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Perspectives of using Electric- and Alternately Fuelled Freight Transport Vehicles among Road Haulage Companies in Finland

Erika Kallionpää^{a*}, Sheba Nair^a, Heikki Liimatainen^a

^aTampere University, P.O. Box 600, 33104 Tampere, Finland

Abstract

A rising interest in electric and other alternately fuelled vehicles of the freight transport industry is due to the emission targets and technological advancements. The purpose of this study is to measure the perceptions and opinions of road haulage companies on the use of electric and alternately fuelled vans and trucks, as a part of urban logistics operations and long-haul transport in Finland. The paper is based on a case study in the form of expert interviews and a survey among road haulage companies. The paper provides valuable, new information to the companies about investing in electric and alternately fuelled freight vehicles, and to the local authorities in cities about developing urban environment and infrastructure. As a result, this paper introduces benefits, barriers, policy recommendations and factors affecting the competitiveness of these vehicles.

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1. Introduction

Due to increasing emissions and sustainability targets, both in Finland and in the European Union (EU), the logistics sector is facing developmental challenges. The European Green Deal (European Commission, 2020) aims to cut transport greenhouse gas (GHG) emissions by at least 90% compared to 1990 levels by the year 2050. Continuous technological development offers new possibilities to decrease emissions and to address developmental challenges in road freight transport. Technological development and aiming sustainability targets have led to increasing interest in using green vehicles especially in urban areas, but also in long-haul transport. (de Oliveira *et al.*, 2017; Patella *et al.* 2021). In literature, electric freight vehicles (EFVs), gas-powered (e.g., biogas, compressed natural gas (CNG), liquefied natural gas (LNG)) vehicles, biofuels and hydrogen-based vehicles have been introduced as potential alternatives in road freight transport. Unfortunately, there are still uncertainties to be tackled before road haulage

* Corresponding author. Tel.: +358 40 849 0287.

E-mail address: erika.kallionpaa@tuni.fi

companies are ready for wider use of alternative fuels and new technologies.

Based on literature review there has been only a small number of comprehensive studies done on comparing the different alternatively fuelled freight vehicles (including EFVs) from the point of view of the road haulage companies. The purpose of this study is to find out the current opinions of road haulage companies on the deployment and the use of electric and alternatively fuelled vans and trucks as a part of urban logistics operations and long-haul transport in Finland. The aim is to estimate the prospects about the willingness to invest in and to deploy electric and alternatively fuelled vehicles in road freight transport, and to investigate the possible barriers to invest in these vehicles now and in the future. The research questions to be answered are: 1) What kind of perceptions or opinions do road haulage companies have about electric and alternatively fuelled vehicles in road freight transport? 2) What are the factors affecting the competitiveness of the use of electric and alternatively fuelled vehicles in road freight transport? 3) What are the current barriers to and benefits of the deployment and the use of electric and alternatively fuelled vehicles in road freight transport? 4) What are the policy recommendations offered by road haulage companies for accelerating the uptake of electric or alternatively fuelled vehicles in road freight transport? The remainder of the paper is organized as follows. In Section 2, the literature review about EFVs and alternatively fuelled freight vehicles (AFFVs) in transport operations is briefly presented. Section 3 deals with methodology used within our study and results of the study are discussed in Section 4. Section 5 is for discussion, and closing remarks are given in Section 6, along with limitations of the study and potential future research.

2. Literature review

2.1. *Electric and alternatively fuelled vehicles in freight transport*

Due to environmental problems, there is a need to transition to alternative fuels and technologies in freight transport (Brauer & Khan, 2021; Dahlgren et al. 2022). Gas-powered vehicles represent one step towards greenhouse gas neutral transportation (Macharis & Kin, 2017). Biogas has potential to reduce climate emissions from freight transport, recycle nutrients and increase energy security (Brauer & Khan, 2021; Dahlgren et al. 2022). The bankable advantages of gas as a vehicle fuel are its low price and lower emissions, compared to gasoline and diesel fuel. (Ackerman, 2015; Zhao et al. 2021) However, increasing the use of natural gas and biogas to fuel vehicles requires creation of a wide refueling infrastructure (Ackerman, 2015). Chiaramonti et al. 2021 argue that the role of biofuels will be relevant in future road freight transport. The deployment of hydrogen as an alternative fuel is also a potential solution in the transportation sector. (Yaïci & Longo, 2022; Nughoro et al. 2021). Kotze et. al. (2021) emphasize that the heavy-duty vehicle sector is a particularly difficult sector to decarbonize, but with hydrogen fuel cell trucks the diesel trucks could be substituted.

