentially leading to more trips. Another problem could be posed by vehicle owners who change the ownership particulars of their commercial vans to private use as a low-barrier alternative to purchasing an electric vehicle or adapting operations. As a result, the emission reductions due to ZEZ might be lower than expected.

The results of the SME QuickScan presented a grim view of the situation pertaining to zero-emission zone awareness among small to medium enterprises in the B4 municipalities with two-thirds (67%) of the scanned SME population indicating that they do not know about the upcoming zero-emission zone regulations in their local municipality, leaving only 60 businesses eligible for the higher maturity levels. The highest maturity level reached by these businesses is level 3 – managed, with some efforts as rudimentary as the use of cargo bikes for short inner-city journeys. For example, one such business is a quaint thrift shop with very little daily stock turnover, meaning that workers can cycle between their storage unit and the shop in the mornings, this solution is great for businesses that have similar volumes, however, may not be effective for businesses which need restocks of volumes more than a cubic metre at a time. This also illustrates how businesses need not necessarily replace their vehicles 1-1 and may look into more efficient ways in which to do business, thus presenting opportunities for collaboration among neighbouring businesses due to the high cost of investing in zero-emission trucks.

A total of 32% of the businesses indicating that they are open to collaboration on city hubs is encouraging, however, this is also dependent on entrepreneurs being able to conduct their businesses with as little disturbance to day-to-day operations as possible, meaning that, they would like the same volume of goods delivered at reasonable pricing, something which may be able to be achieved with economies of scale. The successful implementation of the city hub would increase their business zero-emission maturity to levels 4-5.

The number of SMEs which are not yet aware calls for communication from the municipalities being more targeted at these businesses since there is merely a 2.5-year difference in the period of the QuickScans and the ZEZ rollout, these businesses need timely assistance. It also shows that it is difficult to reach these respondents, as these SMEs do not recognized themselves as logistics players and may therefore miss information that they immediately dismiss as not addressed to them. Efforts for municipalities to overcome the barriers of low awareness should include communication to inner city businesses via official forms of communication such as letters and emails timeously as well as community engagement, which has not been done on a widespread basis to date. A few roadmaps towards zero emission city logistics have been created by various parties, however, these have not been distributed to business owners and they address the topic of ZEZs on a level which may not be simple enough for local businesses. However, one does not know what they do not know, therefore availing information is not sufficient, this information needs to be publicized and distributed directly into the hands of the concerned parties.

The limitations of this research include the unavailability of key or decision-making personnel in the scans of some businesses, which may lead to a skewed view of how the businesses are faring in their operational preparation, this is combined with the level of understanding of the Dutch-speaking shop owners who have been interviewed by English speaking students on a topic which is vague to the business personnel. Furthermore, due to a random selection of surveyed businesses, the sample may not be an accurate representation of the whole, particularly when looking into

specific municipalities. However, the level of awareness of personnel presents a clear view of whether the topic has been breached business-wide or not. In addition to this, some of the surveyed businesses are branches of larger businesses which are not part of the initial interest group but present an interesting view on the communication between central planning and the filtration of communication to smaller branches.

5. Conclusion

Small businesses are a vital part of the hustle and bustle in Dutch inner cities, some of which are to be transformed into zero-emission zones in order to improve the air quality, quality of life and meet the emission reduction targets. These businesses are engaged in various activities in the retail industry including HORECA, which extends to home deliveries from the shops. The research indicated a jarring insight into the obliviousness of 67% of small to medium businesses, indicating that municipalities need to engage in great drives to establish roadmaps for SMEs and engage in discussions with them on the simplest way to collaboratively make their zero-emission logistics more efficient by the joint use of resources.

As indicated by the businesses with higher maturity, as low-hanging fruit, small businesses could enlist the services of larger logistics service providers who have already embarked on making their city logistics operations more sustainable and focus on their core retail and restaurant businesses.

Acknowledgements

This contribution partly follows from the Topsector Logistiek implementatie-voucher ‘Het ontwikkelen van een maturity model waarbij aan de hand van een quick scan het maturity niveau van een (mkb) bedrijf/organisatie bepaald kan worden ....’ projectnumber TSL99.61.005, and the (financial) support of Logistics Community Brabant (LCB), the LCB program ‘Leefbare Stad’ and the Lastmile.info project that was funded via the European Union (EFRO - Europees Fonds voor Regionale Ontwikkeling vanuit het OPZuid programma).

References

Brundtland, G. H., 1987. Report of the World Commission on Environment and Development: Our Common Future, Geneva: World Commission on Environment and Development.

Cui, H., Gode, P. & Wappelhorst, S., 2021. A Global Overview of Zero-emission Zones. [Online] Available at: https://theicct.org/publication/a-global-overview-of-zero-emission-zones-in-cities-and-their-development-progress/ [Accessed 27 October 2022].

European Commission, 2021. Transport and Green Deal. [Online] Available at: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/transport-and-green-deal_nl [Accessed 02 02 2023].

Kamer van Koophandel, 2021. What is an SME. [Online] Available at: https://business.gov.nl/starting-your-business/first-steps-for-setting-up-your-business/what-is-an-sme/ [Accessed 27 01 2023].

Klimaatakkoord, 2019. Klimaatakkoord: Belangrijkste stukken. [Online] Available at: https://www.klimaatakkoord.nl/actueel/nieuws/2019/06/28/klimaatakkoord-in-stukken [Accessed 25-4-2023]OECD, 2003. Delivering the Goods - 21st Century Challenges to Urban Goods Transport, USA: Organisation for Economic Co-operation and Development.

Quak, H. & Motloung, T., 2021. Towards A Zero Emission City Logistics Maturity Model, Breda: VervoersLogistieke Werkdagen.

Rijksoverheid, 2020. Uitvoeringsagenda Stadslogistiek, s.l.: Rijksoverheid.

TNO, 2021. CO2 Uitstoot van de logistiek in Nederland, s.l.: TNO.

United Nations Environment Programme, 2020. Emissions Gap Report, Nairobi: United Nations Environment Programme.

United Nations, 2015. Paris Climate Agreement, Paris: United Nations.

Verweij, P. et al., 2016. QUICKScan as a quick and participatory methodology for problem identification and scoping in policy processes, Wageningen: Wageningen University and Research Centre.