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Operational Insights from Logistics Actors: Running 70 Electric Heavy-Duty Trucks in Sweden

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Executive Summary

Opportunities and challenges in regional electrified logistics have been demonstrated by an innovative project; REEL, which combines both confidential and open research and innovation. The system demonstration includes around 70 battery electric heavy-duty trucks, and associated charging infrastructure, operating various types of commercial goods flows. A total of 45 Swedish stakeholders, including 32 logistics operators, are part of the project. This paper presents findings from multiple in-depth interviews conducted with the logistics operators and shippers between 2022 and 2024. The study explores key areas such as operational experiences with electric trucks and charging infrastructure, policy concerns, business model implications, and the potential for scaling up the system.

Keywords: Heavy Duty Electric Vehicles & Buses, Public Policy & Promotion, Consumer Behavior, AC & DC Charging Technology, Optimal Charging Locations

1 Background

The transport system faces significant societal challenges in its transition to meet climate goals, which must occur alongside rapid technological advancements across various levels. Successfully transitioning to fossil-free, safe, equitable, and efficient road transport requires collaboration among relevant stakeholders to identify and address potential barriers that could hinder the swift and widespread implementation of new solutions. In the fall of 2021 45 Swedish actors joined forces in the project REEL 2, Regional Electrified Logistics 2, (hereafter referred to as REEL) to accelerate the transition to electrified, emission-free heavy goods road transport.

The goal of REEL, was to collaborate with relevant operator groups, including shippers/receivers of goods, freight forwarders, haulers, terminal and charging point operators, power providers, grid operators, terminal owners, vehicle manufacturers, digital service and charging equipment providers, as well as local, regional, national, and EU authorities and regulators, subject matter experts, startups, and academia to accelerate the transformation to electrified emission free regional road freight transport with heavy trucks, powered by stationary charging. The REEL initiative aimed at creating an experimental and theoretical foundation for the accelerated large-scale electrification of a significant portion of regional logistics systems. This was achieved through the deployment of 67 heavy battery-electric trucks (>16 tons) and sufficient charging capacity at points where vehicles would naturally remain stationary. In Table 1 all 67 battery electric trucks are listed.

Table 1: Battery electric trucks in REEL per actor

Transport company	# of trucks	OEM	Short description	Type of goods	Localization
Alltransport i Östergötland	1	Scania	Container shuttle	Retail products	Norrköping
Boliden Mineral	1	Scania	Local shuttle	Ore	Boliden
Brödservice Stockholm Syd	1	Volvo	Urban distribution	Food products	Stockholm
Börje Jönsson Åkeri	1	Volvo	Regional shuttle	Food products	Helsingborg - Gothenburg
Dagab Inköp & Logistik	2	Scania	Local dist.	Food products	Stockholm area
	1	Scania	Regional dist.	Food products	Gothenburg area
Dania Connect & Höganäs	1	Scania	Regional shuttle	Iron powder	Höganäs - Helsingborg
Derome Bygg & Industri	1	Volvo	Regional dist.	Construction material	Gothenburg area
DFDS Logistics Services	1	Volvo	Local distribution	Industrial components	Gothenburg
DHL Freight Sweden	1	Volvo	Regional dist.	Consumer and industry products	Gothenburg - Jönköping
Elis Textil Service	3	Volvo	Local dist.	Textile products	Stockholm, Helsingborg
Erikssons Åkeri i Tomelilla	9	Volvo	Regional shuttle	Food products	Skåne, Halland
FORIA & Ragn-Sells Treatment & Detox	1	Scania	Regional shuttle	Ash	Stockholm area
Falkenklev Logistik	5	Scania	Local dist.	Pallets and parcels	Malmö
Flygbilar i Landvetter (Flygfrakt)	1	Volvo	Regional shuttle	Pallets and parcels	Gothenburg Jönköping
GLC	2	Volvo	Local dist.	Food products	Gothenburg
	2	Scania	Local dist.	Industrial Components	Gothenburg
Godstransportservice i Umeå	1	Scania	Local dist.	Pallets and parcels	Umeå
ICA Sverige	3	Volvo	Local dist.	Food products	Gothenburg, Stockholm
	1	Volvo	Regional dist.	Food products	Skåne county
Jula Logistics	2	Scania	Regional shuttle	Consumer products	Skaraborg
LBC Frakt i Värmland	1	Scania	Regional dist.	Construction material	Karlstad
	1	Scania	Confined area	Industrial waste	Karlstad
	1	Scania	Local dist.	Construction material	Karlstad
LB Transport	1	Volvo	Local dist.	Food products	Borås
Martin & Servera Logistik	4	Volvo	Local distribution	Food products	Gothenburg, Enköping, Norrköping, Jönköping,
	1	Scania	Local dist.	Food products	Stockholm
M Lab	1	Volvo	Regional distribution	Construction material	Stockholm
Nordisk Återvinning Service	5	Volvo	Local pickup	Waste management	Gothenburg
PostNord Group	2	Scania	Local shuttle	Pallets and parcels	Stockholm area
Renova	1	Scania	Local pickup	Waste management	Gothenburg area
SCA Skog	1	Scania	Regional shuttle	Timber	Umeå
Swerock	4	Volvo	Local dist.	Concrete	Stockholm
VGT i Göteborg	1	Volvo	Regional shuttle	Tires	Gothenburg metropolitan area
Wibax Logistics	1	Scania	Regional dist.	Liquid chemicals and bio-oils	Norrbotten & Västerbotten
Öhrlunds	1	Volvo	Internal transports	Steel fractions	Luleå