Using EFVs have become an attractive option for road haulage companies. Since the mid-2000s, electric vehicles have gained increasing popularity in many countries, and market trends show that electric vehicles are a preferred technology to decarbonize urban freight transport (Pelletier et al., 2016; Transport and Environment, 2020). During the last few years, several projects of using electric vehicles in distribution have been carried out in different European cities (e.g., FREVUE, 2017; Quak et al., 2016). However, the large-scale usage of EFVs has still been limited (Quak et al., 2016). In most European countries, electric vans and trucks are rare (motive powers of new trucks in the EU are 95.8% diesel, 0.5% electric and 3.6% alternative fuels) (ACEA, 2021). Currently, there are more gas-fuelled trucks than electric and hydrogen-fuelled trucks in EU (EAFO, 2021).

The EFVs suit well in urban logistics (Quak et al., 2016). For example, Cornelies et al. (2020) found in their research that 24-hour delivery, when using battery-electric trucks, is profitable and is a promising solution for sustainable city logistics. Liimatainen et al. (2019) state that electric trucks are already technically and commercially feasible solution for a large share of road freight haulage with medium duty trucks. However, Cornelius et al. (2020) argue that there is still limited availability of battery-electric trucks on the market. Moreover, the electrification of trucks requires the development of recharging infrastructure (Liimatainen et al. 2019).

2.2. Benefits and barriers are guiding measures to increase deployment of EFVs and AFFVs

Discussion of the different benefits and barriers to use and implement EFVs and AFFVs have piqued the interest of the researchers (e.g., Quak et al., 2016). The most recognized benefits of using electric vehicles in urban environments are reduced emissions and noise pollution, having a good environmental and social impacts and making cities more livable (Quak et al., 2016; Cornelius et al. 2020). Other benefits are comfortable driving conditions, better acceleration, lower need for basic maintenance (such as oil change) (Pelletier et al., 2016). Important drivers for the diffusion of biogas, as a fuel, in freight transport are positive environmental impact and potential profitability (Brauer & Khan, 2021; Takman & Andersson-Sköld, 2021). Achieving a green brand image is a remarkable advantage for the freight companies, while using electric and alternatively fuelled vehicles. (Lebeau et al., 2016; Denstadli & Julsrud 2019)

On the other side, there are still some challenges and barriers to overcome, to increase the deployment of EFVs. High purchase costs, limited number of available charging stations and technical restrictions, such as limited range and payload and limited lifetime of batteries are examples of these barriers (Pelletier et al., 2016; Quak et al., 2016, Cornelius et al. 2020). The lack of major manufacturers producing electric heavy vehicles and providing after-sales support is also one concern (Cornelius et al. 2020; Quak et al., 2016). For the diffusion of biogas in freight transport the important barriers are higher costs, financial uncertainties, lack of infrastructure, unstable and short-term policies, contract requirements and lack of knowledge (Brauer & Khan, 2021; Takman & Andersson-Sköld, 2021; Dahlgren et al. 2022). Financial incentives, a stable policy context, demonstration projects, and information campaigns could be solutions for overcoming these barriers (Takman & Andersson-Sköld, 2021)

The shift towards a sustainable transport system requires policies and incentive measures that enable the transition. Collaboration of public and private stakeholders, and the support of policy makers and local authorities are essential (Kotze et al. 2020; Gass et al. 2014; Patella et al. 2020). One important measure for the public sector is the development of an extensive charging infrastructure (Lebeau et al., 2016, Gass et al. 2014). The public electric charging infrastructure reduces range anxiety and provides flexible charging. (Transport and Environment, 2020; Denstadli & Julsrud, 2019) Liimatainen et al. (2019) suggest that one solution to promote truck charging could be benchmarking the policies and measures used to promote electric passenger car charging.

