ACTIONABLE FRAMEWORK FOR E-TRUCKS AND CHARGING

- a reference paper to organise climate action

Sophie Punte, October 2023

Contents

Foreword

We face an implementation challenge to meet our shared Paris Agreement goals. Governments and companies set targets to reach net-zero emissions. Solutions and initiatives exists for virtually all sectors. The Breakthrough Agenda, the International Energy Agency, Mission Possible Partnership and others developed roadmaps with milestones until 2050. NGOs advocate for ambitious policies, rate an rank companies, and issue principles and standards on credible climate leadership. Investors demand corporate transparency on climate plans and progress as part of broader environmental, social, and governance (ESG) disclosure.

It is good to put pressure on governments and companies to raise ambition and it is essential to hold them accountable to commitments made. Yet we need to remind ourselves that we can only address the climate emergency and protect our societies by working together, and accepting that we will make mistakes along the way. The UNFCCC in its first Global Stocktake concludes exactly that: “Implementation must accelerate to increase ambition across all fronts, taking an all-of-society approach to make progress towards the Paris Agreement goals and respond to the climate crisis.”

Governments and companies also need help to translate their commitments into concrete action. My proposed solution is an “Actionable Framework” that provides a full picture of success factors for decarbonising key sectors (‘what’), steps to make that happen (‘how’), and what stakeholders need to take the lead or should be involved (‘who’). This is supported by sharing of real-world insights on what exists and what is needed to make climate action work in practice.

I prepared an Actionable Framework for electric trucks and charging infrastructure as a first example, given my role in the founding of Smart Freight Centre. I encourage the freight community to use this framework to organise the transition to net-zero trucking in Europe and elsewhere. My belief is that Actionable Frameworks are essential to accelerate decarbonisation of other sectors too, such as power, steel, aviation, buildings, and agriculture.

It is science that tells us where we need to go, it is people who get us there.

Sophie Punte
Amsterdam, October 2023

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Disclaimer

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1. Introduction

The challenge

Electrification of trucks is accelerating. Truck manufacturers have announced new models of electric trucks (e-trucks), shippers and carriers commit to purchase or contract zero-emission trucks, and private sector players are willing to investing in EV charging infrastructure. However, one barrier is rapidly becoming the bottleneck: the time it takes to build charging infrastructure for trucks, especially for those that travel long distances. What isn't helping is that many different stakeholders are involved who each hold a piece of the puzzle - they must coordinate to put the puzzle together.

Objective and scope

The objective was to create an Actionable Framework for stakeholders to advance e-trucks and charging infrastructure with a particular focus on Europe. The framework identifies success factors for e-trucks and charging infrastructure ('what'), steps to make that happen ('how'), and what stakeholders need to take the lead or should be involved ('who').

The scope covers private, shared and public charging for medium/heavy-duty battery-electric trucks, with a focus on the EU and UK. Work was carried out during March-July 2023 and involved online conversations with stakeholders from government, business, NGOs and research, supplemented with participation in workshops/events and a review of selected documents to identify existing practices that could serve as solutions.

Output

This reference paper presents the context of e-truck charging (section 2) and an Actionable Framework that links these together (section 3). The annexes provide abbreviations and definitions (Annex A), EU plan, policies and regulations (Annex B), more detailed insights and action measures for each of the ten success factors gained through interviews and literature (Annex C), and references to source websites and documents (in footnotes).

This framework can be used to inform stakeholders, coordinate action at the EU level, and to develop national action plans tailored to the specific situation and needs of different countries. The framework could also be useful to other geographies like US, India, China and others.

Among the 10 success factors and 30 steps in this framework the priority in relation to e-trucks is for truck manufacturers is to ramp up the production of e-trucks to meet growing demand. Organising action in relation to charging infrastructure should start with governments, regulatory authorities and grid operators because the solution to many of the challenges lie in their hands. Three immediate priorities are:

- Grid operators should speed up the installation of new charging connections where there is existing grid capacity, in parallel to planning and securing investments for grid upgrades for the next 3-5 years that is powered by renewable energy.
- National and local governments and authorities should help identify and make available suitable sites for public charging infrastructure, which can be both green sites for new charging infrastructure as well as brown sites where charging infrastructure is added.
- All stakeholders can help to establish a platform for sharing data relevant to the planning, development and operation of charging infrastructure - governments and regulatory authorities, utilities and grid operators, truck manufacturers and suppliers, freight companies, CPOs and EMSPs.

2. Context of E-trucks and Charging

This section provides the context including e-truck technologies, applications and charging; the ten success factors to advance e-truck charging; and stakeholders.

E-Truck technologies, applications, charging

Choices are made regarding truck electric vehicle technologies; operations or applications for freight companies that also differ between sectors (and which tend to have common energy needs, emissions, and challenges); and charging locations, systems and strategies. This study focused especially on battery-electric medium and heavy duty trucks (defined within the EU as N2, 3.5-12 tonnes and N3, >12 tonnes). See Annex A for definitions.

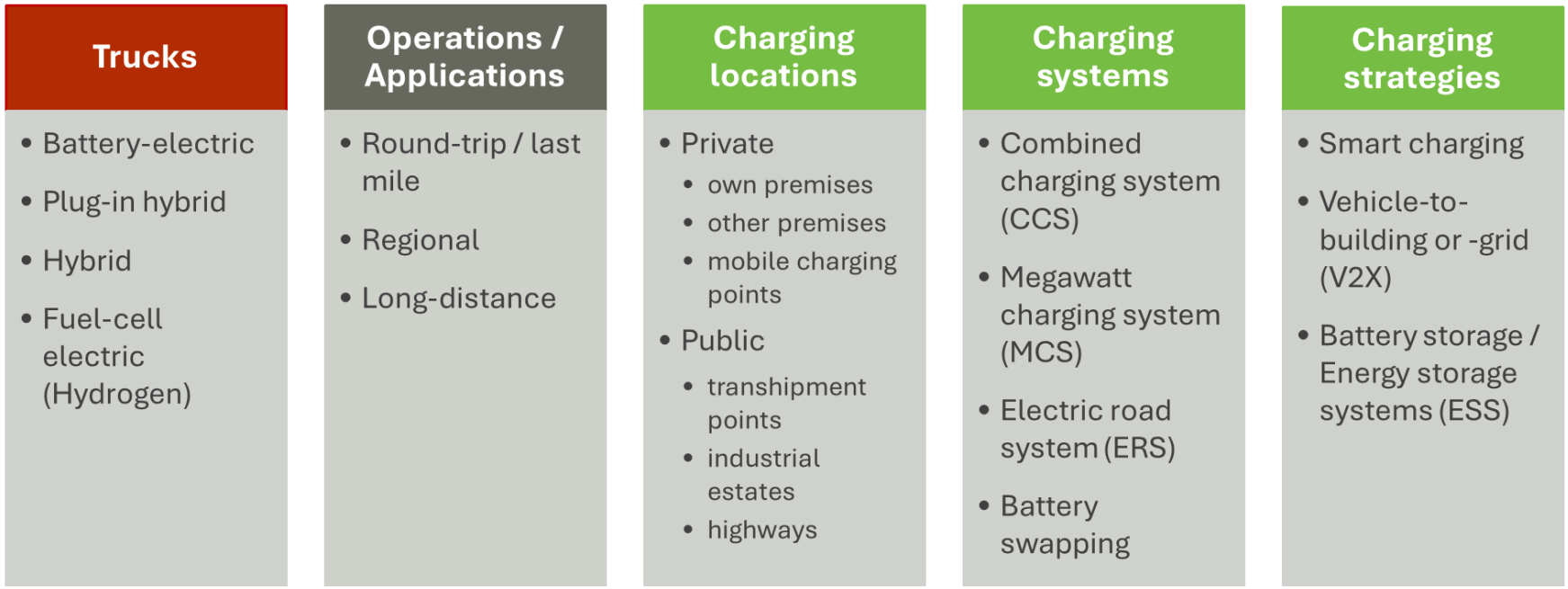

Figure 1. E-truck technologies, applications and charging

Ten success factors to advance e-trucks and charging

Ten success factors to advance e-truck charging were identified that are interconnected and are further explained in the Actionable Framework (section 3) and in (Annex C).

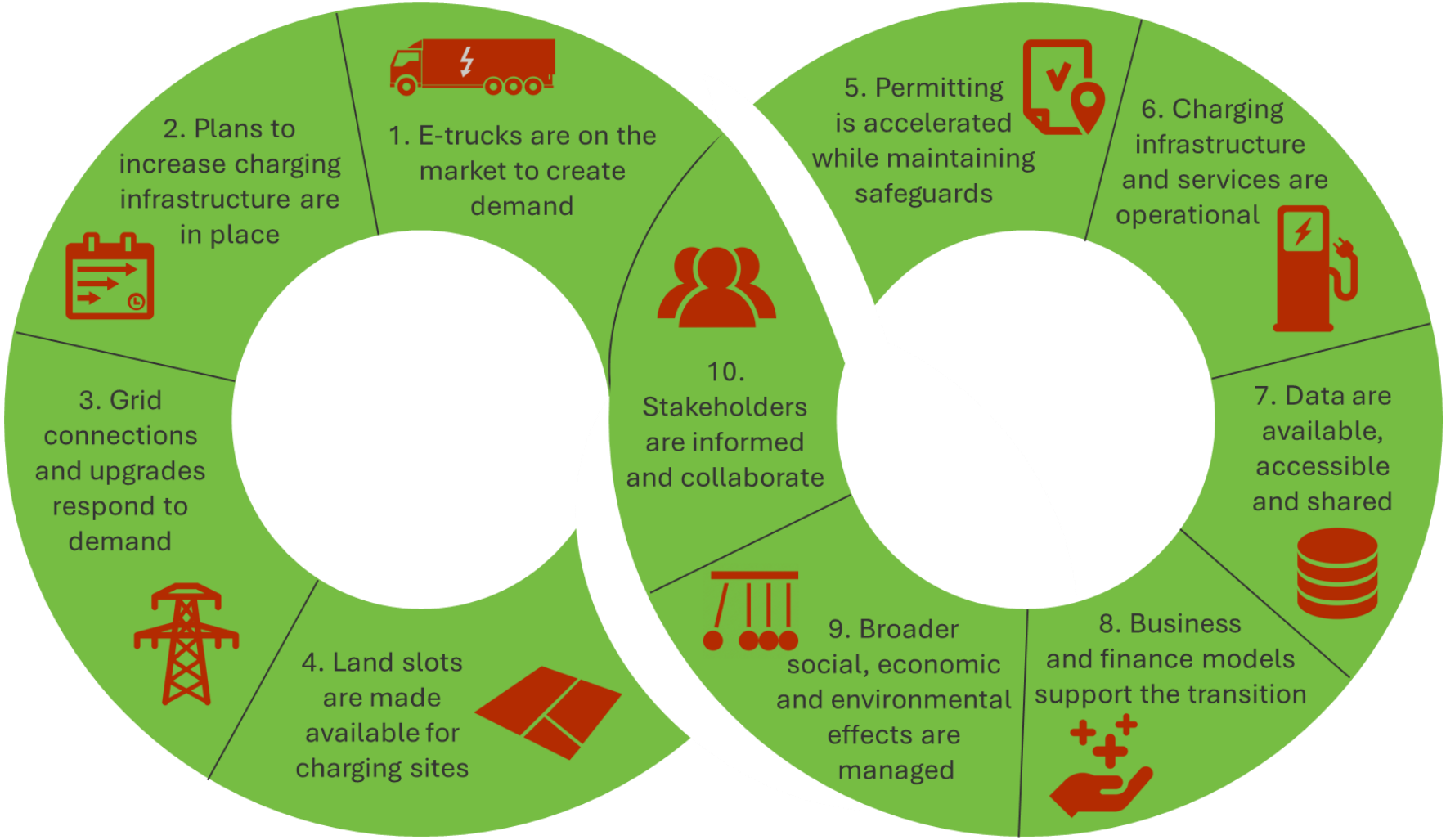

Figure 2. Ten success factors for e-trucks and charging

Stakeholders playing different roles

Different stakeholders play a role in e-trucks and charging but must collaborate. On the right, relationships for charging sites. See Annex A for definitions.

Figure 4. Stakeholders of e-trucks and charging

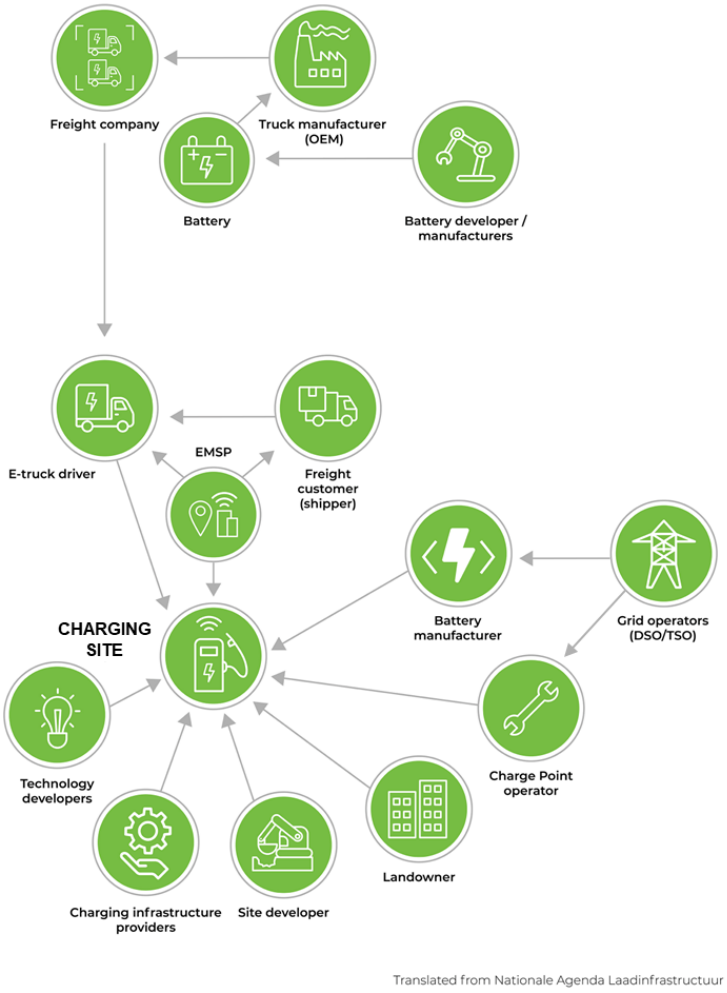

Figure 5. Stakeholders of charging sites[1]

[1] Nationale Agenda Laadinfrastructuur (NAL, 2022). Roadmap Logistieke Laadinfrastructuur. https://www.agendalaadinfrastructuur.nl/ondersteuning+gemeenten/documenten+en+links/bibliotheek+-+logistiek/default.aspx

3. Actionable Framework

This section presents an 'Actionable Framework' that connects the ten success factors for e-truck charging with the stakeholders needed for implementation. For each of the ten success factors three specific needs/actions are listed, who should take the lead, what other key stakeholders need to be involved. Annex C gives more detailed insights for each of the ten success factors: current situation, a checklist of possible action measures, and examples/sources of existing practices. These insights were based on interviews, workshop participation, and literature review and reflect views/perspectives from different stakeholders. This framework can be used to coordinate action at the EU level and to develop national action plans tailored to the specific situation and needs of different countries. It is acknowledged that it could also be used for other geographies like US, India, China and elsewhere.