The project sought to develop integrated, efficient, and innovative system solutions to benefit climate, local environment, health, and traffic efficiency while minimizing logistics losses and additional costs. Exploratory system demonstrations of individual electrified logistics cases, representing a substantial portion of regional logistics operations, were designed, implemented, monitored, explored, and evaluated during the 2021–2025 period. A mix of new pre-commercial and commercial subsystem modules—comprising vehicles, chargers, power modules, and digital control and information systems—were integrated into functional total system solutions alongside existing subsystems and modules used by cargo owners/receivers, freight forwarders, terminals, and haulers. Data characterizing the performance of the various subsystems were monitored, and analyses were conducted on for example environmental benefits, associated cost savings, operational expenses, and business opportunities.

The REEL system demonstrator project was organized, into a series of vertical- (V), horizontal- (H), and project management- (PM) work packages (WPs). Within the vertical WPs exploratory demonstrations of electrified logistics systems, encompassing both total and subsystem solutions, were established, operated, and analyzed by various competing consortia composed of essential stakeholders. Information, results, and data from these demonstrations, excluding business-critical information, were shared with the horizontal WPs via the project's trustee function. This process and its role are elaborated in Chapter 2, *Methodology*. In the horizontal WPs, collaborative system innovation efforts focused on the following areas:

- H1.1 Policy and Regulatory Development
- H1.2 Business and Financing Models
- H1.3 Working Environment and Knowledge Development
- H2 System Architecture, Tools, Interoperability & Interfaces

These WPs aimed to develop frameworks and mechanisms essential for accelerating the transition and addressing the challenges and barriers associated with moving from diesel-based to electrified logistics systems. During the project, additional innovation needs emerged, prompting an expansion of scope to include:

- E-Trailer
- Fleet Optimization Study
- International Ideas for Electrification Scale-Up
- Range Extender

The REEL project consortium included a broad range of 45 Swedish actors, such as shippers and receivers of goods, freight forwarders, logistics service providers, distributors, haulers, terminal and charging point operators, power providers, grid operators, terminal owners, vehicle manufacturers, regional authorities, subject matter experts, and academia. Furthermore, significant collaboration was conducted with external stakeholders, including charging equipment providers, digital service providers, national and EU authorities and regulators, and start-ups. The REEL project is funded by the participating business partners and the Swedish Vehicle Research and Innovation Program (FFI), which is supported by the Swedish Innovation Agency, the Swedish Energy Agency, and the Swedish Transport Administration.

2 Methodology

In the REEL project, processes were developed and implemented to ensure the handling of descriptions of subsystems, variables and parameters included in the exploratory demonstrations. A designated trustee function was established to collect, aggregate, and filter data before making it accessible to consortium and project partners within the vertical and horizontal WPs. This trustee was responsible for gathering data from all project participants active in the exploratory demonstrations, encompassing construction, operational, and analytical data from various subsystems in the demonstrations. When necessary, the collected data was aggregated, filtered, and subsequently summarized in reports with public access or made available for use by the horizontal WPs. This centralized approach streamlined data management and eliminated the need for each horizontal WP to independently gather data from all project actors.

In the spring of 2022, a draft questionnaire template was developed for collecting variables and parameters associated with subsystems within the REEL project. The template was structured into the following thematic areas: (1) Organizational Information, (2) Logistics Setup for the Electrified Case in REEL, (3) Hardware, Software, and Infrastructure for the Electrified Case in REEL, (4) Policy, (5) Business Models,

(6) Working Environment and Knowledge Gaps, (7) System Architecture and Tools, (8) Scaling Up. The draft was refined by the various horizontal work packages (WPs). Subsequently, a workshop was held with representatives from Chalmers University of Technology, CLOSER, Linköping University, Lund University, and the University of Gothenburg. The workshop aimed to review and enhance the questionnaire to ensure it effectively captured the innovation needs identified by each horizontal WP. As a result, a total of 141 questions were formulated. Between 2022 and the spring of 2023, interviews were conducted with 31 REEL participants. At the beginning of 2024, a second questionnaire template was developed to gather insights on the operation of electrified road logistics. Building on the template created for the first round of interviews. The new template was structured into the following thematic areas: (1) Operational experiences with vehicles, (2) Data from operations, (3) Operational experiences with charging infrastructure, (4) Policy, (5) Business models, (6) Planning, management, and tools, (7) Information and interfaces, (8) Scaling up. The template was refined by the horizontal work packages and by academic partners listed above. This collaborative process resulted in the formulation of 170 questions. Throughout 2024, interviews were conducted with 27 REEL participants. The list of respondents and their roles is provided in Table 2. Most participants were interviewed two to three times per interview round, with each session lasting approximately 1.5 to 2 hours to comprehensively address the full scope of the questionnaire. Interviews were conducted either in person or digitally and were recorded to ensure accurate transcription and analysis. In all interviews, two representatives from CLOSER participated. Responses were documented in real-time and displayed to the interviewee, allowing them to continuously review and verify the information. This process reduced the risk of misinterpretation and ensured accuracy in capturing the interviewee's input.