Quak et al. (2016) emphasize that private companies could be encouraged to invest in EFVs because of the overall sustainability awareness, availability of subventions to make the business model more attractive, and support from local government. Gass et al. (2014) suggests an up-front price support system (e.g., direct financial support, exemption from registration tax, bonus system) instead of CO₂ taxation, which has also been suggested (Denstadli & Julsrud, 2019). Related to biogas trucks, climate objectives within organizations, increased demand for renewable products and potential profitability were mentioned as actor-level incentives (Mignor & Bergek, 2016). Overall, green public procurement stimulates the adoption of environmentally friendly technologies. (Denstadli & Julsrud 2019)

3. Methodology

The paper is based on literature review, a case study in the form of expert interviews and a survey among road haulage companies operating in Finland. We performed our literature search for the study on the Scopus database. We limited the search to journal articles written in English. In the case study, the perceptions, the opinions, the prospects of the deployment and the use of EFVs and AFFVs in road freight transport are examined. Firstly, the employees from road haulage companies are interviewed using the semi-structured interview method, and content analysis was carried out to analyze the answers. After this, a survey was conducted across Finland among road haulage companies.

The expert interviews were conducted in September-December 2021. Altogether 10 road haulage companies, operating in Finland, were interviewed, out of the 14 companies we contacted. Six of the companies interviewed are medium-sized independent companies, one is a larger-sized independent company, one is a subsidiary of an international transport company and two are international transport companies. The interviewed companies are key and active operators in the road transport industry in Finland. The interviewees are CEOs (Chief Executive Officer), Directors of Development and Operations, etc. All interviewees were asked questions related to the six themes: general opinions and experiences, benefits and advantages, suitability for transport, future prospects and investment, obstacles

and challenges, and stakeholders and policy measures. The average duration of interviews was ca. 30 minutes. The interviews were recorded and transcribed verbatim.

Based on the interview questions, in March – April 2022, a survey was conducted within the Finnish Transport and Logistics (SKAL), with about 4,300 members. The survey was constructed using the online survey tool, LimeSurvey. The questionnaire consisted of questions related to the same six themes, as in the interviews. It took about 20-25 minutes to complete the survey. To categorize the respondents, the survey also mapped the respondents' background information. A total of 20 respondents participated in the survey, out of which 8 completely answered the survey and the rest answered partially. The background of the respondents varied from being the Chairman of the board and managing director to being a freight transporter or driver. The annual turnover ranged from EUR 0.01 – 2.7 million. Most of the respondents have petrol/diesel powered freight vehicles, more trucks than vans. There was only one respondent that has an alternatively fueled freight truck. Two database tables were created, one for the transcribed material from the interviews and the other to analyze the survey results and were automatically coded. Based on the research questions, the transcribed material and the results from the survey were categorized to answer them. Related to electric vehicles, in this study we focus on battery electric freight trucks and vans.

4. Results

4.1. General opinions and experiences

The interviewees welcomed environmentally friendly development, and the adoption of clean vehicles in transport operations seems to be a “hot topic”. 50% of the interviewees have a positive opinion about EFVs, and the rest have neutral or negative opinions. Two interviewees said that it is good that novel solutions are being developed, but they also stated that solutions for heavy and long-distance transport are still far away. One company said that EFVs raised some doubts in the beginning and two interviewees mentioned that EFVs do not give rise to negative emotions, but there are still many problems. When asked the opinions about the other AFFVs, they are seen as a necessity for sustainable development. Some interviewees saw the gas-powered trucks as a technically viable solution and a good option for long distances. However, the availability of gas, as a fuel, caused concern among the interviewees. For example, one company said that with only one gas refueling station in Central Finland, it is impossible to do business. Hydrogen, as a fuel, was also mentioned as an interesting future solution by three companies. “*Hydrogen and gas can be ranked a little after electricity. Gas is certainly a satisfactory solution for long distances, only if its availability is assured.*” All the companies interviewed have a little experience either with electric vehicles or gas-powered vehicles. Seven out of the ten transport companies interviewed have used or have tested either electric vans or electric delivery trucks in their transport. 50% of the companies interviewed have one or many electric freight trucks. Electric vans are being used by six companies. 90% of the companies interviewed have one or more gas-powered trucks. The experiences with both EFVs and gas-powered trucks are positive, but they also faced challenges. In the survey, the general opinion of the respondents ranged from positive to very positive for alternatively fuelled freight trucks, neutral to positive for alternatively fuelled freight vans, negative to neutral and positive for electric freight vans, and very negative to negative for electric freight trucks. More than 50% of the respondents have no experience with using either EFVs or other alternatively fuelled vehicles. In terms of their use, more than 90% of the respondents said that they do not use EFVs and alternatively fuelled freight vans, and more than 70% of the respondents said that they do not use alternatively fuelled freight trucks.