TEN SUCCESS FACTORS AND SPECIFIC NEEDS/STEPS	LEAD	INVOLVED
Condition 1. E-trucks are on the market to create demand ranging from light to heavy duty trucks and covering different operations/ applications		
a) Supply of all e-truck types and batteries that match freight operations/applications	• Truck & equipment manufacturers	• Carriers, Freight forwarders, LSPs • NGOs, research
b) Education of freight companies and their customers to make an informed decision to demand and invest in e-trucks	• Freight companies & customers • Associations • NGOs	• Governments • Truck & equipment manufacturers • Research • Labour unions
c) Government policies that are consistent by encouraging e-trucks purchase and use while discouraging ICE trucks	• EU • National governments • Regional governments	• Truck & equipment manufacturers • Freight companies & customers • Industry associations • NGOs
Condition 2. Plans for charging infrastructure are in place in anticipation of the transition from ICE trucks to electric trucks		
a) National and local masterplans for e-truck charging public (in line with AFIR) and private infrastructure following a consistent structure/content across the EU and UK	• EU • National governments • Regional/Local govts	• All stakeholders
b) Monitoring and review of key elements of the charging infrastructure	• National governments	• Charging providers • Grid operators • Research
c) Alignment of plans for transport, energy and industry	• EU • National governments	• Industry associations • NGOs, research
Condition 3. Grid connections and upgrades respond to demand for charging infrastructure alongside other uses of electricity		
a) Faster, simplified and predicable procedures for grid connections/expansions covering application, installation and pricing	• National governments and regulatory authorities • Grid operators	• EU • Regional/local governments • Utilities / power producers • Charge Point Operators
b) Consideration of current and projected charging demand of trucks in grid upgrades, congestion management and future planning	• National governments • National regulatory authorities	• Regional governments • Utilities / power producers

TEN SUCCESS FACTORS AND SPECIFIC NEEDS/STEPS	LEAD	INVOLVED
	● EU	● Grid operators ● Truck manufacturers ● Industry associations ● Research
c) Integration of charging strategies and related pricing from the outset to maximise efficiency and minimize costs	● EU ● National governments and regulatory authorities ● Grid operators	● Charge Point Operators ● EMSPs ● Utilities / power producers ● Freight companies
Condition 4. Land slots are made available for charging sites that ensure adequate road network coverage		
a) Sufficient public charging sites in line with charging demand and AFIR requirements	● National governments ● Regional/Local govts	● Charge Point Operators ● Land owners & site developers
b) Increased availability of existing sites close to truck routes and/or transport hubs to integrate charging infrastructure in line charging demand and AFIR requirements	● EU ● National governments ● Regional/Local govts	● Charge Point Operators ● Land owners & site developers ● Freight companies
c) Tendering at government allocated slots and private premises is efficient and meets minimum requirements	● National governments ● Local governments	● Charge Point Operators ● Land owners & site developers
Condition 5. Permitting for public and private charging sites is accelerated, while maintaining environmental and social safeguards		
a) Coordinated and efficient permitting process covering zoning, assessments, consultation and issuance of permits	● Local governments	● National/Regional govts
b) Standardised / harmonised permitting approach for charging sites by municipalities	● National government	● Regional/Local governments ● Charge Point Operators ● NGOs, research
c) Coverage of all relevant issues or give exemptions from standard permit procedures	● Local governments	● National/Regional govts ● Charge Point Operators ● NGOs, research
Condition 6. Charging infrastructure and services are operational (physical and digital) for well-functioning charging sites		
a) Installation, operation and maintenance of key charging system components	● CPOs	● Charging infrastructure providers ● Technology developers ● Service providers ● Grid operators, Utilities / power producers
b) Customer access to affordable charging and associated services	● EMSPs	● Service providers ● CPOs (some act at EMSP)
c) Standardisation, harmonisation and integration/interoperability of essential steps for charging sites	● EU / national governments	● Truck and equipment manufacturers ● Charging providers ● Standard bodies
Condition 7. Data are available, accessible and shared to facilitate planning, construction and especially operation of charging sites and interoperability between market players		

TEN SUCCESS FACTORS AND SPECIFIC NEEDS/STEPS	LEAD	INVOLVED
a) Data for planning and construction of charging infrastructure and related grid connections	● EU ● National governments and regulatory authorities	● Truck manufacturers ● Grid operators ● Charge Point Operators ● Banks and investors ● Regional/local governments and regulatory authorities
b) Data for charging sites operation and services, e.g. truck movements, charging points availability and grid usage	● EU ● National governments and regulatory authorities	● Charge Point Operators, EMSPs ● Grid operators ● Truck manufacturers and suppliers ● Regional/local governments and regulatory authorities
c) Open digital infrastructure for data sharing and interoperability between market players	● EU ● National governments	● All stakeholders
Condition 8. Business and finance models support the transition to e-trucks and matching charging infrastructure and services		
a) Financial support for freight companies to purchase e-trucks and adapt their business models	● EU ● National governments	● Truck & equipment manufacturers ● Freight customers ● Funders and financiers
b) Support for Charge Point Operators to develop charging infrastructure and attract private capital	● EU ● National governments	● Truck and equipment manufacturers ● Funders and financiers
c) Change business models of truck and equipment manufacturers from selling trucks to selling services associated with e-trucks	● Truck manufacturers & suppliers	● Industry associations ● Funders and financiers
Condition 9. Broader social, economic and environmental effects are managed covering the entire value chain of e-trucks		
a) Just transition to address the social and economic effects of the switch to e-trucks	● EU / National governments ● Regional/local governments	● Trucks & equipment manufacturers ● Freight companies ● Industry associations, labour unions ● NGOs, research
b) Circular economy system for e-trucks, batteries and equipment	● EU / National governments ● Trucks manufacturers & suppliers	● NGOs, research ● Funders and financiers
c) Supply chain resilience to geopolitics, climate impacts and other disruptions	● EU / National governments ● Freight companies & customers ● Trucks manufacturers & suppliers	● Industry associations ● NGOs, research
Condition 10. Stakeholders are informed and collaborate with each other on different roles in e-trucks and charging infrastructure		
a) Key stakeholders understand their roles and are supported to execute these	● EU / National governments ● NGOs	● All stakeholders
b) National coordination bodies collaborate with key stakeholders to advance e-trucks and charging infrastructure in their countries	● National governments ● NGOs	● All stakeholders
c) EU network of national authorities/focal points and platform for collaboration and exchange	● EU / National governments ● NGOs	● All stakeholders

Annexes

A. Abbreviations and definitions

Abbreviations

AFIF	Alternative Fuels Infrastructure Facility
AFIR	Alternative Fuel Infrastructure Regulation
BEV	Battery electric vehicle
CaaS	Charging as a Service
capex	Capital expenditures
CCS	Combined Charging System
CPO	Charge Point Operator
DMD	Dynamic metering device
DSO / DNO	Distribution System Operator / Distribution Network Operator
EMP / EMSP	E-Mobility Provider / E-Mobility Service Provider
EMDS	European Mobility Data Space
EPBD	Energy Performance of Buildings Directive
ERS	Electric road system
ESS	Energy storage system
ETS	Emissions trading scheme
E-truck	Electric truck
EV	Electric vehicle
FCEV	Fuel cell electric vehicle
HDV	Heavy duty vehicle
HEV	Hybrid electric vehicle
ICE vehicle	Internal combustion engine vehicle
IRA	(US) Inflation Reduction Act
kW	Kilowatt
LSP	Logistics service provider
MCS	Megawatt Charging System
MW	Megawatt
NGO	Non-governmental organisation
NRA	National regulatory authority
opex	Operating expenditures
PHEV	Plug-in hybrid electric vehicle
RED	Renewable Energy Directive
SME	Small and Medium Enterprise
TaaS	Transport as a service
TEN-E	Trans-European Energy Network
TEN-T	Trans-European Transport Network
TCO	Total cost of operation
V2X, V2H, V2B, V2G	Vehicle-to-home, -building, or -grid

Definitions e-trucks, applications and charging

Scope definition		Description
E-truck technologies	Battery-electric (*focus of this study)*	Vehicle that gets energy exclusively from rechargeable battery packs, and does not have an internal combustion engine, fuel tank, or fuel cell
	Plug-in hybrid	Vehicle that uses electric batteries but automatically switches to the internal combustion engine when electric power is depleted, and can be plugged into regular EV charging stations
	Hybrid	Vehicle that uses both petrol/diesel and electric batteries that recharge via energy generated by the combustion engine or regenerative breaking, but cannot be plugged into regular EV charging stations
	Fuel-cell electric (Hydrogen)	Vehicle that uses a fuel cell to generate electricity, generally using oxygen from the air and compressed or liquified hydrogen, rather than drawing electricity from only a battery (sometimes FCEVs have a small battery)
Operations / Applications	Round-trip / last-mile	Trucks transport freight locally or as a round-trip and return to the home base to recharge
	Regional	Trucks transport freight from a home base to another premise where they can recharge, but may need interim/opportunity charging
	Long-distance	Trucks transport freight over long distances and need interim/opportunity charging and overnight charging
	Other*[2]	Other applications including construction, refuse, logging, oil & gas, moving, towing, agriculture
Charging locations[3]	Private – own premises	Charging at own depot or for on-site transport
	Private – other premises	Charging at loading or unloading site at customer's premise, or at shared site between companies or organisations
	Private – mobile	Charging at a time and location convenient to the user using mobile charging points, e.g. construction site vehicles
	Public – transhipment points	Charging at transhipment points such as ports, airports, or goods distribution centres
	Public – industrial estates	Charging at industrial estates that are public, such as supplier's yard, roadside, public parking area at freight forwarder's premise
	Public – highways	Charging at service stations, rest areas or other hubs on/near highways be during interim/driver or night/longer breaks, or dynamic charging via electric road systems
Charging systems	Combined charging system (CCS)	A charging connector used for DC fast charging of battery electric vehicles, which uses Combo 1 or Combo 2 connectors to provide power usually between 50 and 350 kW but even at up to 600 kilowatts (kW)
	Megawatt charging system (MCS)	A charging connector for large battery electric vehicles used by of medium- and heavy-duty vehicles to provide power at up to 3.75 megawatts, with initial units of 700/800 kW to about 1 megawatt (MW)
	Electric road system (ERS)	Dynamic charging via overhead power lines above the road or ground-level power supply (in-road dynamic wireless charging) through conductive rails or inductive coils embedded in the road
	Battery swapping	E-trucks exchange a discharged battery pack for a charged one as an alternative to a charging station
Charging strategies[4]	Smart charging	Automatic optimisation of a charging session to reduce peak energy demand, keeping the grid stable. minimise energy costs, and make the best use of renewable energy. Charging is optimised based on time, speed, and direction of charging. Smart charging strategies include[5] • Time-of-use without automated control • Basic controlled (on/off) • Unidirectional controlled (V1G) • Bidirectional controlled to vehicle (charging) and to grid (discharging, V2G) • Dynamic pricing with automated control

[2] Fuels Institute, US (April 2022). The Easiest and Hardest Commercial Vehicles to Decarbonize. https://www.fuelsinstitute.org/research/reports/decarbonizing-medium-and-heavy-duty-vehicles
[3] Nationale Leitstelle (2022). Charging scenarios for heavy-duty commercial vehicles – a graphic overview. https://nationale-leitstelle.de/en/downloads/
[4] van den Hoed, R., Maase, S., Helmus, J., Wolbertus, R., el Bouhassani, Y., Dam, J., Tamis, M., & Jablonska, B. (2019). Emobility: getting smart with data. Hogeschool van Amsterdam. https://research.hva.nl/en/publications/e-mobility-getting-smart-with-data
[5] International Renewable Energy Agency (IRENA, 2019). Electric vehicle smart charging – innovation landscape brief. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Sep/IRENA_EV_smart_charging_2019.pdf

Scope definition		Description
		Smart charging tariffs and services include:[6] • Dynamic time-of-use pricing which follow day-ahead wholesale energy market prices • Dynamic charging based on other real-time inputs e.g. carbon intensity of electricity grid or renewable energy available • Static time-of-use pricing with prices lower for charging outside of peak hours of power demand or network load • Balancing mechanism-based tariffs based on the need to balance energy and supply within a market zone • Price signals sent by the local operator of DSO
	V2X: Vehicle to grid (V2G), home (V2H), or building (V2B)	A technology that allows the battery of an electric vehicle to provide power to a home, building or back to the grid, which can help stabilise the grid or make better use o grid capacity. It allows for new charging sites to turn trucks and their batteries into energy storage systems that can return power to the grid when required.
	Battery storage / Energy storage systems (ESS)	On-site batteries charge from the grid at off-peak times, store the energy, and release it when demand is higher. Benefits: reduced electricity costs and demand charges and opportunities to make use of second-life batteries.

Definitions stakeholders

Type	Stakeholder	Description
Governments and regulatory authorities	Inter-governmental organisations	Organisations composed primarily of sovereign states, or of other intergovernmental organisations. IGOs are established by treaty or other agreement that acts as a charter creating the group. Examples include the United Nations, the World Bank, World Trade Organization, International Transport Forum, or the European Union.
	EU	Agencies assisting EU institutions and member states and provide forums for cooperation between regulators and stakeholders
	National	Government ministries, departments, agencies or regulatory authorities responsible for the oversight and administration of specific functions, e.g. energy, transport
	Regional	Authorities responsible for all the public administration, services and facilities of provinces, federal states or regions
	Local	Authorities responsible for all the public administration, services and facilities of towns, cities, counties and districts
	Other	Other government or related bodies such as water boards or government-backed platforms
Truck manufacturers & suppliers	Original equipment manufacturers (OEM)	Manufacturers of trucks (and other vehicles) and their engines, components and other equipment, including batteries
	Suppliers	Suppliers of components and equipment to OEMs or end-users
Freight companies & customers	Carriers / hauliers	A company or truck-owner specialized in transporting 'shipping' goods or products from one location to another
	Shippers	An organisation or company who owns the goods or products that are transported from one location to another
	Freight forwarders	Company that serves as intermediary between carriers and shippers to transport goods or products from one location to another
	Logistics service providers (LSP)	Company that manage on behalf of shippers all aspects of logistics – handling, storage, transportation of goods or products – across a shippers supply chain
Charging providers	Charge Point Operators (CPO)	Entities that builds EV charging systems, installs EV charging stations, and maintains them
	E-Mobility Service Providers (EMSP)	Companies offering an EV charging service to EV drivers by providing access to multiple charging points around a geographic area
	Charging infrastructure providers	Companies providing the physical and/or digital equipment for charging sites
	Technology developers	Companies or other organisations that develop charging and supporting technologies used at charging sites and by users

[6] Hildermeier J, Burger J, Jahn A, Rosenow J (2023)/ A Review of Tariffs and Services for Smart Charging of Electric Vehicles in Europe. In: Energies 2023, 16(1) 88 https://www.mdpi.com/1996-1073/16/1/88

Type	Stakeholder	Description
Energy suppliers & grid operators	Utilities / power producers	Entities that are public (utilities) or private/independent and develop, own, and operate power plants or local sites to generate electricity that meets consumer and industrial demand. Some utilities/power producers help with sourcing of battery systems.
	Energy companies	Companies that provide the energy for utilities/power producers to generate electricity, sourced from fossil fuels, nuclear and/or renewable sources
	Distribution System Operators (DSO)	Entities responsible for grid stability and for connecting small electricity generators and consumers to the distribution networks of the electricity system. This role can be fulfilled by utilities or other organisations.[7]
	Transmission Systems Operators (TSO)	Entities responsible for grid stability and for connecting distribution grids to transmission grids that transport electricity nationally and across borders
Land owners & site developers	Highway stops	Owners/operators of truck parking spaces or toll highway stops
	Transhipment points	Public or private companies in charge of ports, airports, distribution centres and other transhipment points
	Industrial parks	Public or private companies in charge of industrial estates that are public, such as supplier's yard, public parking area at freight forwarder's premise
	Companies	Companies with sites that could be suitable for charging infrastructure, such as LSPs, trailer leasing companies, retailers, utilities/renewable energy development companies
Associations & service providers	Industry associations	Member-based organisations founded and funded by businesses that operate in a specific industry for the protection and advancement of their common interests. Key associations include automotive, road transport, freight forwarders, DSOs/TSOs.
	Service providers	Service providers include consultancies, audit firms, insurers, other
Civil society	Non-governmental organisations (NGO)	Not-for-profit organisations with a social mission, independent from government or business, which can also be the host of platforms or initiatives
	Research	Research institutes and universities
	Standard bodies	The International Organization for Standardization (ISO) is an international standard development organisation composed of representatives from the national standards organisations of member countries.
	Labour unions	Organisations that represent the collective interests of workers
	Local communities	Persons or groups of persons living and/or working in in a given local geographical area (e.g. town, village or neighbourhood) that are economically, socially or environmentally impacted (positively or negatively) by e-trucks and related infrastructure (e.g. roads/parking, charging, power/grid)
Funders and financiers	Foundations	Public charities and private/corporate foundations that support charitable activities by making grants or through direct involvement
	Development agencies	Organisations that assist in cooperation, development, finance or other are of development, and including development banks, UN and other international/national agencies
	Banks	Central banks, commercial banks, investment banks
	Other	Insurers, asset holding companies, other

[7] Black & Veath (2020). Distribution System Operator (DSO) Models for Utility Stakeholders. https://webassets.bv.com/2020-02/20%20Distribution%20System%20Operator%20Models%20for%20Utility%20Stakeholders%20WEB%20updated%20022720.pdf

B. EU Plans, policies and regulations

Several EU plans, policies and regulations are relevant to e-trucks and charging infrastructure as shown below and described in the table on the next pages. National plans and policies are also relevant but not included in this overview.