Table 2: Interviewees in first and second trustee interview round

Actor	Role of interviewee in Round 1	Role of interviewee in Round 2
Alltransport i Östergötland	1) Business Area Manager, 2) Quality and Environment Responsible	1) Business Area Manager
Boliden Mineral	1) Manager Electrification Program, 2) Engineering Specialist	1) Project Manager
Brödservice Stockholm Syd (Polfärskt)	1) CEO	1) CEO
Börje Jönsson Åkeri	1) CEO	N/A
Dagab Inköp & Logistik	1) Fleet Manager, 2) Vehicle Coordinator	1) Fleet Manager, 2) Vehicle Coordinator
Dania Connect	1) CEO	1) CEO
Derome Bygg & Industri	1) Transport Manager	1) Transport Manager
DFDS Logistics Services	1) Fleet Manager	1) Fleet Manager
DHL Freight Sweden	1) Sustainability Specialist	1) Sustainability Specialist
Elis Textil Service	1) Procurement Manager	1) Procurement Manager
Erikssons Åkeri i Tomelilla	1) Logistic Manager, 2) Key Account Manager	1) Logistic Manager, 2) Key Account Manager
FORIA	1) Chief Sustainability Officer	N/A
Falkenklev Logistik	1) CEO	1) CEO
Flygbilar i Landvetter (Flygfrakt)	1) CEO, 2) Quality and Environment Responsible	N/A
GLC	1) Business Area Manager	1) Business Area Manager
Godstransportservice i Umeå	1) CEO	1) CEO
Höganäs Sweden	1) Supply Chain Manager	1) Supply Chain Manager
ICA Sverige	1) Strategic Logistics Developer	1) Strategic Logistics Developer 2) Account Manager
Jula Logistics	1) Senior Logistics Consultant	1) Senior Logistics Consultant
LBC Frakt i Värmland	1) CEO	1) CEO
Martin & Servera Logistik	1) Key Account Manager Logistics	1) Fleet Manager
M Lab	1) CEO	1) CEO
Nordisk Återvinning Service	1) Operational Manager	1) Operational Manager
PostNord Group	1) Senior Green Technology Lead	1) Senior Green Technology Lead 2) Senior Green Technology Lead
Ragn-Sells Treatment & Detox	1) Business Project Lead	1) Business Project Lead

Renova	1) Development Strategist	1) Development Strategist
SCA Skog	1) Business Development Manager, 2) Maintenance Engineer	1) Maintenance Engineer
Swerock	1) Department Manager	1) Department Manager
VGT i Göteborg	1) CEO	1) CEO
Wibax Logistics	1) Chief Logistics Officer, 2) Chief SQE Officer	1) Chief Logistics Officer

To provide additional insights regarding the economic prerequisites for battery electric trucks, and to compare it with their diesel counterparts, a total cost of ownership (TCO) analysis was chosen as the primary method in this study. The TCO method allows for calculating the costs of owning and operating a vehicle over a period of time, and comparing the cost between different types of vehicles in terms of power-train options, and is applied in several other studies examining the economics of battery-electric trucks [1]. It is also a common financial evaluation method used in the Swedish trucking industry. The TCO analysis accounts for different cost components including investment and purchasing costs for e.g., vehicles and charging infrastructure, fixed annual costs, and operation costs. Several factors influencing and defining costs of logistics operations for electric, and diesel driven transport have been identified, see Table 3.

Table 3: Identified items for cost analysis from a hauler perspective

Category		Item
Utilisation	Yearly utilisation	Hours Mileage Days of operation
Investment	1.1 Truck incl. Superstructure (SS)	1.1a Chassis and residual value 1.1b Superstructure (incl. e.g., tail-lift) and residual value 1.1c Trailer and residual value 1.1d Lifespan of investments (years or mileage) 1.1e Public subsidies
	1.2 Charging infrastructure	1.2a Charging infrastructure (incl. installation) and residual value 1.2b Power grid upgrade and residual value 1.2c Other (incl. e.g., IT tools) 1.2d Lifespan of investments 1.2e Public subsidies
	1.3 Interest	1.3a Total yearly interest for investments
Fixed annual costs	2.1 Road tax and tolls	2.1a Vehicle (and trailer) tax 2.1b Road tax 2.1c Other (e.g. road tolls)
	2.2 Insurance and damages	2.2a Vehicle and trailer insurance 2.2b Charging infrastructure insurance 2.2c Average yearly deductible
	2.3 Other costs	2.3a Parking 2.3b Wash 2.3c IT equipment operation and service 2.3d Other
Operating cost	3.1 Tyres and maintenance	3.1a Tyre cost 3.1b Vehicle and trailer maintenance/service 3.1c Charging infrastructure maintenance 3.1d Consumables 3.1e Refinishing 3.1f Other
	3.2 Energy	3.2a Average energy consumption per km 3.2b Energy cost (electricity or diesel)

3.3 Grid transmission, electricity tax and power tariff	3.3a Grid transmission 3.3b Power tariff 3.3c Energy tax
3.4 Staff	3.4a Driver 3.4b Transport management 3.4c Other staff 3.4d Over-head