Based on the experiences, all interviewees shared the same thoughts about the suitability for certain transport operations. EFVs are currently suitable for short distance transport operations and deliveries in urban areas (because they are noise-free and have limited range), but they are not suitable for heavy or long-haulage transport. Whereas gas-powered trucks are suitable for all types of transport (short, long, and urban). Based on the interviews, in Finland, the gas-powered trucks seem to be more widely used compared to electric trucks, but they seem not to be the forerunners in the zero-emission vehicle race. “*Biogas, as a fuel, is a good option, but can suddenly remain an intermediate thing if electricity or hydrogen evolves into a suitable alternative fuel.*” In the survey, the respondents shared the opinion that EFVs are most suitable for urban distribution transport (range less than 50 km radius from the terminal) and AFFVs are most suitable for long distance transport (range greater than 200 km). The respondents also believed that electric- and other alternatively fuelled freight vans are suitable for short distance transport (range of 50-200 km).

4.2. The main benefits are environmental friendliness and brand image

When asked about the benefits of using EFVs and other AFFVs, all interviewed companies mentioned environmental friendliness and improvement of brand image as the main benefits. The interviewees said that due to zero emissions and no noise (in case of EFVs), during transport operations, cities can be more liveable. In addition, the companies' drivers have found them easy to drive. EFVs and AFFVs are seen to have a competitive advantage, good for marketing and to promote corporate social responsibility. The interviewees highlighted that the deployment of EFVs or AFFVs increases customer satisfaction and improves the opportunity to get new customers. Current availability of purchase incentives for electric and gas-powered trucks in Finland was also mentioned as a positive policy measure. Some companies also said that the operational costs are lower for electric trucks, as compared to diesel-powered trucks. According to the survey respondents, the most essential benefit of EFVs and AFFVs is the lower operating costs. In the case of incredibly important benefits, new business opportunities are for EFVs, whereas for AFFVs, better customer satisfaction, and easy to drive and operate the vehicle are incredibly important benefits. Emission saving/ Environmental friendliness is only ranked at a medium level of importance in both types of vehicles, whereas image/ brand enhancement is of low importance to the freight companies.

In terms of the challenges and barriers, the interviewees mentioned that dearth of charging and refueling infrastructure, high investment and purchase price, limited driving ranges (EFVs), battery weight (EFVs), inexperience in maintenance and repair (lack of know-how and service stations), unknown resale value, and the long delivery times for newly ordered vehicles (especially in the current times). *“It is certainly the case that, no matter whether it is electric or gas-powered truck, if there is no infrastructure, then it is hard to be the first ones to use it in transport operations.”* Again, the survey respondents ranked the barriers based on their level of importance. The most essential obstacles EFVs and AFFVs face are the inadequate charging/ refueling stations, limited driving range, and lack of knowledge and service stations for maintenance and repair services. Other than this, high purchase price, lack of subsidies and lack of information on resale value are essential concerns for EFVs. The barrier(s) of EFVs of high importance are lack of information on experiences and total costs, and that of AFFVs are high purchase price and lack of information on resale value. Of medium importance the common barrier of EFVs and AFFVs is the lack of political support, and ambiguous political will or vision.

4.3. The role of stakeholders and means to accelerate adoption of EFVs and AFFVs

The interviewees said that the cooperation among stakeholders (government, manufacturers, researchers, freight companies, etc.) is important, as the transition and environmental goals cannot be carried only on the shoulders of the freight transport companies. *“If transport companies have to pay for this environmental change, then we face an impossible task.”* Interviewees highlighted the commitment of all the stakeholders to a common goal and a shared vision for the future. A common opinion among these transport companies was that manufacturers should provide alternate options of vehicles with better technology and at lower prices, and cities should develop public charging and refuelling infrastructure. The interviewees suggested several means to accelerate the adoption of EFVs and AFFVs, which included purchase subsidies, tax benefits, government-sponsored investment loans, higher number of charging and refuelling stations, and funding and investment in research and development. One proposal was a common database for emissions, lifecycle costs and experiences, which should be available as public information. In the survey, regarding the level of importance of the measures to increase the adoption rate of EFVs and AFFVs, improved driving range, lower operating costs, availability of infrastructure aid for charging point/network providers (home, businesses, offices) and increased availability of charging/ refueling infrastructure are particularly important. Ranked lower, the important measures are lowered purchase price, less charging times, cooperation between stakeholders of the vehicle ecosystem (government, manufacturers, transport companies, etc.), availability of infrastructure development aids for transport companies (e.g., for companies to build depot charging, etc.), and increased availability of direct purchase subsidy.