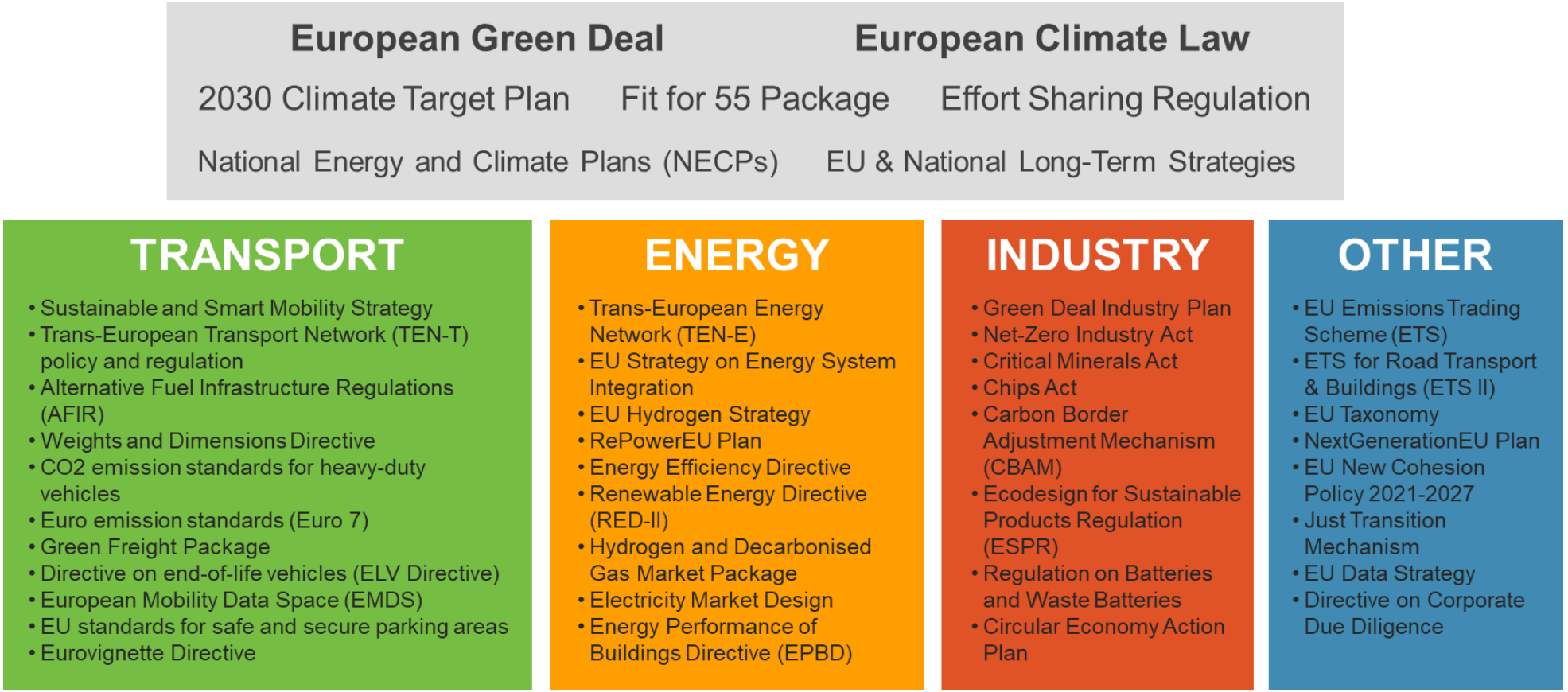

Figure 6. Key EU plans, policies and regulations relevant to e-trucks and charging

Level	Title	Description
EU and climate	European Green Deal[8]	Blueprint of policy proposals adopted in 2019 to make the EU a climate-neutral continent by 2050, underpinned by eight policy areas: climate protection, clean energy, elimination of environmental pollution, sustainable industry, buildings and renovations, sustainable mobility, biodiversity, and sustainable agriculture.
	European Climate Law[9]	Adopted in 2021 to enshrine into law the objectives of carbon neutrality by 2050 and reducing GHGs by at least 55% from 1990 by 2030
	2030 Climate Target Plan[10]	Plan adopted in 2021 to raise the EU's ambition on reducing GHG emissions to at least 55% below 1990 levels by 2030 (previously 40%)
	Fit for 55 package[11]	A package of legislative proposals to deliver the EU 55% GHG reduction target by 2030 in real terms, which includes 13 proposals and covers all sectors of the EU's economy, including for transport
	Effort Sharing Regulation[12]	Regulations, updated in 2023, that establishes for each EU Member State a national GHG reduction target 2030 from 2005 covering almost 60% of EU emissions in the following sectors: domestic transport (excl. aviation), buildings, agriculture, small industry and waste
	Regulation on the governance of the energy union and climate action[13]	Regulation as part of the Clean energy for all Europeans package of 2018 that requires all EU Member states to have 10-year national energy and climate plans until 2030 (NECPs), 30-year EU and national Long-Term Strategies, as well as integrated reporting, monitoring and data publication
Transport	Sustainable and Smart Mobility Strategy[14]	EU strategy released in 2021 on how to transform the transport sector and align it with the European Green Deal, by making it green, digital and resilient. This includes CO_2 emission standards for trucks, Euro 7 emission limited for light and heavy duty vehicles, AFIR, measures to stimulate the demand for zero emission vehicles (carbon pricing, taxation, road charging, changes to the rules on weights and dimensions, vehicles in corporate and urban fleets), and data sharing.
	Trans-European Transport Network (TEN-T) policy and regulation[15]	The EU's network in development of roads, railways, airports and water infrastructure, divided up in the Comprehensive network and the Core network with 9 Core network corridors. Other relevant TENs are the TEN-E for energy and eTEN for telecommunications network. The TEN-T regulation is being revised to align with the European Green Deal and the Sustainable and Smart Mobility Strategy.
	Alternative Fuel Infrastructure Regulation (AFIR)[16,17] and Alternative Fuel Infrastructure Facility (AFIF)[18]	Proposed EU legislation (part of Fit for 55) to provide enough recharging infrastructure and alternative fuel refuelling points for vehicles, planes and ships, and ensure interoperability and ease of use of the infrastructure. AFIR was agreed between the EU Parliament and EU Council in March 2023, replaces the Alternative Fuels Infrastructure Directive (AFID), and will be transposed into national legislation in 2024. AFIR also provides the basis for further national and local masterplans. Truck charging infrastructure targets for the TEN-T (with flexibility for low-traffic roads and a specific review clause to be confirmed in 2026):[19] o Charging pools coverage on TEN-T network: 15% by 2025, minimum 50% by 2027 and 100% by 2030 o Maximum distance between charging pools: 60 km in TEN-T Core network, 120 km in TEN-T Comprehensive network o Minimum kW requirements set for charging pools along TEN-T core network, safe and secure parking areas, and urban nodes AFIF is the corresponding funding mechanism with €1.5 billion in EU grants by end 2023 for infrastructure on the TEN-T road network.

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[9] European Commission (website accessed July 2023). European Climate Law. https://climate.ec.europa.eu/eu-action/european-green-deal/european-climate-law_en
[10] European Commission (website accessed July 2023). 2030 Climate Plan. https://climate.ec.europa.eu/eu-action/european-green-deal/2030-climate-target-plan_en#delivering-the-2030-climate-target-plan
[11] European Commission (website accessed July 2023). Fit for 55: Delivering on the proposals https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal/fit-55-delivering-proposals_en
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[16] Council of the EU. Infographic - Fit for 55: towards more sustainable transport. https://www.consilium.europa.eu/en/infographics/fit-for-55-afir-alternative-fuels-infrastructure-regulation/
[17] Think Tank European Parliament (2023). Briefing: Deployment of alternative fuels infrastructure: Fit for 55 package. https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2021)698795
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Level	Title	Description
	Weights and Dimensions Directive[20]	Rules on maximum authorised dimensions of heavy duty vehicles (HDVs) used in national and international commercial transport and the maximum authorised weights of HDVs used in international commercial transport. Amendments were made to improve energy and operational efficiency through the use of alternatively fuelled powertrains, improve vehicles' aerodynamics, support trials of modular systems (longer and/or heavier vehicle combinations) and incentivise intermodal transport operations. An additional two tonnes is allowed for zero emission heavy duty trucks to account for the additional weight of batteries/fuel cells (introduced through am amendment of this directive as part of the CO_2 emission standards)
	CO_2 emission standards for heavy-duty vehicles[21,22]	EU proposed revision of the Regulation on CO_2 emission standards for heavy-duty vehicles increases emission reduction targets for new trucks to 45% in 2030, 65% in 2035 and 90% in 2040. An explicit aim is to "Increase the share of zero and low-emission vehicles in the market and accelerate the roll-out of recharging and refuelling infrastructure." It includes a credit system that allows OEMs to adjust average CO_2 emissions downwards if the share of zero/low emission trucks exceeds 2% of new trucks manufactured.
	Euro emission standards (Euro 7)[23,24]	New standards to reduce air pollution from new motor vehicles (cars, vans, buses and trucks) sold in the EU to meet the European Green Deal's zero-pollution ambition, covering emissions from tailpipes, brakes and tyres.
	Greening Freight Transport package[25]	Package of proposals under the Sustainable and Smart Mobility Strategy in support of the 90% GHG reduction target 2050, focused on rail infrastructure management, stronger incentives for low-emission lorries, and better information on freight transport GHG emissions.
	Directive on end-of-life vehicles (ELV Directive)[26]	EU proposed rules to make the automotive sector circular, to maximise the efficient use of resources and to protect the environment, covering cover the entire cycle from design and production to end-of-life treatment. It does not cover medium and heavy-duty trucks.
	European Mobility Data Space (EMDS)[27]	The common European mobility data space (EMDS) aims to facilitate data access, pooling and sharing for more efficient, safe, sustainable and resilient transport. A Communication will describe main features, supporting measures, objectives and milestones for the common European mobility data space, as well as a governance system (linked to EU Data Strategy).
	EU standards for safe and secure parking areas[28]	EU standards and procedures to support the development of a network of safe and secure parking areas throughout the EU every 100 km. AFIR supplements this by requiring that each of these parking areas must be equipped with at least 4 charging points by 2030.
	Eurovignette Directive[29]	Directive on the charging of heavy goods vehicles for the use of certain infrastructure, which moves away from a time-based model of charging (vignettes) to a distance-based one (tolls). The aim is to better reflects the polluter-pays and user-pays principles by making it cheaper for energy efficient vehicles to drive across the EU, which will help to reduce the TCO of e-trucks. EU member states have until March 2024 to introduce road tolls based on CO_2 emissions, with at least 50% discounts for battery electric or hydrogen trucks.

[20] European Commission (website accessed June 2023). Weights and dimensions. https://transport.ec.europa.eu/transport-modes/road/weights-and-dimensions_en
[21] European Commission (March 2023). Reducing CO_2 emissions from heavy-duty vehicles. https://climate.ec.europa.eu/eu-action/transport-emissions/road-transport-reducing-co2-emissions-vehicles/reducing-co2-emissions-heavy-duty-vehicles_en
[22] ICCT (2023). Europe's new heavy-duty CO2 standards, explained. https://theicct.org/eu-co2-hdv-standards-explained-feb23/
[23] European Commission (2022). Commission proposes new Euro 7 standards to reduce pollutant emissions from vehicles and improve air quality https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6495
[24] Euractiv (2023). EU Council adopts watered-down Euro 7 position despite German objection. https://www.euractiv.com/section/road-transport/news/eu-council-adopts-watered-down-euro-7-position-despite-german-objections/
[25] European Commission (2023). Green Deal: Greening freight for more economic gain with less environmental impact. https://transport.ec.europa.eu/news-events/news/green-deal-greening-freight-more-economic-gain-less-environmental-impact-2023-07-11_en
[26] European Commissions (2023). End-of-life vehicles. https://environment.ec.europa.eu/topics/waste-and-recycling/end-life-vehicles_en
[27] European Commission (2022). Share your views on a common European mobility data space. https://transport.ec.europa.eu/media-corner/news/share-your-views-common-european-mobility-data-space-2022-11-14_en
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[29] Think Tank European Parliament (2022). Revision of the Eurovignette Directive – briefing. https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2017)614625

Level	Title	Description
Energy	Trans-European Networks for Energy (TEN-E) policy and regulation[30]	A policy that is focused on linking the energy infrastructure of EU countries aiming to integrate renewable energy, complete the European energy market and allow consumers to better regulate their energy consumption. The policy identifies eleven priority corridors and three priority thematic areas: smart electricity grids deployment[31], smart gas grids, and a cross-border carbon dioxide network. The revised TEN-E regulation laying down new EU rules for cross-border energy infrastructure entered into force in June 2023.
	EU Strategy on Energy System Integration[32]	Strategy adopted in 2020 to optimise and modernise the EU energy system by linking the various energy carriers (electricity, heat, cold, gas, solid and liquid fuels) with each other and with the end-use sectors (e.g. buildings, transport, industry). It involves various existing and emerging technologies, processes and business models, such as ICT and digitalisation, smart grids and meters and flexibility markets. Specifically, the Action Plan on the digitalisation of the energy sector[33] is relevant to grid upgrades.
	EU Hydrogen Strategy[34]	Strategy adopted in 2020 with suggested policy action points in 5 areas: investment support; support production and demand; creating a hydrogen market and infrastructure; research and cooperation and international cooperation
	REPowerEU Plan[35]	Plan launched in May 2022, in response to the global energy market disruption caused by Russia's invasion of Ukraine, to help the EU save energy, produce clean energy, and diversify its energy supplies.
	Energy Efficiency Directive[36]	Rules and obligations for achieving the EU's ambitious energy efficiency targets. The updated Directive of July 2023 established 'energy efficiency first' as a fundamental principle of EU energy policy and its role in practical policy applications and investment decision-making.
	Renewable Energy Directive (RED-II)[37]	Proposed revision of the RED-II as part of the Fit for 55 package that sets a new EU target of a minimum 40% share of renewable energy sources in final energy consumption by 2030 (under REPowerEU this was increased to 45%), accompanied by new sectoral targets. It includes a provision for member states to ensure all future private charge points are capable of smart charging.
	Hydrogen and Decarbonised Gas Market package[38]	Policy measures and revision (proposed in March 2023) of the Gas Directive 2009/73/EC and Gas Regulation (EC) No 715/2009, which aims to decarbonise gas consumption, and create optimum and dedicated infrastructure, as well as efficient markets.
	Electricity Market Design[39,40]	Provides common rules and regulations for the internal market for generation, transmission, distribution, energy storage and supply of electricity. Revisions were proposed in March 2023 to better protect consumers, accelerate renewables and energy storage in the energy system, but also enhance protection against market manipulation stability and predictability of the cost of energy and thereby contribute to the competitiveness of the EU industry. Key are the Electricity Directive and Electricity Regulation that set common rules of the internal market for electricity, and the Wholesale Energy Market Integrity and Transparency (REMIT) Regulation to avoid market abuse.
	Energy Performance of Buildings Directive (EPBD)[41]	Proposed revisions to existing EU legislation (part of Fit for 55) that covers buildings, and includes private charging infrastructure for electric vehicles, including trucks. The revised EPBD is currently in trialogue negotiations (between European Commission, Parliament and Council) with them aim to be a final agreement by the end of 2023.