In the TCO analysis, four different types of logistic cases have been developed and calculated based on data from the different flows with electric trucks performed in the REEL project. The cases cover various truck applications, logistics setup and geographical location. The geographic location is of specific relevance for the electrified cases, as opposed to their diesel counterparts, considering the presence of different electricity price areas in Sweden. In the comparison all cost were defined on a yearly basis. Investment costs are calculated by accounting for the purchasing price of the vehicle and charging infrastructure, respectively, while also considering a potential residual value of the equipment. The average annual investment cost, as used in the comparison, is estimated based on the economic lifetime or the number of years the truck and charging infrastructure is assumed operated by the haulier. For interest cost, the annual average interest cost for the analysed period is used. Elements such as insurance, vehicle and road tax, parking, wash and IT are assumed fixed over the year and not dependent of the usage of the truck. Operation costs include: costs for tyres, services and maintenance, which mainly depends on the annual mileage of the vehicle; costs of staff which are associated to the annual use of the vehicle; and costs for energy which depends on annual driving distance and specific fuel consumption of the vehicle. As the fuel (energy) cost varies over time, both for electricity and diesel, an average over the period between January and December 2024 was applied, to reflect current price levels. While the diesel case only includes costs for the diesel fuel, the cost of fuel for the electric truck, in addition to the electricity market price, also includes electricity transmission and grid cost. The size and distribution of these cost elements have a strong geographic dependency attributed to the local electricity grid company. To account for these cost elements, discussions with grid companies were conducted to understand what power subscription model is the most common among logistic companies to use. The performed TCO calculations allowed for a further comparison between electrified and diesel-based logistics cases. The electrified cases were further divided into subsidized and non-subsidized cases, i.e., indicating presence of governmental incentives partially covering additional costs for electric trucks and charging infrastructure. The outcome of the TCO calculations as well as the method were also presented to all participating organisations in the project to acquire feedback. However, no significant feedback affecting the outcome was obtained.

3 Results

Below a selection of results from both interview rounds with REEL actors are presented.

3.1 Operational Experiences of Trucks and Charging Infrastructure

The REEL project involves trucks in both urban and regional transport, covering a broad daily mileage from 30 to 1,000 kilometers [2, 3]. Operational patterns vary: 45% of trucks run a single daily shift, another 45% operate on two-shifts, and 10% follow a three-shift schedule. Six vehicles have been in operation for up to 240 days per year, 47 vehicles between 241 and 280 days annually, and the remaining vehicles operate more or less daily. As detailed in Figure 1, the resulting yearly mileage per vehicle ranges significantly, from 7,000 kilometers for an urban refuse truck to 280,000 kilometers for a line-haul tractor trailer combination.

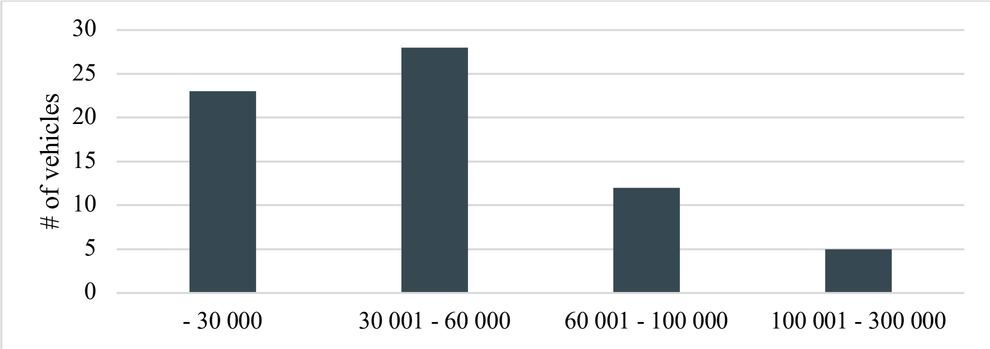

Figure 1: Yearly mileage in kilometers for trucks in REEL

Interviewed stakeholders generally hold positive views regarding the dependability and consistency of the electric trucks. Over the project period from 2021 to 2024 (up to the time when the interview was performed with each actor), the unplanned downtime varied across the fleet of 67 vehicles: 44 vehicles experienced less than five days of unplanned downtime, 13 vehicles had between six and 25 days, and 10 vehicles incurred more than 25 days of such downtime. It is important to note that 18 of these 67 trucks were prototypes. Figure 2 presents a detailed overview of stakeholder perceptions concerning the uptime and operational consistency of the electric trucks.

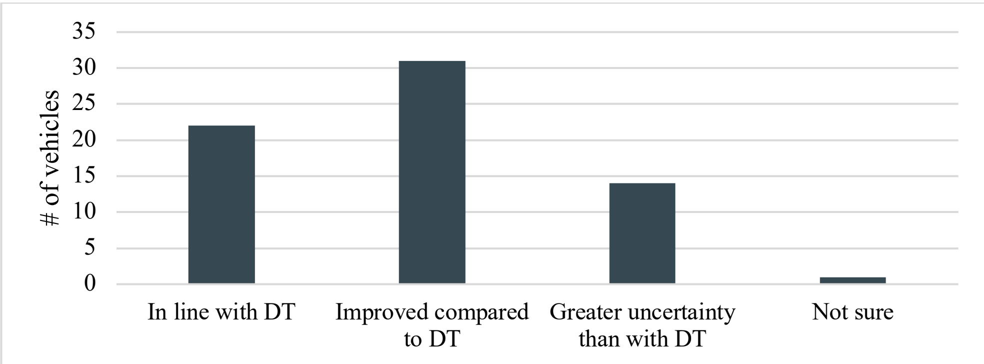

Figure 2: Actors view on uptime and consistency of electric trucks compared to diesel trucks (DT)

Electrified logistics operations within the REEL framework predominantly utilize depot and terminal charging infrastructure [4]. Approximately half of the logistics flows operate on single-shift schedules with relatively short daily distances, enabling the use of simpler charging solutions. Around 40% of vehicles primarily employ chargers with power ratings up to 44 kW during overnight periods. The remaining 60% utilize a combination of lower power chargers during extended standstill periods and higher power chargers (up to 350 kW) for rapid charging during short loading and unloading intervals, such as lunch breaks and between shifts. Figure 3 presents data detailing the temporal distribution of vehicle charging events throughout the day.