4.4. Willingness to invest in new technologies in future

All interviewees agreed that road freight transport will be cleaner and more environmentally friendly in the future.

But there are still some differences in their opinions. Three companies said that hydrogen will be used in future, especially in heavy and long-haulage transport. One interviewee believed in the electric fleet. Two believed in both electricity and hydrogen as future motive powers. One interviewee believed in biogas. Others stated there would be a variety of zero-emission options for freight companies including electricity, hydrogen, gas, renewable diesel, and biodiesel. All interviewees wanted to be involved in sustainable development, and saw it as a necessity, but several also mentioned that they do not want to be the pioneers. They highlighted that they have no desire to take big and unnecessary risks in investments due to existing uncertainties. All freight companies interviewed said that they are following the technological development and most of the interviewees are still waiting for technology to evolve to offer better solutions before making investment decisions. Due to the risks involved and the high price of the vehicles, the willingness of the freight companies to invest is low. *“So, it's really a challenging situation, because even if one wants to invest in electric freight trucks or alternatively fuelled freight trucks, the situation is still very foggy (unclear).”* However, all freight companies interviewed have some investment plans for the future. Some of the interviewees believed that the period to transition to new types of vans and trucks is less than ten years, and they believe that a lot will happen in the following two years. Carbon-neutrality targets are also pushing these investments. One interviewee said, that *“in the future, we will invest in electric delivery trucks rather than gas-powered trucks.”* Most of the survey respondents agreed that both electricity and other alternative fuels (natural gas, biogas, biofuels, hydrogen, etc.) will be needed in the future road freight transport. For the future, none of the survey respondents have goals to adopt electric freight trucks for their transport operations. 15% of the respondents have goals to use electric vans, and 25% of the respondents have plans to use alternatively fuelled trucks and vans. The reasons for not having future goals are limited driving range (EFV), inadequate charging infrastructure (EFV), awaiting technological advancement (AFFV), high purchase price (AFFV) and unsuitable for their transport operations (common).

5. Discussion

This paper studied the use of EFVs and AFFVs in daily operations both in urban areas and long-haulage transport from the perspectives of road freight companies. As a result, this paper introduces the perceptions, opinions, benefits, barriers, future prospects and factors affecting competitiveness of using EFVs and AFFVs. In addition, the policy recommendations, and measures to encourage the road haulage companies to invest in EFVs and AFFVs were studied. The study sought answers to the four research questions.

Firstly, the study examined answers to the research question, *“What kind of perceptions or opinions do road haulage companies have about electric- and alternatively fuelled vehicles in road freight transport?”* Based on the literature, road haulage companies realize the need for green development, and, therefore, due to the rising interest in EFVs and AFFVs, an upward trend in their use is also seen. In comparison to this, in the interviews, EFVs and AFFVs brought up positive and negative opinions among the companies, which was based on their doubts and experiences. They feel that the freight transport industry requires green development, even though there are challenges and uncertainties. In the survey, the general opinion of the respondents ranged from very positive to positive for alternatively fuelled freight trucks, positive to neutral for alternatively fuelled freight vans, neutral to negative for electric freight vans, and negative to very negative for electric freight trucks. In terms of suitability to transport operations, the companies interviewed, and survey respondents are of the same opinion that EFVs are more suitable for urban logistics, and gas-powered trucks are for long-haulage. The companies also commented that the future motive powers of road freight transport will include electricity, gas (CNG, LNG, biogas), biofuels and hydrogen. They are willing to invest in these technologies when the technology advances, purchase price lowers and vehicles become more suitable for their transport operations.