[30] European Commission (website accessed July 2023). Transport European Networks for Energy (TEN-E) https://energy.ec.europa.eu/topics/infrastructure/trans-european-networks-energy_en
[31] European Commission (website accessed July 2023). Smart grids and meters. https://energy.ec.europa.eu/topics/markets-and-consumers/smart-grids-and-meters_en
[32] European Commission (website accessed July 2023). EU strategy on energy system integration. https://energy.ec.europa.eu/topics/energy-systems-integration/eu-strategy-energy-system-integration_en
[33] European Commission (2021). Action plan on the digitalisation of the energy sector – roadmap launched. https://commission.europa.eu/news/action-plan-digitalisation-energy-sector-roadmap-launched-2021-07-27_en
[34] European Commission (website accessed July 2023). Hydrogen. https://energy.ec.europa.eu/topics/energy-systems-integration/hydrogen_en
[35] European Commission (website accessed July 2023). REPowerEU. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en
[36] European Commission (website accessed July 2023). Energy Efficiency Directive. https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en
[37] Think Tank European Parliament (2022). Briefing on Revision of the Renewable Energy Directive: Fit for 55 package. https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2021)698781
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[39] European Commission (2023). Electricity Market Design. https://energy.ec.europa.eu/topics/markets-and-consumers/market-legislation/electricity-market-design_en
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Level	Title	Description
Industry	Green Deal Industry Plan[42]	Plan to improve the competitiveness of EU's net-zero industry and accelerate the transition by scaling manufacturing capacity for technologies and products. Four pillars are the regulatory environment, funding, skills development, and open trade for supply chains.
	Net-Zero Industry Act[43]	An Act that stems from the Green Deal Industry Plan to attract investments, create better success factors and market access, and simplify the regulatory framework for clean tech in the EU. The aim is to reach net-zero technologies manufacturing capacity of at least 40% of annual deployment needs by 2030. It covers eight technologies including electrolysers/fuel cells, batteries and storage, and grid technologies that are relevant for freight electrification.
	Critical Raw Materials Act[44]	Proposed regulation in March 2023 to ensure the EU's access to a secure, diversified, affordable and sustainable supply of critical raw materials. The Regulation embeds the Critical Raw Materials List[45] (last updated in 2020) in EU law.
	EU Chips Act[46]	Regulation to double the EU's global market share in semiconductors of 10% to at least 20% by 2030 by strengthening the European semiconductor industry, attract investment (€43 billion in public and private investment with €3.3 billion from the EU budget), promote research and innovation, and prepare Europe for any future chip supply crisis.
	Carbon Border Adjustment Mechanism (CBAM)[47]	Tool to put a fair price on the carbon emitted during the production of carbon intensive goods entering the EU, and to encourage cleaner industrial production in non-EU countries. It will initially cover cement, iron/steel, aluminium, fertiliser, hydrogen, electricity.
	Eco-design for Sustainable Products Regulation (ESPR)[48]	Proposed regulation of March 2022 that establishes a framework to set eco-design requirements for specific product groups to significantly improve their circularity, energy performance and other environmental sustainability aspects. It will enable the setting of performance and information requirements for almost all categories of physical goods placed on the EU market.
	Regulation on Batteries and Waste Batteries ("Batteries Regulation")[49]	Regulation adopted in July 2023 that strengthens sustainability rules for batteries and waste batteries, covering the entire life cycle of batteries – from production to reuse and recycling – and ensure that they are safe, sustainable and competitive.
	Circular Economy Action Plan[50]	An action plan adopted in 2020 as part of the EU Green Deal with legislative and non-legislative measures along the entire life cycle of products. It targets how products are designed, promotes circular economy processes, encourages sustainable consumption, and aims to ensure that waste is prevented and the resources used are kept in the EU economy for as long as possible.

[42] European Commission (website accessed July 2023). The Green Deal Industry Plan. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/green-deal-industrial-plan_en
[43] European Commission (website accessed July 2023). The Net-Zero Industry Act. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/green-deal-industrial-plan/net-zero-industry-act_en
[44] European Commission (2023). Critical Raw Materials: ensuring secure and sustainable supply chains for EU's green and digital future. https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1661
[45] European Commission (website accessed July 2023). Critical Raw Materials. https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en
[46] European Council ((2023). Chips Act: Council gives its final approval. https://www.consilium.europa.eu/en/press/press-releases/2023/07/25/chips-act-council-gives-its-final-approval/
[47] European Commission (website accessed July 2023). Carbon Border Adjustment Mechanism. https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en
[48] https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/sustainable-products/ecodesign-sustainable-products-regulation_en
[49] European Council (2023). Council adopts new regulation on batteries and waste batteries. https://www.consilium.europa.eu/en/press/press-releases/2023/07/10/council-adopts-new-regulation-on-batteries-and-waste-batteries/
[50] European Commission (website accessed Aug 2023). Circular economy action plan. https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

Level	Title	Description
Other	EU Emissions Trading Scheme (ETS) and ETS II[51]	A carbon market introduced in 2005 that is based on a system of cap-and-trade of emission allowances for energy-intensive industries and the power generation sector. As part of Fit for 55, the existing ETS was reformed and a new ETS was introduced for building and road transport fuels (ETS- II), which will come into effect in 2027.[52]
	EU Taxonomy[53]	Green classification system that translates the EU's six climate and environmental objectives into criteria for specific economic activities for investment purposes. At the basis are four overarching success factors of the 2020 Taxonomy Regulation (substantial contribution to at least one environmental objective, no significant harm to other environmental objectives, minimum social safeguards, technical screening criteria). Lists of environmentally sustainable activities are created through Delegated Acts that define Technical Screening Criteria. The Climate Delegated Act and Environmental Delegated Act are most relevant to transport,[54] while the Complementary Delegated Act (CDA) controversially classifies certain uses of gas as environmentally 'sustainable'.[55] Under the Corporate Sustainability Reporting Directive (CSRD) companies must report to what extent activities are covered by the EU Taxonomy and comply with the criteria of delegated acts.
	NextGenerationEU[56]	EU's €800 billion temporary recovery instrument to support the economic recovery from the coronavirus pandemic and build a greener, more digital and more resilient future. The Recovery and Resilience Facility of €723.8 billion in the form of grants and loans to member states, and includes 'Recharge and Refuel' or sustainable transport and charging stations. In addition, €54 billion will go to Horizon Europe, the EU's research and innovation programme (2021-2027, 35% of Horizon Europe is allocated towards climate change).
	EU New Cohesion Policy 2021-2027[57]	Support policy to strengthen economic, social and territorial cohesion, correct imbalances between countries and regions and deliver on EU political priorities, especially the green and digital transition. One of the five policy objectives is a greener, low carbon transitioning towards a net-zero carbon economy. It also includes weighted climate and environmental contribution of investments, minimum targets for funds, and climate adjustment mechanism. Related is the EU Regional Cluster Development and Collaboration policy[58] to link port planning and inter-regional coordination regarding corridors, and the Just Transition Mechanism (see next).
	Just Transition Mechanism[59]	Mechanism to address social and economic effects of the transition by mobilising €55 billion in 2021-2027 for most affected EU regions.
	EU Data Strategy[60]	Strategy for a new European way of data governance to facilitate data sharing across sectors and Member states.
	Directive on Corporate Sustainability Due Diligence[61]	Directive to foster sustainable and responsible corporate behaviour and to anchor human rights and environmental considerations in companies' operations and corporate governance, including in their value chains inside and outside Europe.

[51] European Commission. EU Emissions Trading Scheme (EU ETS). https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en
[52] European Council (2022, updated February 2023). 'Fit for 55': Council and Parliament reach provisional deal on EU emissions trading system and the Social Climate Fund https://www.consilium.europa.eu/en/press/press-releases/2022/12/18/fit-for-55-council-and-parliament-reach-provisional-deal-on-eu-emissions-trading-system-and-the-social-climate-fund/
[53] European Commission (website accessed July 2023). EU Taxonomy Navigator. https://ec.europa.eu/sustainable-finance-taxonomy/home
[54] European Commission (2023). Sustainable finance – investing in a sustainable future. https://finance.ec.europa.eu/system/files/2023-06/230613-sustainable-finance-factsheet_en_0.pdf
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[56] European Commission (website accessed July 2023). NextGenerationEU. https://commission.europa.eu/strategy-and-policy/eu-budget/eu-borrower-investor-relations/nextgenerationeu_en
[57] European Commission (website accessed July 2023). New Cohesion Policy. https://ec.europa.eu/regional_policy/2021-2027_en
[58] European Cluster Collaboration Platform (website accessed July 2023). Smart Regions. https://clustercollaboration.eu/tags/smart-regions
[59] European Commission (website accessed July 2023). The Just Transition Mechanism: making sure no one is left behind. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism_en and Just Transition Fund https://www.europarl.europa.eu/factsheets/en/sheet/214/just-transition-fund-jtf-
[60] European Commission (2019). European Data Strategy. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy_en
[61] European Commission (website accessed Jul 2023). Corporate sustainability due diligence. https://commission.europa.eu/business-economy-euro/doing-business-eu/corporate-sustainability-due-diligence_en

C. Insights on the success factors to advance e-truck charging and possible action measures

This annex goes deeper into the ten success factors, describing for each a) specific needs; b) current status; c) possible action measures address bottlenecks, which can be used as a checklist to choose from; and d) examples of existing practices and information sources. It is noted that insights are based on interviews and literature and as much as possible supported by evidence from published sources, which are referenced in footnotes.

1. Electric trucks are on the market to create demand ranging from light to heavy duty trucks and covering different operations/applications
2. Plans are in place to increase charging infrastructure in anticipation of the transition from internal combustion engine (ICE) trucks to e-trucks
3. Grid connections and upgrades respond to electricity demand for charging infrastructure alongside other uses of electricity
4. Land slots are made available for charging sites that ensure adequate road network coverage
5. Permitting for public and private charging sites is accelerated, while maintaining environmental and social safeguards
6. Charging infrastructure and services (physical and digital) are operational for well functioning charging sites
7. Data are available, accessible and shared to facilitate planning, construction and operation of charging sites and ensuring interoperability between market players
8. Business and finance models support the transition to e-trucks and matching charging infrastructure and services
9. Broader social, economic and environmental effects are managed covering the entire value chain of e-trucks
10. Stakeholders with different roles in e-truck charging are informed and collaborate with each other

Condition 1: Electric trucks are on the market to create demand

CONDITION 1: Electric trucks are on the market to create demand ranging from light to heavy duty trucks and covering different operations/applications	
Needs	a) Supply of all e-truck types and batteries that match freight operations/applications (e.g. distance before recharging, payloads, mountains) b) Education of freight companies and their customers to make an informed decision to demand and invest in e-trucks c) Government policies that are consistent by encouraging e-trucks purchase and use while discouraging ICE trucks
Current situation	● Supply of e-trucks o E-trucks are on the market and create demand ▪ Models are on the market for all truck types and applications. In Europe there are at least 27 models of battery-electric heavy-duty trucks by 17 truck manufacturers with a range of up to 350 km, and some models reach over 500 km.[62] ▪ The IEA in its updated version of the Net-zero Emissions by 2050 (NZE) Scenario predicts that 37% of heavy duty trucks sales in 2030 worldwide will be plug-in hybrid, battery and fuel cell electric vehicles.[63] ▪ According to given information of truck manufacturers, around 75% of new registrations of heavy-duty vehicles in Germany and around 60% in Europe will be emission-free by 2030.[67] ▪ Demand for e-trucks varies between models and countries, with lower demand in Eastern Europe with fewer subsidy schemes and e-trucks being 2-4 times the price of ICE trucks. o Despite models being available, the production volume is currently too low to meet demand, especially for medium and heavy duty trucks, with waiting times of more than a year. ▪ As a result, freight companies may put off new purchases or continue to invest in diesel trucks. ▪ At the same time, some European OEMs have clearly mobilised to scale up domestic production, following policy signals in support of zero-emission trucks and the realisation that the future market growth lies in zero-emission trucks. It is acknowledged that truck manufacturers' commitments for e-truck sales needs to be met with investments in manufacturing. ▪ Large-scale battery and e-truck production in Europe may be hampered by access to and rising costs of raw materials and investments, amplified by the Inflation Reduction Act[64] in the US (drawing investments and manufacturing plants to US) and dependency on China for materials and batteries. See also condition 9, supply chain resilience. o Several truck manufacturers make parallel investments in other truck technologies and charging systems. "The market has a say but it clearly is also a political decision on which type of trucks to promote as the commercial stakes are high." ▪ A global ranking of truck brands' readiness to transition to zero-emission sales finds a mixed picture with some European brands leading and others lagging compared to US and Chinese counterparts, which can be linked to their commitments to zero-emission trucks manufacturing.[88] ▪ Further investments in improvements of ICE trucks are linked to the proposed Euro 7 standards.[23] ▪ PHEVs are considered a transition technology especially for truck applications where BEVs currently face challenges. ▪ The uptake of hydrogen fuel cell e-trucks is far behind that of battery electric trucks, and their share is estimated at only 0.02% to maximum 10% of total European truck sales, thus requiring less hydrogen infrastructure.[65,66] Manufacturers that only focus on battery-electric trucks

[62] CALSTART (website accessed May 2023). Zero-Emission Technology Inventory (ZETI) Data Explorer. https://globaldrivetozero.org/tools/zeti-data-explorer/
[63] International Energy Agency (IEA, 2023). Road Transport Net-zero Emissions Guide. In: Net-zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach. https://www.iea.org/reports/road-transport
[64] McKinsey (2022). The Inflation Reduction Act: Here's what's in it. https://www.mckinsey.com/industries/public-sector/our-insights/the-inflation-reduction-act-heres-whats-in-it
[65] TNO (2022). Techno-economic uptake potential of zero-emission trucks in Europe. https://www.tno.nl/publish/pages/3655/tno_2022_r11862_techno-economic_uptake_potential_of_zero-emission_trucks_in_europe.pdf
[66] International Transport Forum (2022). Decarbonising Europe's Trucks How to Minimise Cost Uncertainty. https://www.itf-oecd.org/sites/default/files/docs/decarbonising-europes-trucks-minimise-cost-uncertainty.pdf

CONDITION 1: Electric trucks are on the market to create demand ranging from light to heavy duty trucks and covering different operations/applications	
	mentioned in German "cleanroom talks" with industry that the low operating costs of battery trucks lead to a better TCO than those of hydrogen and fuel cells, and that cost parity with ICE trucks will happen relatively soon. Forecast N3 heavy truck sales in Germany in 2030 is 57% battery, 26% diesel and 17% hydrogen fuel cell.[67] Studies by consulting firms McKinsey for the US[68] and BCG for South Africa[69], however, put FCEV in the lead for heavy duty trucks. Some interviewees commented that hydrogen shortfalls from a climate perspective are insufficiently considered, especially hydrogen leaks with a global warming potential 11 times higher than CO_2, and life cycle emissions for hydrogen that are three times higher than direct truck electrification. It is noted that none of the interviewees believed that FCEV will prevail even for heavy duty trucks, with a few exceptions such as heavy timber. ▪ Autonomous trucks can be combined with e-trucks developments, and could become more important as driver shortages worsen. Autonomous trucks can reduce 60% of operating costs (drivers, automated fuel systems, lower insurance premiums, higher truck utilization) and downtime for charging is less of an issue because there are no additional costs for the driver waiting. However, lower costs could lead to rebound effects through induced additional travel that partially offsets the fuel and emission savings of energy efficiency. ▪ The models of e-trucks are also affected by the type of charging. Battery swapping, overhead catenary charging or electric road systems (ERS), and in-road wireless charging could reduce charging downtime and reduce upfront truck costs by enabling reduced battery sizes. However, political and business challenges impact the deployment of these technologies.[70] There are also concerns about market readiness of battery swapping and ERS on public premises. ● Education of freight companies and their customers o The notion persist of the impossibility of heavy-duty e-trucks due to battery weight, lack of models, overpricing of early models, or other reasons. o Freight companies make decisions to switch based on their operations/applications, and truck manufacturers don't always factor this in. o Most freight companies buy trucks and continue to prefer buying their own trucks, although the percentage of companies switching to truck leasing is increasing with greater education. o Some truck manufacturers provide training on electric trucks to their customers. o The perspective of drivers is overlooked, whereas many parts of the world face truck driver shortages. One factor is driving an e-truck compared to an ICE truck: differences in range depending on driving conditions, driving in heavy traffic, charging.[71] Another factor is impact on not only public health but also driver health from lower in-cabin air pollution and reduced noise.[72] o Several truck manufacturers and suppliers, freight companies, grid operators and CPOs are also endorsers of the Global agreement on Zero Emission Trucks and Buses signed by 27 countries/regions (as of June 2023) to enable 100% zero-emission new truck and bus sales by 2040 with an interim goal of 30% sales by 2030.[73] o Freight companies and customers (shippers) send market demand signals to truck manufacturers and governments to accelerate the market scale-up worldwide of EVs that include trucks through initiatives, many of which are united through the Drive Electric Campaign[74], e.g.