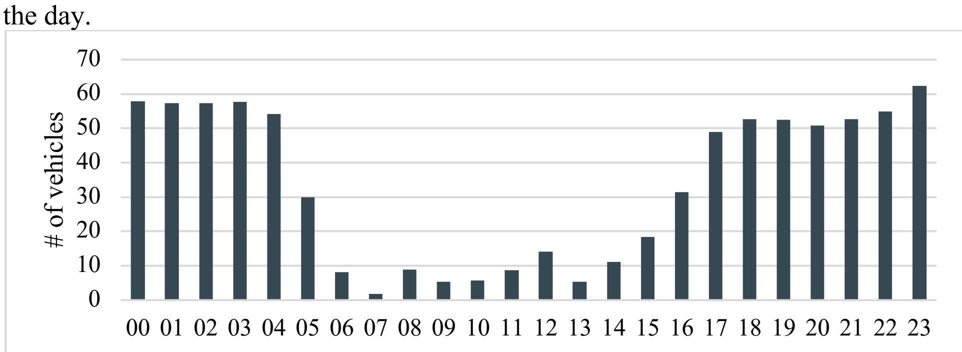

Figure 3: Hours of the day when vehicles have been connected to a charger

A key advantage of depot and terminal charging highlighted by the actors is relative cost control. Charging at public stations is sometimes twice as expensive—or more—compared to depot charging. Additionally, haulers benefit from the ability to charge vehicles during natural standstill periods, such as during loading and unloading operations. Figure 4 presents the share of different types of charging, in terms of locations, where charging is performed by every truck in the REEL project.

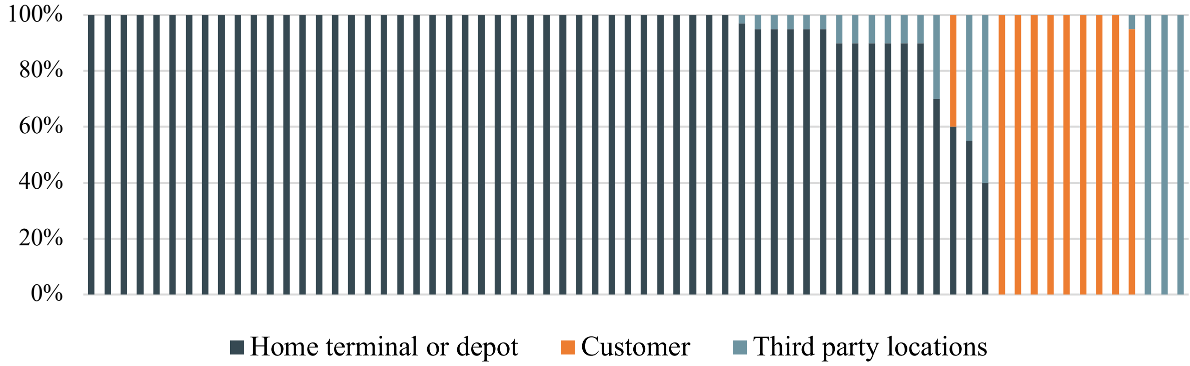

Figure 4: Share of different types of charging for each truck in the REEL project

Charging at depots and terminals presents several challenges that require resolution:

- Synchronization of charging: When multiple trucks require charging, e.g. between shifts, needs for various trucks will require synchronization. To cope with this, multiple actors have introduced various types of Charging Management System and seek to synchronize the charging planning with the overall transport planning.
- Power Availability and Energy Supply: Needs for an increase in grid capacity may arise. There are additional solutions to ensure energy and power supply, such as local production from solar panels and integration of BESS, both of which have been observed in REEL.
- Charging Layout and Placement: The positioning of charging equipment within terminals and depots is critical to maintaining operational efficiency, and balance cost. Figure 5 provides a conceptual overview of charging solutions deployed at logistics terminals in REEL, illustrating their placement and interaction with power and energy supply systems.