The second research question studied in this paper was: *“What are the factors affecting the competitiveness of the use of electric- and alternatively fuelled vehicles in road freight transport?”* We found that the factors affecting the competitiveness are environmental friendliness, functionality of technology, purchase price, operating costs, resale value, and customer satisfaction. The functionality and reliability of technology ensures the smoothness of and suitability to transport operations. Competitive advantages can be gained through ease of operation, high efficiency, and reduced emissions. Environmental friendliness and brand image go together and can lead to improved customer satisfaction and improved opportunities to get new customers. High purchase price and an uncertain resale value decrease the competitiveness, whereas low operating costs can increase the competitiveness. Policies and measures also have a significant impact on competitiveness and strongly guide the direction of the future deployments.

The third question studied in the paper was: *“What are the current barriers to and benefits of the deployment and*

the use of electric- and alternatively fuelled vehicles in road freight transport?” The barriers of using EFVs and AFFVs were unanimously voiced through literature, interviews, and the survey. In the case of the companies studied, the most essential barriers to using EFVs are its high purchase price and limited driving range. However, the common obstacles that the AFFVs- and the EFVs industries face are the lack of charging/refueling stations, lack of knowledge of maintaining and repairing, and inadequate number of service stations. A highlighted benefit of using EFVs and AFFVs is that they are environmentally friendly and make a good environmental and social impact. Additionally, using these vehicles will lead to incurring lower operating costs, improve the company’s brand image, and can provide better customer satisfaction.

Lastly, this study examined the answer to the fourth question, “What are the policy recommendations offered by road haulage companies for accelerating the uptake of electric or alternatively fuelled vehicles in road freight transport?” This paper confirms that measures and policy recommendations are needed from the whole ecosystem to accelerate the adoption rate of these vehicles. In this study, we found that road haulage companies highlight a common target and a shared political vision, as also recognized in literature. Based on this study, the most important prerequisites are technological development (e.g., improvement of driving range), availability of infrastructure and lowered purchase price. In terms of policy recommendations, availability of purchase subsidy, state-guaranteed investment loans, and infrastructure developments are highlighted. Additionally, the companies interviewed also highlighted the importance of information, and therefore proposed the creation of a common database, detailing, e.g., the lifecycle costs and emissions of alternative motive powers.

6. Conclusions

In this paper, we have contributed to the understanding of the current state and future role of EFVs and AFFVs in road freight transport and daily distribution operations. As a result of this study, we found that road haulage companies welcome green development, and they recognize the environmental and social value gained by it. However, due to some challenges related to EFVs and AFFVs, such as, lack of experience (especially in arctic winter conditions), availability problems, unclear common future vision of the politicians, etc., there are doubts in the minds of the road haulage companies whether to invest or not in EFVs or AFFVs. While most companies are still waiting for technology to evolve and develop, a few are taking bold steps by investing and facing the risks, to be pioneers. Overall, the road haulage companies emphasize the strong cooperation among stakeholders of this ecosystem and a shared goal for the future.

Since there are only a few scientific articles published in the area of perceptions of road haulage companies, this study contributes to the information about the road haulage companies’ opinions, and perceptions of EFVs and AFFVs in Finland. In terms of the practical implications, this paper gives information for future actions to authorities, decision-makers, and other stakeholders in the transport industry, to speed up sustainable development. Additionally, this paper gives valuable information to all road haulage companies about the opinion of the whole road freight transport industry about this topic. The strength of the research process in this study lies in the diverse research methods utilized and the participation of more than one researcher in gathering and analyzing data. These strengths increase the reliability of the research results. The survey conducted, however, has some limitations, which decreases the level of accuracy, and therefore the reliability, of the results. There were only a small number of responses, due to which a reliable statistical analysis was not possible. Therefore, these survey responses were analyzed qualitatively. We estimate that the survey responses were low due to many reasons. Considering the current global political situation, several reasons could have affected the interest of the Finnish road haulage companies, including the rise in fuel prices, the effect of the war on operations in Ukraine, Russia, and its neighboring countries. Additionally, we also observed that the respondents who answered that their opinion on EFVs and AFFVs are moderate or positive, went onto complete the survey. Whereas those who answered that their opinion on EFVs and AFFVs are negative or very negative, did not proceed to complete the survey after this question. As it is difficult to measure the perceptions of logistic companies on EFVs and AFFVs, due to several factors (such as, political stands, fuel prices, etc.), it should be noted that the results of this study are mostly indicative and should be supplemented with more in-depth future research. Additional case studies are needed both internationally and in the Finnish context. It would be valuable to compare perceptions and experience between the Nordic countries, and find similarities, differences, and their reasons.

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