[67] Germany NOW (2022). Marktentwicklung Klimafreundlicher Technologien im Schweren Strassengüterverkehr (Market developments of climate-friendly technologies in heavy good transport) https://www.klimafreundliche-nutzfahrzeuge.de/wp-content/uploads/2023/02/Marktentwicklung-klimafreundlicher-Technologien-im-schweren-Strassengueterverkehr.pdf and English https://www.klimafreundliche-nutzfahrzeuge.de/wp-content/uploads/2023/05/BroschuereNOWCleanroom_ENG_web.pdf

[68] McKinsey (2023) Why the economics of electrification make this decarbonization transition different. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/why-the-economics-of-electrification-make-this-decarbonization-transition-different

[69] NBI, BUSA, BCG (2023). Decarbonising the South African Transport Sector. https://www.bcg.com/publications/2023/decarbonising-the-south-african-transport-sector?linkId=206662066

[70] ICCT (2022). Charging solutions for battery-electric trucks. https://theicct.org/publication/charging-infrastructure-trucks-zeva-dec22/

[71] Don Trucking Group (2023). DON Trucking's Electric Truck Test Week - interview with our driver. https://don-trucking.eu/don-truckings-electric-truck-test-week-interview-with-our-driver/

[72] CleanTechnica (2023). Truckers' Health & The Rise Of Zero-Emission Trucks. https://cleantechnica.com/2023/08/20/truckers-health-the-rise-of-zero-emission-trucks/

[73] Drive to Zero (website accessed May 2023). Global Agreement on Zero-Emission Trucks and Buses. https://globaldrivetozero.org/mou/

[74] Drive Electric Campaign (website accessed May 2023). https://www.driveelectriccampaign.org/

CONDITION 1: Electric trucks are on the market to create demand ranging from light to heavy duty trucks and covering different operations/applications	

- EV100+: five companies are committed to only procuring zero-emission medium-duty vehicles by 2030 and a full deployment of zero-emission MHDV by 2040.[75]
- Corporate Electric Vehicle Alliance (CEVA): 28 corporate members collectively represent more than USD 1 trillion in annual revenue, and own, lease or operate more than 1.3 million on-road fleet vehicles in the US alone. They accelerate the deployment of zero-emission vehicles (both passenger and freight) in the US by aggregating demand, advocating for strong policies at multiple levels and sharing best practices on fleet electrification.[76]
- First Movers Coalition: freight companies commit to purchase at least 30% of heavy-duty trucks and 100% of medium-duty trucks by 2030 that are zero-emission trucks; and shippers (freight customers) commit to requiring all of their freight suppliers to meet those zero-emission trucks purchasing requirement.[77]
- Fleet Electrification Coalition co-hosted by Smart Freight Centre and CALSTART: demand for e-trucks from shippers, LSPs and carriers, charging infrastructure, financing solutions and guidance work.[78]

  - However, freight customers (shippers) that demand for freight companies to adopt lower carbon strategies including e-trucks are often not willing to pay an extra price for freight services or financially contribute to help freight companies switch to e-trucks. There are exceptions, such as Lidl Sweden who committed to fossil-free transport and partnered with Einride.[79]
  - Freight companies and customers (shippers) that have set emission reduction targets through the Science-based Targets Initiative or otherwise are more interested to switch to e-trucks where electricity is generated from renewable energy because they must reduce emissions across the fuel/energy life cycle and not just tailpipe emissions.

- Government policies
  - *"Market certainty is key to success and regulations increase market certainty."*
  - EU regulation on CO_2 emission standards for HDVs are the main regulation driving the supply of e-trucks, as these standards can only realistically be achieved through sales of e-trucks. "CO_2 emission standards will work as a warranty for the minimum speed of the transition to zero-emission trucks." Truck manufacturers' announced 2030 sales targets for e-trucks collectively exceed the EU targets.[80] EU RED II and EU ETS will help reduce green electricity costs and increase fossil fuel costs. Overarching view is there are enough carrots but too few sticks to phase out ICE and fossil fuels, and implementation is the bottleneck.
  - National policies include zero emission zones in cities, subsidies for e-trucks and associated infrastructure, but these vary greatly between EU member states and are insufficient to help especially SMEs.[81]
  - Mixed messaging risks undermining good policies. Examples are 90% (not 100%) of e-trucks sales by 2040, e-fuels, LNG/CNG,
  - Some consider Euro 7 a costly policy[82] when ICE technology is coming to an end and as EU truck manufacturers won't get commercial benefits as geographies outside the EU are unlikely to adopt it. Others see Euro 7 as a stick to accelerate the switch to e-trucks and a necessity to deal with air pollution especially in urban areas.[83] In the adopted Euro 7 standard, limits for heavy-duty vehicles will be lowered and test conditions slightly adjusted compared to the original proposal.[24]

[75] Climate Group (website accessed May 2023). EV100+ Creating a market for medium and heavy-duty zero emission vehicles. https://www.theclimategroup.org/creating-market-medium-and-heavy-duty-zero-emission-vehicles
[76] Ceres, Corporate Electric Vehicle Alliance (CEVA), https://www.ceres.org/climate/transportation/corporate-electric-vehicle-alliance
[77] First Movers Coalition, https://www.weforum.org/first-movers-coalition/sectors
[78] Smart Freight Centre and CALSTART. Fleet Electrification Coalition (FEC). https://smartfreightcentre.org/en/projects/ongoing-projects/fleet-electrification-coalition/
[79] Einride (2023). How Lidl is making the switch. https://www.einride.tech/insights/how-lidl-is-making-the-switch
[80] Transport and Environment (2022). Addressing the Heavy Duty Climate Problem. https://www.transportenvironment.org/discover/addressing-the-heavy-duty-climate-problem/
[81] Transport & Environment. How to buy an electric truck. https://www.transportenvironment.org/wp-content/uploads/2022/11/TE-Briefing-2022-ZET-funding-FINAL.pdf
[82] ACEA (2023). ACEA on Euro 7 emissions standard: costs from 4 to 10 times higher than EU Commission estimates https://www.sustainabletruckvan.com/acea-euro-7-study-costs/
[83] Transport and Environment (2023). Euro 7: Let's make it count. https://www.transportenvironment.org/discover/euro-7-lets-make-it-count/

CONDITION 1: Electric trucks are on the market to create demand ranging from light to heavy duty trucks and covering different operations/applications	
	○ Several truck manufacturers and their industry associations lobby for support for e-trucks and infrastructure while also opposing ICE phase out and supporting e-fuels and gas. ○ The political landscape is very different between EU member states resulting in different levels of support for truck electrification and enforcements. National interests often get in the way of EU ambition, for example, Germany's campaign to exempt 100% e-fuel powered cars from a 2035 ban on new ICE cars.[84] "Germany's effort to weaken the ICE sales ban sent a signal to other countries that loopholes can be found, which will affect implementation and enforcement."
Checklist of possible action measures	● Supply of e-trucks ○ Trucks manufacturers/suppliers to maximise investments in domestic production of e-trucks and batteries to allow for rapid uptake when demand is on the upward S-curve. There is the opportunity for EU truck manufacturers to keep existing customers if they fully invest in e-trucks, because freight companies are more brand conscious (risk averse) and existing brands have the sales and services set up to build on. ○ NGOs/research to track investments/fund allocation of truck manufacturers/suppliers to assess if these meet required e-truck production/sales. ● Education of freight companies and other players ○ Conduct research on the concerns freight companies have surrounding e-trucks and carry out surveys of truck drivers to understand under what circumstances they would prefer e-trucks over ICE trucks. Communicate results together with the trade press. ○ Carry out demonstration/collaboration projects with companies and other actors to test e-trucks in practical settings. ○ Allow driver of freight companies to test drive EV trucks especially to convince older drivers. Municipalities could make electric trucks available to small carriers to test. ○ Create harmonised and at-scale education/awareness programs for freight companies and drivers across Europe covering e-trucks (including maximising the range on one battery charge) as well as charging infrastructure. ○ Create overviews for different industry sectors in different countries of the demand and availability of e-trucks (as a supplement of overviews of different e-truck models) to support truck manufacturers, freight companies and policy makers. ○ Develop more use cases of electrification of truck fleets and experiences with charging, covering different truck sizes, applications, carrier sizes, sectors and countries. Comparable information/format, central access and translation are important. ○ Raise awareness among freight customers to, either directly or by joining initiatives, send a market demand signal by committing to zero-emission / e-trucks through their subcontracted freight companies, including the commitment to help overcome the investment barrier. The Science-based target initiative (SBTi) could be a good entry point because more than 3,500 companies, covering over a third of the global economy's market capitalisation, have approved science-based targets that include their Scope 3 emissions, thereby covering transport by staff and outsourced freight transport.[85] ○ Establish an online database that publishes test results of actual drive ranges for different e-trucks to increase confidence of freight companies. ● Government policies. EU/Governments to: ○ Explore complementing the CO_2 emission standards with minimum e-truck manufacturing/sales mandates for truck manufacturers and minimum procurement mandates for the biggest corporate truck fleet operators and contractors to the government, such as the army. ○ Enact policies to keep the EU competitive by securing access to raw materials and making investments in batteries, e-trucks, charging infrastructure, factory conversions (from ICE trucks to e-trucks), re-skilling of workers, battery manufacturing (cell and pack), retrofits, and the transition of the aftermarket. ○ Ensure there is medium-long term policy that is predictable and consistent (e-trucks X ICE/fossil fuels) to give the sector the confidence to accelerate the transition to e-trucks. This includes clarity on the need for Euro 7.

[84] Euronews (2023). In win for Germany, EU agrees to exempt e-fuels from 2035 ban on new sales of combustion-engine cars. https://www.euronews.com/my-europe/2023/03/28/in-win-for-germany-eu-agrees-to-exempt-e-fuels-from-2035-ban-on-new-sales-of-combustion-en

[85] Science Based Targets Initiative, 2022. Science Based Targets Dashboard. https://sciencebasedtargets.org/companies-taking-action#dashboard, accessed March 2023

CONDITION 1: Electric trucks are on the market to create demand ranging from light to heavy duty trucks and covering different operations/applications	
Examples / sources	● Supply of electric trucks can be tracked using the Zero-Emission Technology Inventory (ZETI) Data Explorer.[86] ● Fuels Institute prepared an overview of medium/heavy duty vehicle applications by GHG impact for the US, which could be applied to the EU.[87] ● T&E conducted a global study on truck brands' readiness to transition fully to zero-emission truck sales, comparing European manufacturers to counterparts in China and the US.[88] ● Demonstration project in Sweden assesses 60 regional logistics flows for different transport assignments[89,90]: Regional Electrified Logistics (REEL), linked to E-Charge that gathers 14 actors who in collaboration develop, test and demonstrate battery electric long-haul trucks.[91] ● US Environmental Protection Agency (US EPA) tests and publishes actual ranges of electric cars to increase consumer confidence.[92] UC Davis used US EPA and International Energy Agency (IEA) data to develop an EV Explorer that allows consumers to compares annual costs for available electric cars between different locations, for example the daily home-work commute.[93] Both could be replicated/expanded to e-trucks. ● NACFE provides training for fleet managers focused on fleet depots with 15 or more electric trucks.[94] ● Truck manufacturers that provide training on e-trucks, for example Volvo.[95] ● DHL Group trained couriers of electric vehicles and managed to increase the range from 100 km to 170 km on a single battery charge.[96] ● California Air Resources Board (CARB) issued a mandate in 2020 that requires truck manufacturers to start selling zero-emission medium-duty and heavy-duty commercial trucks in 2024, and reach 55% of Class 2b – 3 truck sales, 75% of Class 4 – 8 straight truck sales, and 40% of truck tractor sales by 2035.[97] CARB in April 2023 issued a mandate that requires trucks to be electric or hydrogen-powered by 2042 for fleets of 50 or more, and by 2035 for port trucks, government fleets, and local delivery fleets.[98] This was followed by a partnership between CARB and leading truck manufacturers on zero-emission trucks announced in July 2023.[99] ● Resource for the Future describes challenges for medium/heavy-duty electric truck including economics, fleet operations, manufacturing, as well as policy solutions, particularly focused on the US.[100]

[86] CALSTART (website accessed June 2023). ZETI Data Explorer. https://globaldrivetozero.org/tools/zeti-data-explorer/
[87] Fuels Institute (2022). The Easiest and Hardest Commercial Vehicles to Decarbonize. https://www.fuelsinstitute.org/research/reports/decarbonizing-medium-and-heavy-duty-vehicles
[88] Transport & Environment (2023). Ready or not: Who are the frontrunners in the global race to clean up trucks? https://www.transportenvironment.org/discover/ready-or-not-who-are-the-frontrunners-in-the-global-race-to-clean-up-trucks/
[89] REEL (2022). Regional Electrified Logistics – Report based on interviews with logistics actors. https://closer.lindholmen.se/en/project/reel
[90] Zaiko, Nikita (2023). E-Charge: System demonstration of long-haul battery electric trucks with megawatt charging system (MCS). https://closer.lindholmen.se/sites/default/files/2023-04/evs36-final-paper-e-charge_0.pdf
[91] E-Charge. https://www.lindholmen.se/en/project/e-charge
[92] US Environmental Protection Agency (website accessed July 2023). https://www.fueleconomy.gov/
[93] UC Davis (website accessed July 2023). https://gis.its.ucdavis.edu/evexplorer/#!/locations/start
[94] NACFE (website accessed May 2023). Electric Depot Bootcamp. https://runonless.com/electric-depot/electric-depot-bootcamp/
[95] Volvo (2022). Volvo Trucks Academy Opens New Facility to Better Serve Electric Truck Training. https://www.volvogroup.com/en/news-and-media/news/2022/may/volvo-trucks-academy-opens-new-facility-to-better-serve-electric-truck-training.html
[96] DHL Group (2020). In IRENA webinar (at 41 min): The future for heavy-duty vehicles in the Pentalateral Region: Integrating electromobility in the energy transition. https://www.irena.org/events/2020/Oct/Heavy-Duty-Vehicles-in-the-Penta-Region
[97] California Air Resources Board (CARB, 2021). Advanced Clean Trucks Fact Sheet. https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-trucks-fact-sheet
[98] California Air Resources Board (CARB, 2023). Advanced Clean Fleets Regulation Summary https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-fleets-regulation-summary
[99] California Air Resources Board (CARB, 2023). CARB and truck and engine manufacturers announce unprecedented partnership to meet clean air goals. https://ww2.arb.ca.gov/news/carb-and-truck-and-engine-manufacturers-announce-unprecedented-partnership-meet-clean-air
[100] Spiller B, Lohawala N, DeAngeli E for Resources for the Future (2023). Medium- and Heavy-Duty Vehicle Electrification: Challenges, Policy Solutions, and Open Research Questions. https://www.rff.org/publications/reports/medium-and-heavy-duty-vehicle-electrification-challenges-policy-solutions-and-open-research-questions/

Condition 2: Plans for charging infrastructure are in place

CONDITION 2: Plans are in place to increase charging infrastructure in anticipation of transition from ICE trucks to electric trucks	
Needs	a) National and local masterplans for e-truck charging public (in line with AFIR) and private infrastructure following a consistent structure/content across the EU and UK b) Monitoring and review of key elements of the charging infrastructure c) Alignment of plans for transport, energy and industry
Current situation	● Masterplans o The EU developed the Sustainable and Smart Mobility Strategy and the AFIR with charging infrastructure targets, but AFIR provides the minimum network requirements and EU member states are building on these, increasing their own targets to the actual projected demand and developing national plans for implementation and roll out of infrastructure. o Plans, policies and regulations are emerging, such as in Germany with an updated Charging Infrastructure Masterplan II[105] and Norway with a National Charging Strategy.[110] o Different strategies exist in the EU, US and China, each with their strengths and uncertainties. The EU has a planning-first strategy that marks out clear goals, areas and requirements, is coordinated across member states with a consideration of system integration (e.g. ERS and charging/refuelling stations into the TEN-T network), but less worked out at the level of funding or stimulating investments. This contrasts with China, where the government mandates both planning and implementation actions across the country, supports local manufacturers and provides financial incentives; and with the US where the focus is less on planning but more strongly on empowering states to take the lead and on promoting local brands and manufacturing, backed by local, state and federal subsidies, most notably the Inflation Reduction Act.[64] o Industry associations are supportive of masterplans at the EU/national levels because this is what industry needs to plan and invest and understand the impact on the grid so as to inform grid reinforcement/development plans. o Emerging plans are not yet fully clear on battery sizes of e-trucks and by extension the need for CCS and MCS to charge e-trucks. Large batteries mean longer distances, e.g. tests with Volvo's Futuricum showed 1,000+km on a single charge is possible, but a large battery is expensive (around 30k Euro for a 300 kW battery) and adds 5-8 tonnes to the payload. The current focus is more on CCS, whereas investments in MCS would reduce the charging time and thus allow for smaller batteries combined with more frequent fast charging and that reduce the e-truck's payload, although MCS may also make grid challenges worse. Modular batteries (one in small trucks, 2 or more in large trucks) could make battery production and customisation for trucks easier. MCS requires high capacity grid connections, but as long as MCS use stays within the installed capacity, costs are manageable. The choice by CPOs and customers comes down to what is more costly: large battery, fast charging, longer waits, and if trucks can be sufficiently recharged using CCS during the 45 min rest period to drive for another 4.5 hours, or if this is only possible with MCS. o There is a lack of clarity on whether electric road systems (ERS) should exist alongside charging sites. Differences in opinions exist: ▪ Pros: ability to operate trucks 24/7; no need for unscheduled stops; fits with parallel developments in automated loading and trucks, which will be accompanied with 40% cost reductions from drivers; ERS and transformers installed along TEN-T network could be less expensive that fast chargers in all depots warehouses and highly utilised; smaller batteries reduce payload and critical materials challenges. ▪ Cons: higher investment risks compared to charging sites; mandatory clearing requirements that are easy to underestimate (e.g. bridges and tunnels); requires a gapless network of key routes; requires alignment between highways and high-powered grid lines; truck manufacturers hesitation to support ERS; government investment, coordination and willingness to help carry the investment risk are essential; replaces the need for some but not all charging points; interest of OEMs may be reduced if ERS is adopted in the EU but not in other geographies, which reduces the ability to sell truck models that are suitable for ERS outside of the EU.