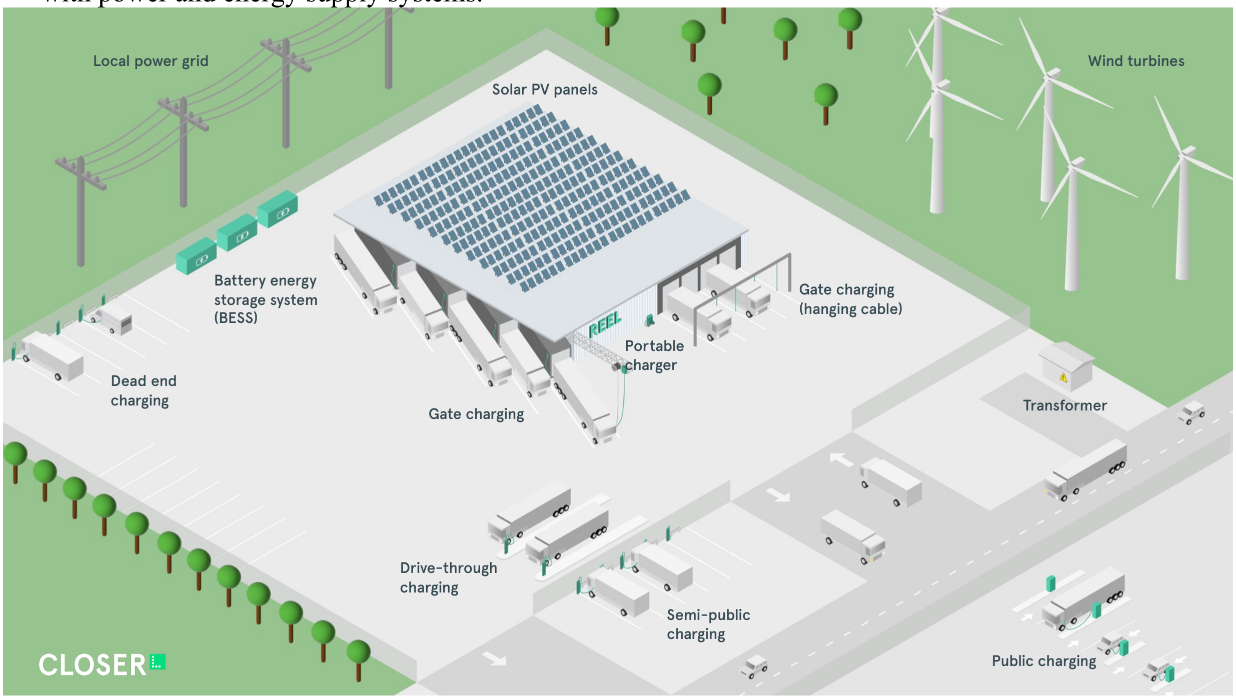

Figure 5: Conceptualized view of a logistics terminal hosting a variety of charging infrastructure, power and energy supply solutions.

3.2 Policy Concerns

The interview study further elicited stakeholder perspectives on the three most critical existing or potential policy and regulatory measures to accelerate the adoption of electric trucks. Across both interview rounds, investment incentives for electric trucks and subsequent charging infrastructure consistently emerged as the foremost priorities. In the initial interview phase, the third most frequently cited policy measure was the establishment of emission-free zones within urban areas. However, the second round of interviews indicated a shift in emphasis, with an *increased reduction quota for diesel fuel*, aimed at elevating its price, being identified as the third most important measure. In Figure 6, the top 14 cited policy measures are presented.

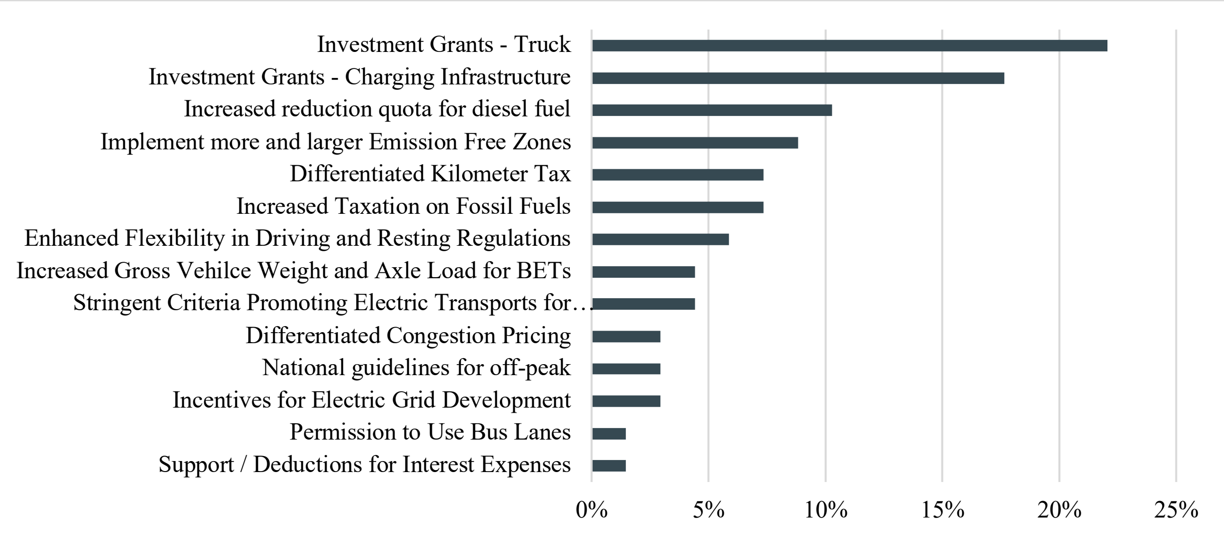

Figure 6: Most cited policy measures to accelerate the adoption of electric trucks

3.3 Business Model Implications

Electrifying logistics flows impacts the balance between capital and operational expenditures compared to diesel-powered logistics flows. To compare the cost for an electric and diesel-powered logistics solution from a hauler's perspective, four different transport cases performed with battery electric HDVs have been constructed based on aggregated data and analysis from the transport cases within the REEL project. These encompass; *Local distribution*, *Regional distribution*, *Line-haul operation*, and *Drayage operation*, and are detailed in Table 4. The reported results and conclusions are grounded in real-world experiments, projecting the situation towards the stakeholder-relevant year of 2024.

Table 4: Description of the four transport cases analyzed

	Local distribution	Regional distribution	Line-haul operation	Drayage operation
Mileage per year (km)	30,000	50,000	180,000	150,000
Operating hours per year (h)	2,000	2,200	4,032	3,600
Operating days per year (days)	240	220	250	250
Operating time	1 shift / day	1 shift / day	2 shifts/day	2 shifts/day
Charging infrastructure	25 kW, depot	40 kW, depot	300 kW, terminal	300 kW, terminal
Electricity area	SE 4	SE 1	SE 3	SE 2
Truck	Rigid, 6x2	Rigid, 6x2	Rigid, 6x2 & trailer	Tractor, 4x2 & trailer
Maximum Gross Combination Weight	27 tonnes	44 tonnes	64 tonnes	44 tonnes
Battery size (kWh)	300	600	600	600
Average energy consumption (kWh/km)	1.2	1.5	2.0	1.6

The subsequent TCO calculations assume an interest rate of 7.2%. The net salary for drivers is set at 33,600 SEK per month, and Swedish collective agreement conditions apply; social costs and taxes are included in these calculations. The presented cost comparison calculations utilize the average energy price for the period spanning January to December 2024 and are specifically based on MK1 Diesel and electricity prices within Sweden. For physical limitations in the national grid, Sweden is divided into four geographical electricity price areas: SE1, SE2, SE3, and SE4. Notably, due to these physical limitations, the national grid areas often exhibit divergent electricity price levels, as summarized in Table 5.

Table 5: Average electricity prices (SE1-4) and diesel prices (MK1) in Sweden January-December 2024 [5,6].

	SE1 (SEK/kWh)	**SE2** (SEK/kWh)	**SE3** (SEK/kWh)	**SE4** (SEK/kWh)	**MK1** (SEK/l)
Average Jul-Sep	0.4176	0.4138	0.5552	0.7155	14.60

Costs for grid transmission and power outtake varies depending on geography, time, and subscription model. In the presented calculations, Vattenfall's subscription model for companies with 80 Ampere or higher with low voltage connection is applied. Moreover, electricity energy tax varies depending on geography and type of business sector, which is also accounted for in the calculations. The current incentive schemes in Sweden for battery electric trucks allow for a maximum of 20% investment support of total cost although it cannot exceed 30% of the additional cost compared to a similar conventional truck for large enterprises [7]. For semi-public charging infrastructure, a maximum of 20% investment support of total installation cost can be obtained for large enterprises [8]. The economic comparison presented in Figure 7 demonstrates that the difference between the electric and diesel-powered solutions varies from +11 to -3% when public co-funding of both charging infrastructure and trucks can be obtained. It is noteworthy that the TCO for diesel-powered solutions are lower than their electric counterparts in local and regional distribution, but with increased mileage, the TCO for the electric option with the presented conditions tends to be lower than the diesel option.

With the introduction of electric operation, the cost-type distribution shifts compared to conventional diesel-powered operation. For electric vehicles, costs associated with investments in trucks and charging infrastructure—including depreciation and interest—account for approximately 35-40%, compared to 10-20% for diesel operations. However, energy-related costs for electric operation are notably lower, making up only 5-10%, whereas they can reach up to 30% for diesel operation. No substantial changes have been observed in the cost categories of *"Insurance, vehicle and road tax, parking, washing, and IT"*. These categories have remained relatively consistent across both types of operations. Approximately 40% of actors have noted higher tire wear for electric trucks, while 10% have noted a reduction and approximately 50% have noted similar tire wear as for diesel trucks.

To cope with the higher investment costs and uncertainties with regard to residual value of the battery electric vehicles, participating transport companies in REEL experience a need for increasing the length of the transport contracts to ensure the utilisation of their electric trucks in advance. It is difficult to calculate residual value of electric trucks as a second-hand market does not yet exist and potential degradation of the batteries remains uncertain as well. Historically, when using diesel trucks, the participating companies have applied contract lengths for transport services spanning mostly from 12 to 36 months. For electric transports, most companies consider it necessary to increase the contract length to an interval between 36 to 60 months to reduce the risk due to high investment cost. Increase contract lengths have been applied for REEL transport flows. For some transport segments even longer contracts lengths are desired.