CONDITION 2: Plans are in place to increase charging infrastructure in anticipation of transition from ICE trucks to electric trucks	
	○ Battery swapping is introduced in China for closed sites and certain routes[101] but currently not considered for e-trucks in emerging plans in Europe. Reasons cited are costs (batteries are 2/3 of vehicle costs and you need ~150% batteries in a swapping system); batteries in right locations; interoperability between brands/providers. ● Monitoring and review ○ EU and member states lack monitoring and review processes that are harmonised, which makes assessments of the current state and developments of e-trucks charging infrastructure more difficult, time-consuming and costly. ● Aligned plans ○ A strategy to facilitate the trucking transition is still at a very high level and there is a lot of need for more detail. ○ Lack of connection/integration between plans and policies across sectors. "*Discussions on energy, industry and transport are happening on different planets.*" ○ The US IRA is considered more of an integrated strategy that stimulates investments in industry, energy and transport. ○ E-mobility depends on various 'external' factors: a resilient supply chain, clean and green power, accessible charging infrastructure, a smart grid, digitalisation and skilled labour.[102]
Checklist of possible action measures	● Masterplans/deployment plans. EU/Governments to: ○ Develop national masterplans for charging infrastructure for e-trucks using a consistent structure/content across EU member states. ○ Support provinces/federal states/local municipalities to develop subnational/local masterplans for the deployment of charging infrastructure. ○ Plans (and supporting policies) should consider ▪ International transport, e.g. Poland has a relatively high share of international road freight.[103] ▪ Truck traffic density. ▪ A determination of the long-term (2025, 2030, 2035, 2040) and site specific demand for e-trucks charging, to be able to inform especially land allocation, grid connections, and financing (see success factors described later). ▪ Both CCS and MCS, and challenges and opportunities of ERS because of fundamental implications on charging infrastructure planning. ▪ Developing local capacity for planning, development and management: staff, templates/models, guidance, tools. ▪ The market by including performance-based elements to harness market forces and accelerate market deployment rather than delay it. ○ Involve truck manufacturers, freight companies, their industry associations and toll way operators for better projections of future demand. ○ Ensure that plans are backed by industry through real engagement, e.g. clean-room talks. ● Monitoring and review. EU/Governments to: ○ Develop a harmonized monitoring and review process across EU member states/UK (with the Germany example as input) that covers the ongoing technical development, standardisation processes and development of charging infrastructure for heavy duty trucks. ○ Ensure that monitoring and review is integrated in national Masterplans. ● Aligned plans. EU/Governments to: ○ Determine from a e-truck and charging infrastructure perspective what is needed for transition from ICE to e-trucks, energy and industry; assess gaps and determine recommendations for inclusion in other plans. ○ Make use of the current opportunity to influence both Ten-T and Ten-E and the EU's response to the US IRA and make this work for e-trucks charging infrastructure, as well as ensure consistency. ○ Ensure that utilities and new decentralised power generation increasingly produce renewable energy that future charging sites can access.

[101] Yanying Li (2023). Electric trucks: a logistics panacea. https://www.intertraffic.com/news/electric-trucks-a-logistics-panacea
[102] EY and Eurelectric (2023). Six essentials for mainstream EV adoption. https://www.eurelectric.org/publications/joint-ey-eurelectric-report-six-essentials-for-e-mobility/
[103] https://ec.europa.eu/eurostat/statistics-explained/index.php?oldid=549004

CONDITION 2: Plans are in place to increase charging infrastructure in anticipation of transition from ICE trucks to electric trucks	
	○ Assess the relevance of broader EU policies such as the ETS for road transport, NextGenerationEU Plan, and the EU New Cohesion Policy as several of these could provide solutions to some of the challenges faced in taking e-trucks and associated charging infra to scale.
Examples / sources	● ACEA in collaboration with other associations developed a research white paper on a European Electric Vehicle Charging Infrastructure Masterplan, covering charging infrastructure, grid upgrades and energy supply, and other key interventions. This includes a chart that depicts private and public charging energy demand in 2030 for different locations and charging speeds.[104] ● Germany's National Centre for Charging Infrastructure (Nationale Leitstelle Infrastruktur) released a Charging Infrastructure Masterplan II.[105] A useful infographic was developed separately by consulting firm FfE.[106] ○ Backcasting from final network Germany wants to have in place by 2040. ○ Cleanroom talks with 25 OEMs in Germany/EU provided the necessary estimates for ICE, BEV and FCEV trucks until 2030 in detail with a forecast until 2035, as a basis for the Masterplan.[67] ○ 68 measures across funding, empowering communities, universal availability, integration into the power grid, charging at buildings, and with an expanded focus on charging infrastructure for heavy commercial vehicles on motorways and commercial premises. with a dedicated chapter with 10 actions for heavy duty trucks and buses. ○ Includes the development of a model/template of local masterplans for the deployment of charging infrastructure, including "local deployment goals as well as the coordinating, regulatory, financial and other measures to achieve them (competition approach with competing operators of charging points, possible tending, land acquisition, involvement of local actors, institutional rooting, designation of priority sites, if necessary, amendment of the land use plan, development planning or parking statutes)." ○ Includes a monitoring and review process by the Federal Ministry for Digital and Transport that was planned early 2023 ○ StandortTOOL can be used to map charging infrastructure needs and plan ahead until 2030.[107] ● Germany's roll-out plans for an initial charging network by 2027/2030 are based on clean-room talks with OEMs that give an indication of the number of zero-emission trucks on the road[67] as well as data from toll collect (truck toll system operator)[108], data from industry, such as commercial vehicle registrations by ACEA,[109] and from universities and research institutes/NGOs, such as Fraunhofer. This allows Germany to develop a network with a significantly higher total power output, compared to the AFIR-targets that will be applied to Germany. ● Norway developed a National Charging Strategy that includes charging of 50% of new trucks by 2030 and covers the grid system, sites and permitting, public charging points, and used solutions such as payment solutions and price information.[110] ● Netherlands developed a 'Knowledge and action agenda" to support the roll out of charging infrastructure for the logistics sector around five themes: a) prognosis of the charging needs from logistics players; b) public stimulation of charging by logistics vehicles, c) private charging (on industrial sites); d) the base network for heavy duty vehicles; and e) charging at construction sites. This is also available in English.[111] ● Netherlands produced a Roadmap Logistics Charging Infrastructure covering four phases (startup, basis network, scaling, market penetration), with heavy trucks being in the startup phase; recognises the need for different charging needs per sector and urban/ regional/long distance; and

[104] ACEA (2022). Research White Paper - European Electric Vehicle Charging Infrastructure Masterplan. https://www.acea.auto/publication/european-electric-vehicle-charging-infrastructure-masterplan/
[105] The Federal Government Germany (2022). Charging Infrastructure Masterplan II. https://nationale-leitstelle.de/wp-content/uploads/2023/01/Masterplan-Ladeinfrastruktur-II-der-Bundesregierung_Englisch_DIN_A4_barrierefrei.pdf
[106] FfE (2020). Infographic Master Plan Charging Infrastructure II. https://www.ffe.de/en/publications/master-plan-charging-infrastructure-ii/
[107] Federal Ministry for Digital and Transport (website accessed May 2023). StandortTOOL. https://www.standorttool.de/
[108] https://www.toll-collect.de/de/toll_collect/tc_homepage.html and English version: https://www.toll-collect.de/en/toll_collect/tc_homepage.html
[109] ACEA (website accessed May 2023). New commercial vehicle registrations in the EU. https://www.acea.auto/figure/new-commercial-vehicle-registrations-in-eu/
[110] Norwegian Ministry of Transport (2023). National Charging Strategy. https://www.regjeringen.no/en/dokumenter/national-charging-strategy/id2950371/
[111] Nationale Agenda Laadinfrastructuur (2021). How to support a fast uptake of zero-emission freight vehicles in The Netherlands. https://www.agendalaadinfrastructuur.nl/ondersteuning+gemeenten/documenten+en+links/bibliotheek+-+logistiek/default.aspx

CONDITION 2: Plans are in place to increase charging infrastructure in anticipation of transition from ICE trucks to electric trucks	
	based on charging needs determined the number of charging points needed until 2035. Monitoring of the rollout will be organised at the national level.[112] ● UK Government issued a plan for energy security that builds on both its Electricity Security Strategy and Net-zero Strategy, recognising that "By the middle of the next decade, demand may grow by up to 60% as we electrify transport and heat." [113] ● ICCT: Assessed the charging infrastructure needs for near-term (2025 & 2030) charging and refuelling infrastructure needs for Class 4-8 medium- and heavy-duty vehicles at the national and sub-national levels in the US.[114] Estimated costs of hardware, installation and planning required for public and private charging infrastructure across different geographies including EU and UK until 2030, covering both light and heavy duty vehicles[115] ● New York State proposed an Act to amend laws in relation to establishing a highway and depot charging plan covering planning, priority sites, grid expansion and connection, charging deployment priorities including for trucks.[116]

[112] Nationale Agenda Laadinfrastructuur (NAL, 2022). Roadmap Logistics Laadinfrastructuur. https://www.agendalaadinfrastructuur.nl/ondersteuning+gemeenten/documenten+en+links/bibliotheek+-+logistiek/default.aspx
[113] UK Government (April 2023). Policy paper - Powering Up Britain: Energy Security Plan. https://www.gov.uk/government/publications/powering-up-britain/powering-up-britain-energy-security-plan
[114] ICCT (2023). Near-term infrastructure deployment to support zero-emission medium- and heavy-duty vehicles in the United States. https://theicct.org/publication/infrastructure-deployment-mhdv-may23/
[115] ICCT (2022). Deploying charging infrastructure to support an accelerated transition to zero-emission vehicles. https://theicct.org/publication/deploying-charging-infrastructure-zevtc-sep22/
[116] State of New York. Senate Bill S4830. AN ACT to amend the public authorities law and the public service law, in relation to establishing a highway and depot charging action plan. https://www.nysenate.gov/legislation/bills/2023/S4830

Condition 3: Grid connections and upgrades respond to demand

CONDITION 3: Grid connections and upgrades respond to demand for charging infrastructure alongside other uses of electricity.	
Needs	a) Faster, simplified and predicable procedures for grid connections/expansions covering application, installation and pricing b) Consideration of current and projected charging demand of trucks in grid upgrades, congestion management and future planning c) Integration of charging strategies and related pricing from the outset to maximise efficiency and minimize costs
Current situation	Grid upgrades are considered one of the most urgent challenges in the transition to e-trucks. A distinction is made between the more urgent short-term grid connection processes (the responsiveness of utilities and grid operators and ease of an applicant to get a grid connection or expansion) and medium-term grid capacity (the planning and execution of grid upgrades to meet growing electricity demand over a longer period of time). ● Faster, simplified and predictable processes for grid connections/expansions. Charge point operators (CPOs) and freight companies charging at own sites face challenges in applications and subsequent authorisation and installation of grid connections or expansions: o Attractive sites for truck charging lack sufficient power. o Who acts as the CPO as part of the application process is not always clear, despite the rights and obligations that come with this role. o The application, authorisation and installation process is so lengthy that CPOs risk having to adjust their rollout plans multiple times. o Applications: ▪ Lengthy connection procedures (5-16 months) in combination with lack of transparency, predictability and digitalisation of the application process for grid connections/expansions adds to the uncertainty of companies wanting to invest in e-trucks and charging infrastructure. ▪ Inconsistencies exist between application processes and success factors in different jurisdictions within countries and between countries. o Installation: ▪ CPOs that operate in several grid areas have to take into account different grid success factors, which can lead to inefficiencies and delays. ▪ Up to 20 months time to get access to grid also due to shortage and long delivery times of transformers.[104] ▪ An example is the City of Amsterdam purchasing 27 diesel trucks and 10 e-trucks for garbage collection (instead of 37 e-trucks) citing insufficient charging infrastructure and grid access,[117] putting 2030 zero-emission transport targets at risk as garbage trucks last >10 years. o Pricing ▪ Each DSO will charge differently (grid connections, grid fees, charging rates) with often limited flexibility and transparency. ▪ Connection charges vary, and Eurelectric identified three types: shallow fees (costs of equipment), shallowish fees (costs of equipment and proportion of grid reinforcement), and deep fees (costs of equipment and grid reinforcements).[145] ▪ An analysis of nearly 140 tariffs and services for EV smart charging (all vehicle types) in Europe found varying services: Scandinavia/Nordic states and Spain have dynamic time-of-use energy tariffs (i.e. high RE supply and low demand leads to lower prices), which are emerging in some other EU countries, but are largely absent in France, Germany and Eastern European countries.[118] ▪ For large underutilised grid connections a CPO will pay relatively more, unless this is considered in the network tariffs structure applied. For example, in Germany the tariff is based on price at peak demand, whereas in Spain/Portugal this is based on price at average demand. ● Grid upgrades, congestion management and future planning o Grid capacity expansion/reinforcement needs a 5-10 year lead time (network planning, cost allocation, building transformers, etc) and should be 2-3 years ahead of charging infrastructure, but is behind. The risk is that a delay in grid upgrades in the coming years could down the uptake of battery-electric trucks.[119] Costs can be reduced and time delays be prevented if grid upgrades are planned well in advance.