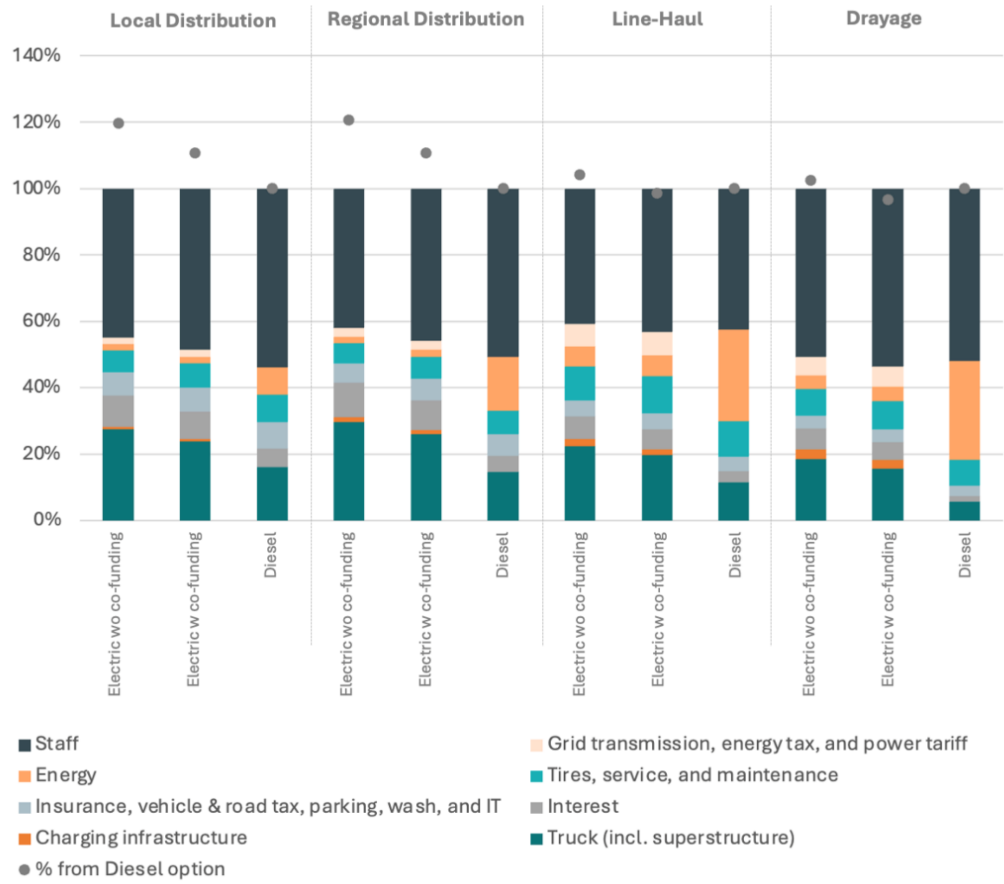

Figure 7: Economic comparison of Swedish transport cases, comparing diesel and electric operation.

In contrast to when acquiring diesel trucks, 58% of the transport companies in the REEL project have chosen to use operational leasing as the financing model for their battery electric trucks. 21% are using financial leasing while the remaining 21% are purchasing the trucks up-front. Transport companies state they were unsure of the performance of the first-generation trucks, for example, considering battery degradation. They also believe that specifications of these trucks will be outdated in a few years' time due to the rapid technological development. Thus, operational leasing was used to minimize risk of potentially low residual value. Figure 8 illustrates the actors' views on the financing model that will be prevalent in 2030. Actors who anticipate continuing with operational leasing in five years from now argue that these arguments will still hold true at that point. Multiple actors state that the financing of trucks will be a hurdle for smaller haulers. A potential solution, according to some of the larger actors and the hauler network organizations, involves larger actors taking ownership of trucks themselves and subsequently leasing the vehicles to smaller haulers. Furthermore, a shift from operational leasing to cash payment is anticipated by the logistics companies within a five-year timeframe.

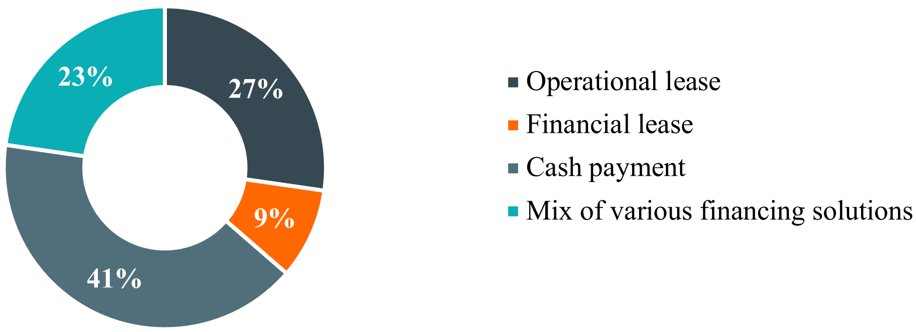

Figure 8: Financing solution anticipated for future use

Actors who prefer cash payment state that they benefit economically through either cash payment and/or financial leasing. They anticipate that the performance of electric vehicles will improve in the coming years and that battery electric trucks will have a longer useful life than conventional trucks. Therefore, actors express a desire to retain the vehicles for as long as possible in their own operation, with some even mentioning a period of up to 12 years. These actors foresee a potential of keeping trucks in operation by transitioning them to other transport assignments as the battery degrades. When the battery is no longer sufficient for vehicle propulsion, it is expected to have a valuable second life in grid frequency up and down regulation services to optimize battery value generation for the logistics companies.

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Presenter Biography

Andreas Josefsson joined the Swedish innovation platform for sustainable logistics; CLOSER, in 2018 holding the role as responsible for developing and driving projects to accelerate the transition to energy-efficient and fossil-free freight transport in collaboration with industrial actors, academic institutions, and societal organizations, e.g. the REEL project targeting the electrification of regional logistics systems through demonstrating around 70 electric HDVs in various types of goods flows together with 45 stakeholders. Before joining CLOSER, Andreas worked at Volvo Cars and Accenture Strategy where he ran multiple projects related to logistics and supply chain development, in both Europe and China. He holds a M.Sc. in Supply Chain Management from Chalmers University of Technology and CSR & Sustainable Management from University of Buenos Aires.

Nikita Zaiko joined Lindholmen Science Park (LSP), a non-economic organization hosting several R&I-programs e.g., mobility, in 2020 in the role of project manager, coordinating and participating in several complex innovation projects involving multiple stakeholders from the industry, academia, and public sector, with electrification of heavy-duty vehicles being the common theme. He holds a M.Sc. in Logistics and Transport Management from School of Business, Economics and Law at Gothenburg University.