[117] TTM.nl (2023). Staatssecretaris heeft begrip voor Amsterdamse aanschaf dieseltrucks. https://www.ttm.nl/fleet/fleetmanagement/staatssecretaris-heeft-begrip-voor-amsterdamse-aanschaf-dieseltrucks/155106/

[118] Regulatory Assistance Project (RAP, 2022). The time is now: smart charging of electric vehicles. https://www.raponline.org/knowledge-center/time-is-now-smart-charging-electric-vehicles/

[119] Will Sierzchula (Dec 2022). Electrifying US long haul trucks will require 504 TWh a year. But that won't be the hardest part. https://www.utilitydive.com/news/electrifying-us-long-haul-trucks-will-require-504-twh-a-year-but-that-won/636684/

CONDITION 3: Grid connections and upgrades respond to demand for charging infrastructure alongside other uses of electricity.	
	○ A key reason is that DSOs and TSOs have a monopoly position because it does not make sense to have multiple independent grids in the same geographical area. As such grids are regulated (rather than market-driven), DSOs/TSOs are supervised by energy regulators and are evaluated based on cost-of-service (sales, revenue, rates, reliability). Therefore their starting point is a customer request for expansion rather than anticipation of future demand, which doesn't mix well with trucking as a market-driven sector. Furthermore, DSO investments are capped both in terms of the investment amount (fixed % of revenues) as well as timeline (e.g. maximum 2 years ahead) making grid modernise the grid more difficult.[45] "*This is a recipe for potential policy failure. If you mandate e-trucks then you should also regulate grid capacity and upgrades.*" ○ The number of DSOs varies significantly between countries, for example in the UK there are 6 large DSOs, in Spain 5, in France 1 but in Germany 800+. Many DSOs causes problems for mapping the distribution systems, for example, this makes it difficult to have uniform data sets for medium and low voltage grids. CPOs spend significant time on DSO coordination across Europe.[104] ○ National regulatory authorities (NRAs) within EU member states are in different stages regarding deployment of charging infrastructure, integration of EVs into the electricity system, and consumer participation and protection, according to a CEEW survey (annex 2 of report).[120] ○ When highways were built, access to electricity was not considered, and therefore grid upgrades need to coincide with the development of charging infrastructure. An example cited for Poland from the Polish EV Outlook[141], 240 charging points along highways are required under AFIR, 123 for the core network, 87 for the comprehensive and 30 for the urban nodes, which will require at least a 5-fold increase in installed capacity by 2025 from about 78 MW today, but in many cases the distance between those charging points and the grid is more than 10 km. ○ Some DSOs are known to support new renewable energy capacity (as part of a decentralised system/microgrids) by offering alternative connection solutions that involves a connection with less expensive chargers and shorter delays, but on the condition that the DSO can limit the amount of power injected into the grid during times when the grid is at full capacity, as in experienced in Norway (CEEW, case study 5).[120] ○ Several aspects that are important for grid connections and expansions are currently taken too little into consideration: ▪ Where. Demand will be especially high where trucks park and (un)load: industrial areas, ports, depots and rest stops along highways, and which may require own connections and transmission substations to meet future demand, which could also be an opportunity for grid investments. This is very different from passenger EVs which are often charged at homes and at lower capacities. ▪ When & what size. A large expansion to meet future demand is more expensive in the short term and creates an excess capacity in the early years, while multiple smaller expansions will not keep up with e-truck uptake and is ultimately more expensive. ▪ How. Not all steps are taken into account: regulatory approval, grid allocation to charging sites, determining technical connection requirements, sufficient equipment to upgrade grids (and lead times for additional equipment), sufficient staff (staffing shortages, especially technical staff, is also putting a strain on grid upgrades). RMI estimates average waiting times of 3-8 months for a new transformer to 1-2 years for a new substation installation.[121] ▪ Who first. Applications for grid connections for charging sites competes with those from industry, housing, retail, and at present a first-come-first-serve approach is applied in most jurisdictions without setting priorities. ▪ Who pays. Grid expansions that precede demand are likely necessary for the e-truck rollout, and we need a policy and regulatory environment which makes this less of a burden on consumers. Grid operators cannot easily pass on costs to consumers, unless provisions/ amendments are made in regulations. Government subsidies or tariffs / cost models like time-of-use or demand charges[6,122] (based on peak power usage rather than overall energy consumption) could be used to cover the time gap, for example for high capacity chargers that are expensive to operate as they likely will have excess capacity in the first years of operation as the e-truck market ramps up. ● Integration of charging strategies and related pricing

[120] Council of European Energy Regulators (CEER, 2023). CEER Report on Electric Vehicles: Network Management and Consumer Protection. https://www.ceer.eu/2346
[121] RMI (2023) Preventing Electric Truck Gridlock. https://rmi.org/insight/preventing-electric-truck-gridlock/
[122] Electric Autonomy (2022). Understanding demand charges part 1: what are they and why they need to change. https://electricautonomy.ca/2022/03/09/chargepoint-understanding-demand-charges/

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	○ Even with better planning it may not be possible for the grid to fully meet the demand for electricity, although this depends on where charging is needed and how much capacity is available, which differs per location. ○ Connection management or peak capacity of the grid is considered by some as a bigger barrier for electricity for truck charging than the overall grid capacity. This is also affected both by other new electricity users, such as new industrial plants or electrification of existing industrial processes, buildings and households, as well as solar parks and wind farms that seek grid connection. Grid operators tend to estimate additional capacity based on *"All trucks charging at the same time at the worst time of the day."* Charging strategies (smart charging, V2X and battery storage) are currently not optimised. An example was given for depots at an industrial estate that could make use of existing charging capacity from adjacent premises that do not operate at night, however, this was not considered in the grid expansion plan and sharing of capacity may not be allowed under current centralised grid systems with contracts for individual users. ○ The remuneration model of DSOs that is based on capex rather than opex does not incentivise DSOs to explore smart charging and pricing strategies. DSOs are therefore less encouraged to understand the user load profiles, which in turn hinders DSOs to predict and evaluate alternative solutions to grid reinforcements (e.g. time-of-use/TOU, decentral power solutions).[45] The pricing has a direct impact on congestion management.
Checklist of possible action measures	● Faster, simplified and predictable processes for connections/expansions ○ National governments with support from national regulatory authorities (NRAs) to ▪ Create a one-stop-shop or platform per country to assess all types of applications for grid access/expansion, and embed the authority to prioritize applications that make the biggest contribution to CO_2 emission reductions. ▪ Establish a cross-sectoral stakeholder platform to coordinate grid upgrades. A study for Germany on coordination of TSO and DSOs found this could save up to € 300 million https://www.standorttool.de/ in 2030 on redispatch (=replanning of the use of power plants in the event of power grid fluctuation).[66] ▪ Consider establishing a public support scheme administered by energy regulatory authorities / NRAs to cover costs of grid connections/expansions. ▪ Allow DSOs and TSOs to act in advance of need under the supervision of NRAs, and implement the reinforcements at shallow fee, i.e. without cost for the customer requesting the connection (currently in UK, China and California). ○ NRAs can help reduce connection timelines (suggestions by CEER)[120] ▪ Introduce exemptions to facilitate the deploying of charging infrastructure within the framework of the prerogatives conferred by national law, (case study 1 for Norway). ▪ Monitor the time taken by TSOs and DSOs to carry out connection and repairs (case study 2 for France). ▪ Monitor and evaluate the performance of TSOs and DSOs based on a limited set of indicators, at NRA's discretion. ○ NRAs can help reduce costs associated with charging points installation (suggestions by CEER)[120] ▪ Set and/or approve, on the basis of transparent criteria, transmission and distribution tariffs of their calculation methods. ▪ Express an opinion on subsidy mechanisms/public policies (within the framework of prerogatives entrusted to them by national law), when setting network tariffs, to ensure that they are fair, stable and acceptable (case study 3 for Portugal). ▪ Supervise experiments/trials carried out by DSOs as part of regulatory sandboxes or experimental services. ▪ Work with TSOs and DSOs to monitoring the impacts of EV charging on the system and its contribution to flexibility. ▪ Ask TSOs and DSOs to publish network data to facilitate the choices of location for new charging points (case study 7 for Ofgem UK) ○ DSOs to ▪ accelerate application process for grid connections with a binding/predicable delivery timeline (from request to realization) based on DSO best estimates and reporting on status of new requests.

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	▪ set up customer teams dedicated to e-truck fleets to, at low cost, reduce procedural delays. This can also help DSOs to learn about e-trucks and how these can be used to contribute to grid reliability.[124] o Utilities/grid operators to make network tariffs cost-reflective and pilot tariffs that allow CPOs to phase in a high-capacity charging market. o Utilities and CPOs to apply time-of-use tariffs/pricing to give pricing signals to freight companies to optimise e-truck charging that consider both operational schedules as well as grid capacity/usage. o EU to harmonise technical connection requirements nationally and ideally across the EU. o EU/Governments with NGO support to develop case studies for CPOs to understand rights and obligations in different countries/regions. ● Grid upgrades and future planning. o Determine e-truck charging demand forecasts for consideration in the grid planning, with the input from truck manufacturers, freight operators and charging providers (e.g. through 'cleanroom talks' between government and industry). These should ideally cover different applications (city, regional, long-distance as well as sectors) o Create 'grid maps' (or 'hosting capacity maps') that compare hosting capacity and needs capacity to then determine what additional capacity is required, combined with where, when and what size of expansion is needed. This is key to convincing regulators, utilities and grid operators. o NRAs to put transparency requirements on DSOs to provide both data on grid capacity and usage to inform plans and allow optimal charging strategies, as well as local hosting capacity maps to inform freight companies/logistics operators when building/upgrading depots. o Develop interim solutions where demand outstrips grid capacity to avoid delays in e-trucks uptake because it takes several years to get grid upgrades ready. This includes consideration of decentralised/off-grid/microgrid solutions such as battery storage and co-location of renewable power generation and charging points, to avoid that companies continue to order diesel trucks due to a lack of grid access for charging points. o Develop scenarios for grid expansion needs based on e-truck and charging demand projections, which will enable forward-looking grid upgrades and securing the necessary investments. o Improve monitoring, evaluation and power management as the number of electric trucks increases. o Include all relevant aspects/steps in the planning for new grid connections and expansions covering where, when/what size, how, who first, who pays (see earlier description). In particular, explore how grid upgrades can align with key trucking routes and locations where trucking services are high such as industrial areas, ports and depots, and rationalise what falls within the distribution grid and the transmission network. This approach would coincide with EU New Cohesion Policy.[57] o Consider port electrification measures in Fit for 55 and in Ten-T, and airport electrification measures in TEN-T for grid upgrades planning. o For data-related action measures see criterion 8. ● Integration of charging strategies and related pricing o DSOs and CPOs to assess from the outset what charging strategies could be included in the charging site: smart charging, dedicated metering devices, V2X, self-generated renewable energy (usually solar power), energy storage (or co-location charging sites with RE sites). It is noted that these strategies alongside back-up generators can also help with power shortages or outages. For DSOs this will help with connection management and for CPOs as a strategy to mitigate the grid capacity gap. o Governments to allow and facilitate the deployment of smart meters, dedicated metering devices (DMDs, also known as submetering) and dynamic energy tariffs that reflect network success factors, to improve system management and reduce costs.[123] Although more relevant for cars which can be plugged over longer periods to chose the lowest electricity price, these are also relevant for e-trucks to improve the TCO. DMDs can be deployed by CPOs and other market actors, whereas smart meters are deployed only by DSOs or other regulatory bodies. o Facilitate non-discriminatory bidirectional charging by assessing, among other things, how the legal, technical, fiscal and economic framework success factors can be improved in order to remove any obstacles (this is being explored in Germany).

[123] Burger, J and Hildermeier J in Energy Monitor (2022). EV smart charging: A golden opportunity for distribution system operators. https://www.energymonitor.ai/policy/ev-smart-charging-a-golden-opportunity-for-distribution-system-operators/

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	○ NRAs to adapt network tariffs to incentivise smart charging (suggestions by CEER):[120] ▪ Time-of-use tariffs with high time-differentiations, reflecting network costs. ▪ Differentiated contractual capacity limit to incentivise EV charging in off-peak hours. ● Suggested measures for the EU and governments/regulatory authorities that cover all 3 needs ○ Consider the detailed policy recommendations to support DSO, developed by four European organisations and facilitated by the Regulatory Assistance Project: better network planning, faster connection processes, and smarter grid connection management,[124] and which draw from the three Roundtables organized with Eurelectric.[145,146,147] ○ Establish national task forces to assess and upgrade/reinforce the grid transmission and distribution networks that considers truck charging alongside other applications/uses. ○ Develop EU/national grid strategies while making immediate policy changes where possible given the grid upgrades urgency, including: ▪ Plan for grid expansion and reinforcement (including substations) to prepare for electricity demand from truck EV charging points (and other technologies, e.g. heat pumps), grid connections and cables for access to wind and solar farms and batteries for storage. ▪ Provide public financing to upgrade the grid as well as streamline and speed up the process of adapting infrastructure to charging needs. ▪ Revise regulatory frameworks for DSOs to encourage adequate and timely investment in grid connection capacity at strategic parking and charging locations, especially at TEN-T Core and Comprehensive corridors. ▪ Allow DSOs to prioritise grid expansion/allocation based on contribution to the energy transition and climate targets. ▪ Include performance-based regulation to improve on the cost-of-service model, which will encourage DSOs/TSOs to also consider customer satisfaction and public policy outcomes[76,125] (such as connecting renewable energy sites, charging sites and CO_2 reductions), as well as performance on opex (rather than capex) to incentivize them to introduce smart operations and optimizing the grid capacity. ▪ Address the barrier of DSO investment caps. This could involve assessing the number and type of 'grid services' where caps could be removed, and finding a balance between the need for new grid services and protecting tax/ratepayers. ▪ Develop policies that stimulate investment in and create a market for grid edge technologies, including EV charging infrastructure, so that grid upgrades are met with the required demand; as well as co-location of solar parks/wind farms and charging infrastructure and the use of battery storage, so that the risk of insufficient grid capacity is mitigated. ▪ Ensure strategic synergies between TEN-T and TEN-E projects through co-funding opportunities for charging sites together with on-site renewable energy deployment and battery storage to alleviate peak stress on local electricity distribution networks. ▪ Facilitate for utilities and grid operators to integrate of grid planning with the EU New Cohesion Policy because the demand for truck charging infrastructure will grow most at industrial areas, ports and other key hubs that are the focus of EU policy. The (relative) predictability of growth in demand at these sites should help convince utilities and grid operators to support this integration. ▪ Apply smart charging, battery storage, and bidirectional charging (V2G) at charging sites, in combination with smart tariffs and services.[6] ▪ Implement the provisions related to dedicated metering devices (DMDs) included in the proposal for regulation to improve the EU's Electricity Market Design to help reduce costs of charging at depots/charging sites.[39,126] ▪ Policy recommendation ICCT: Empower utilities to support ZEVs by designing electric vehicle-friendly rate structures and encouraging smart charging. Regulators can enable public and investor-owned utilities to pay for grid upgrades through phased introduction of new rate

[124] AVERE, ChargeUp Europe, Eurelectric, POLIS, and Regulatory Assistance Project (RAP) (2023). Joint Declaration: How DSOs can integrate the E-Mobility Boom. https://www.eurelectric.org/publications/joint-declaration-power-drive-how-dsos-can-integrate-the-e-mobility-boom/

[125] Regulatory Assistance Project (RAP, 2022). Roadmap for Electric Transportation: Policy Guide. https://www.raponline.org/knowledge-center/roadmap-electric-transportation-policy-guide/

[126] European Commission (2023), Commission Staff Working Document – Reform of Electricity Market Design. https://energy.ec.europa.eu/system/files/2023-03/SWD_2023_58_1_EN_autre_document_travail_service_part1_v6.pdf

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	structures for electric vehicle charging. Additionally, as smart charging balances the grid load, it can potentially defer expensive grid upgrades.[70] Such tariffs/phase-in models could be applied by utilities and grid operators to cover grid costs of high-capacity charging. o EU to consider in the proposed revisions of the Electricity Directive[39] ▪ Harmonization of grid connection procedures for consistency across the EU, including digital one-stop shops with transparent monitoring. ▪ Sharing costs fairly among all users of the grid. ▪ DSOs to consult CPOs for long-term grid planning purposes. ▪ Prohibit DSOs to also be CPOs except for rural/remote areas to avoid monopolies/lack of market competition.
Examples / sources	● The Council of European Energy Regulators (CEER) issued a report with a survey of and recommended actions for national regulatory authorities to ensure that the development of electric mobility can meet European decarbonisation targets, while considering economic, technical and consumer impacts.[120] A second publication is recommendations on dynamic price implementation.[127] ● The International Energy Agency developed a manual for policy makers on the grid integration of electric vehicles, including a framework of four phases that covers the charging strategy, technology requirements, system operations and regulation and market design[128] ● ACEA identified best practices for Europe to streamline infrastructure approval processes.[104] ● Germany's Masterplan II includes several of the above-mentioned measures.[105] ● German TSOs developed their (draft) network development plan 2023-2037/2045 to incorporate the need for electric vehicle charging.[129] ● UK o Department for Transport leads a Freight Energy Forum that brings together freight, energy sector and government representatives and focuses especially on energy infrastructure and supply across the whole freight sector, including e-trucks charging infrastructure.[130] o Ofgem (DSO) developed a plan for the expansion of the grid that takes EV growth into account, and updated regulations per April 2023 on how energy infrastructure is paid for and requires grid operators to make projections of new connections and investment plans[131]; introduced a shallow-fee (CPOs pay for equipment but not grid reinforcement)[132]; introduced supporting schemes – 'Green Recovery Scheme'.[133] o National Grid (DSO/TSO) used the data maps of charging locations of ACEA[149] for its proposal for a fast-charging network along major English motorways, which requires similar connections to the transmission network and in similar locations required by cars and vans.[134] ● France Enedis: issued the Network Development Plan to invest more than €5 billion per year by 2032 to connect wind/solar power to the public distribution grid and for charging infrastructure for EVs (although truck EV charging does not seem to be covered).[135,136] This includes an overview of truck charging needs on highways and supporting CPOs with an indirect subsidy through reduced connection fees. ● Netherlands:

[127] Council of Energy Regulators (CEER, 2020). Recommendations on Dynamic Price Implementation. https://www.ceer.eu/documents/104400/-/-/2cc6dfac-8aa7-9460-ac19-4cdf96f8ccd0
[128] IEA (2022). Grid integration of electric vehicles – a manual for policy makers. https://www.iea.org/reports/grid-integration-of-electric-vehicles
[129] Bundesnetzagentur (website accessed May 2023). Network Development Plan. https://www.netzausbau.de/nep
[130] Freight Energy Forum. https://www.gov.uk/government/groups/freight-energy-forum
[131] Ofgem, Patrick Cassels (May 2022). Changes to charging: How Ofgem is preparing for a very different grid. https://www.ofgem.gov.uk/news-and-views/blog/changes-charging-how-ofgem-preparing-very-different-grid
[132] UK Ofgem (2022). Access and Forward-Looking Charges Significant Code Review: Decision and Direction. https://www.ofgem.gov.uk/publications/access-and-forward-looking-charges-significant-code-review-decision-and-direction
[133] UK Ofgem (2021). Decision on the proposed modifications to the RIIO-ED1 licences for the Green Recovery Scheme. https://www.ofgem.gov.uk/publications/decision-proposed-modifications-riio-ed1-licences-green-recovery-scheme
[134] National Grid (2022). New National Grid-led analysis shows expanding Government's electric vehicle Rapid Charging Fund (RCF) would accelerate the decarbonisation of all road transport. https://www.nationalgrid.com/new-national-grid-led-analysis-shows-expanding-governments-electric-vehicle-rapid-charging-fund-rcf
[135] Enedis (March 2023). Transition écologique: Enedis dévoile les travaux préparatoires à son futur 'Plan de Développement de Réseau'. https://www.enedis.fr/presse/transition-ecologique-enedis-devoile-les-travaux-preparatoires-son-futur-plan-de
[136] Enerdata (March 2023). French electricity distributor Enedis plans to invest €5bn/year through 2032. https://www.enerdata.net/publications/daily-energy-news/french-electricity-distributor-enedis-plans-invest-eu5bnyear-through-2032.html

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	○ Grid operators developed 3 energy system scenarios for 2025-2030-2035, in support of investment plans for electricity, gas and hydrogen, covering all sectors. The scenarios include climate ambition (existing policy ambition 55% by 2030), national drivers (+more electrification and generation on land), and international ambition (+green gas and hydrogen). [137] ○ Elaad NL developed a dashboard to help DSOs and local municipalities to plan for grid expansions from truck charging at industrial parks. They determined current and projected vans and trucks (based on public data from Central Bureau of Statistics); number of vehicles to go electric in different future years; additional charging capacity required; which industrial parks will face grid capacity challenges.[138] ○ The Authority Consumer and Market (ACM) will change the codes in 2023 to allow DSOs to prioritize projects that are causing congestion or are beneficial to society as exceptions to the 'first-come-first-serve' approach.[139] ○ Existing high-voltage net of the metro in Rotterdam can be used to charge buses, and could be similarly applied to truck charging ● Italy carried out 2 studies (in Italian) to plan for future charging needs.[140] ○ Roadmap that considers the sector-specific applications of electric vans and trucks and determined the growth in number of vehicles (including TCO sensitivities), km driven, tonnes transported – 90% of trucks run less than 300 km per day ○ Report on recharging systems and solutions for different use cases / sectors covering private and public sites ● Poland developed the Polish EV Outlook[141] and is the first EU country to have mapped EV requirements and charging points in accordance with AFIR, which was mandated by the Ministry and backed by companies such as IKEA, H&M and Amazon with a strong presence in Poland. ● Transport & Environment carried out interviews with DSOs in 5 countries, Spain, France, Poland, Czech Republic, Romania, to determine the grid readiness for HDV charging in the perspective of the various AFIR targets in these member states.[142] ● New York State proposed an Act to amend laws in relation to establishing a highway and depot charging plan includes a requirement for electric network and interconnections upgrades for highway charging hubs, importantly including "future-proofing upgrades". [116] ● Run on Less demonstrations by NACFE in the US can help DSOs/utilities to understand e-trucks and future electricity demand and supply.[143] ● Eurelectric analysed how utilities/DSOs can turn EVs into managing grid balances[144] and held three roundtables on how DSOs can integrate the e-mobility boom covering 1) congestion procedures[145]; 2) congestion management[146]; and 3) making grids greener and more flexible.[147]

[137] Netbeheer Nederland (2023). Scenario's investeringsplannen 2024. https://www.netbeheernederland.nl/nieuws/netbeheerders-presenteren-scenariorapport-voor-investeringsplannen-2024--1611
[138] ELaad NL (2022). Bedrijventerreinen in beweging – Elektrificatie van bestelauto's en trucks op bedrijventerreinen tot en met 2050. https://elaad.nl/publicaties/
[139] Netbeheer Nederland (2023). Duidelijke regels bij prioriteren zijn essentieel. https://www.netbeheernederland.nl/nieuws/netbeheer-nederland-duidelijke-regels-bij-prioriteren-zijn-essentieel-1614
[140] Motus-e (2023). L'elettrificazione del trasporto merci (The electrification of commercial transport). https://www.motus-e.org/studi_e_ricerche/lelettrificazione-del-trasporto-merci/
[141] Polish Alternative Fuels Association (PSPA, 2023). Polish EV Outlook 2023. https://pspa.com.pl/2023/reports/how-many-charging-stations-will-be-built-in-poland-by-2030/?lang=en
[142] K. Burges, S. Kippelt, on behalf of Transport & Environment (2023). Grid Readiness for HDV Charging a Survey among European DSOs https://www.transportenvironment.org/wp-content/uploads/2023/08/2023_07_TE_AFIR_grid_readiness_final.pdf
[143] North American Council for Freight Efficiency (NACFE, website accessed May 2023). Run on Less. https://runonless.com/
[144] EY and Eurelectric (2022). Power sector accelerating e-mobility. https://evision.eurelectric.org/event/2022/report/
[145] Eurelectric (2023). E-mobility DSO 'Power Drive: how can DSOs integrate the E-mobility boom'. Conclusions Roundtable 1 https://www.eurelectric.org/publications/conclusions-roundtable-1-e-mobility-dso-power-drive-how-can-dsos-integrate-the-e-mobility-boom/.
[146] Electric (2023). E-mobility DSO 'Power Drive: how can DSOs integrate the E-mobility boom'. Conclusions Roundtable 2 https://www.eurelectric.org/publications/conclusions-roundtable-2-e-mobility-dso-power-drive-how-can-dsos-integrate-the-e-mobility-boom/
[147] Eurelectric (2023). E-mobility DSO 'Power Drive: how can DSOs integrate the E-mobility boom'. Conclusions Roundtable 3. https://www.eurelectric.org/publications/conclusions-roundtable-3-e-mobility-dso-power-drive-how-can-dsos-integrate-the-e-mobility-boom/

Condition 4: Land slots are made available

CONDITION 4: Land slots are made available for charging sites that ensure adequate road network coverage	
Needs	a) Sufficient public charging sites in line with charging demand and AFIR requirements b) Increased availability of existing public and private sites close to truck routes and/or transport hubs to integrate charging infrastructure in line charging demand and AFIR requirements c) Tendering at government allocated slots and private premises is efficient and meets minimum requirements
Current situation	● Sufficient public charging sites ○ Alternative Fuels Infrastructure Regulation (AFIR) will fast track the mapping and allocation of charging infrastructure by EU Member states, at a minimum along TEN-T corridors. This responds to pressing demand from European truck manufacturers for whom infrastructure is essential for them to produce zero-emission trucks at scale.[148] It is an obligation to member states and in the case of non-compliance the EU can start and infringement procedure. Some interviewees noted that unless this is strictly enforced, private companies with highway concessions may choose to not act or at least delay acting. ○ For heavy-duty trucks, growth rates needed in the EU and UK are high, and almost no public charging has been deployed so far.[194] ○ Suitability of locations often depends on available space, planning/zoning, complexity of tendering/permitting, access to grid, and other factors. ○ Different legal set ups exist for land ownership (some owned by the federal or local governments, other privately) and therefore each site needs to be assessed differently. ○ Increased potential for value add of land and this opportunity will help drive to development of new EV charging sites. ○ Parking space availability is already a limitation for adding charging infrastructure, and this situation could become worse. ● Increased availability existing sites ○ Parking / rest areas with concessions owned by private companies along highways are not sufficiently incentivised or able to integrate charging infrastructure, which is partly due to many of those sites being petrol stations that serve ICE vehicles and oil companies paying high loyalties, as well as limited available space for e-trucks charging. ○ Logistics depots are suitable sites for charging because this is where trucks load and unload. At present, the Energy Performance of Buildings Directive does not cover charging at logistics depots. ○ Industrial areas/parks are good locations for charging infrastructure because they are centrally located for CPOs and their customers; tend to have sufficient power access or ability to upgrade; have space available for charging infrastructure and truck parking. ○ Renewable energy sites are often not located near highways along the TEN-T. ○ Owners /operators across sites tend to have a conservative mindset and are relatively unaware and unconvinced about EVs, which slows the ability to secure existing sites for integration of charging infrastructure. ○ Mobile charging for construction sites. ● Tendering ○ The allocation/tendering of sites for truck charging infrastructure is in most countries not centrally coordinated but is left to the market. This leads to CPOs (existing and prospect) competing for attractive land slots, while all will only want profitable sites. This in turn reduces coverage of road networks. ○ Tendering process of new charging sites (especially of initial charging network) in inconsistent between countries/regions with authorities not always possessing the knowledge of the requirements for a well-functioning charging site. ○ Different type of players are existing or prospect CPOs, such as CPOs for car charging that want to expand to trucks (e.g. Greenway), CPOs dedicated to trucks (e.g. Milence), and oil and gas companies wanting to add charging alongside fossil products.

[148] L'Ínstitut Paris Region (2023). Zero emission" trucks to decarbonize road freight https://www.institutparisregion.fr/nos-travaux/publications/des-poids-lourds-zero-emission-pour-decarboner-le-fret-routier/

CONDITION 4: Land slots are made available for charging sites that ensure adequate road network coverage	
	○ Multiple CPOs at the same site will lead to grid connection problems.
Checklist of possible action measures	● Sufficient public charging sites ○ Set binding installation targets at the subnational/local level for charging infrastructure to align with expected ZEV growth. These are most effective when they carry binding obligations for public and private stakeholders to ensure that infrastructure deployment matches the needs of different vehicle types and travel patterns (recommendation ICCT).[70] ○ Apply a phased approach: the infrastructure roll-out must not be homogeneous across member states, due to their large differences in traffic volumes, but instead should be targeted to locations where the need is greatest (recommendation ICCT).[70] ○ National governments to translate the AFIR requirements of minimum charging sites and capacity to provincial/local levels. ○ Governments to work with national road agencies and associations of TSOs/DSOs to tackle current bottlenecks for developing truck charging hubs along motorways, such as available space, limiting concession requirements, and available power capacity. ○ National regulatory authorities (NRAs) can help ensure a minimal distribution of public EV charging points (suggestions by CEER)[120]: ▪ Encourage DSOs to foster transparency and cooperation with stakeholders involved in the deployment of charging infrastructure. ▪ Supervise the development of Distribution Network Development Plans (D-NDPs). ▪ Ensure compliance of DSOs with their obligations under the Directive on common rules for the internal market for electricity.[39] ○ Apply a systematic approach to land slots identification and allocation for public charging sites including at a minimum: ▪ Map existing parking/rest and fuel stations along/near highways concessions and identify other possible public and private properties that can integrate truck charging infrastructure. ▪ Determine the expected demand for truck charging along different highways. ▪ Select locations and number of charging points based on additional criteria such as available electricity grid power, existing/planned renewable energy sites, costs of land, existing concessions, etc. ▪ Planning / zoning to allow for charging sites. ▪ Tender sites as packages. ▪ Maintain a central record of identified and allocated sites. ● Increased availability existing sites ○ Parking / rest areas: EU to promote as strategic EU infrastructure hubs where HDV charging infrastructure can be integrated and that are safe and secure for truck drivers. ○ Logistics depots: ▪ EU to expand revisions of the Energy Performance of Buildings Directive beyond buildings to also include logistics depots to ensure these are upgraded with EV charging infrastructure too. ▪ Provide training / guidance for owners/operators of logistics depots on how to implement truck charging ○ Renewable energy sites: EU to ensure strategic synergies between TEN-T and TEN-E projects through co-location of charging sites and solar farms / wind farms. ○ Industrial parks: EU/national governments to explore program aimed at reusing defunct industrial sites for building warehouses/truck depots including charging infrastructure, which could save costs as electricity cables and other infrastructure is already there. ● Tendering ○ Centrally coordinate (at national or regional level) the tendering of charging sites, while considering market rollout developments. ○ Create a standardized checklist / procedure for tendering that can be used as a basis for authorities across Europe. This can build on the checklist from the STF Handbook developed for light-duty charging infrastructure.[155] ▪ Well-designed and well-positioned recharging points. ▪ Interoperable infrastructure including hardware (connector fits vehicle) and software (infrastructure can communicate and interact).

CONDITION 4: Land slots are made available for charging sites that ensure adequate road network coverage	
	▪ Future-proof infrastructure, i.e. both state-of-the-art today and configuration to future standards. ▪ User-friendly infrastructure with high uptime, while errors and bugs are quickly resolved. ▪ Cyber-security. o Apply 'public service obligation' tendering that requires CPOs that through a public tender get a very profitable spot to deploy charging infrastructure to also deploy infrastructure at less favourable locations where utilisation is lower. Another option is to create packages for public tendering that include profitable and less profitable sites, but as a package are profitable. o Allow only one CPO per site, although this may be challenging from a competition law perspective especially for public charging sites.
Examples / sources	● ACEA developed maps with priority locations for charging points for e-trucks across Europe, including interactive maps for central, northern, southern, south-eastern and western Europe. It gives per country total truck stop locations, total truck stops per day, locations requiring chargers by 2027, and stops/day at locations requiring chargers by 2027.[149] The underlying approach is described by Fraunhofer.[150] ● Netherlands developed several handbooks on charging infrastructure (applicable to several success factors in this study), among others: o A handbook for municipalities on charging infrastructure for the logistics sector and the role they should play, which includes determining the local charging need of logistics players and connecting with national/local policies and financial and other support that municipalities can draw from. It also includes an overview of pros and cons for selection and tendering of individual charging sites, covering individual selection (unsolicited proposal, self-realisation by a landowner, and land exchange whereby private land is offered in exchange for municipal land to build charging infrastructure) and tenders multiple direct selection with or without dialogue, public auction, sales process with pre-selection, dialogues with pre-selected competing parties).[151] o A handbook for depot managers on the establishment of large charging infrastructure for depots (available in English) that covers charging needs, charging system, electricity grid connection, location and civil work.[152] o A handbook for rollout of charging infrastructure in industrial parks and the role of municipalities, covering needs/feasibility, policy and permitting, inform and support industrial parks, initiate the concessions, and management.[153] ● Germany: NLL Germany has tender templates/concepts that it uses to prepare draft tender documents, after which the Ministries issue tenders ● ICCT reviewed public infrastructure needs in the EU (in 2022 as input into the AFIR developments), and made policy recommendations.[154] ● The Sustainable Transport Forum developed a Handbook for public authorities on ow to design tenders for e-charging infrastructure[155], based on detailed recommendations procuring, awarding concessions, licenses and/or granting support for electric recharging infrastructure for passenger cars and vans. This could also be used for charging infrastructure for trucks. ● NACFE (North American Council for Freight Efficiency) provides a 10-step approach to implement truck charging at logistics depots/private sites, which could be used as a basis for training/guidance for operators of logistics sites.[156] ● Smart Freight Centre issued guidance to companies owning and operating private truck depots to inform charging solutions.[157]

[149] ACEA (2022). Electric trucks: new data maps out priority locations for charging points https://www.acea.auto/press-release/electric-trucks-new-data-maps-out-priority-locations-for-charging-points/
[150] Fraunhofer (2021). Truck Stop Locations in Europe – final report. https://www.isi.fraunhofer.de/content/dam/isi/dokumente/cce/2021/ACEA_truckstop_report_update.pdf
[151] Nationale Agenda Laadinfrastructuur (2020). Handleiding Snelladen van Electric Vervoer. https://nklnederland.nl/aan-de-slag-met-snelladen-handreiking-nu-beschikbaar/
[152] Nationale Agenda Laadinfrastructuur (NAL, 2022). Charging Handbook for Transport Depots – a practical checklist for e-charging infrastructure. https://www.agendalaadinfrastructuur.nl/ondersteuning+gemeenten/documenten+en+links/bibliotheek+-+logistiek/default.aspx
[153] Nationale Agenda Laadinfrastructuur (NAL, 2023). Uitrol van laadinfrastructuur op bedijventerreinen. https://nklnederland.nl/nieuw-handreiking-uitrol-laadinfra-bedrijventerreinen/
[154] ICCT (2022) A review of the AFIR proposal: public infrastructure needs to support the transition to a zero-emission truck fleet in the EU https://theicct.org/publication/afir-eu-hdv-infrastructure-mar22/
[155] Sustainable Transport Forum (STF, 2021). STF Handbook. https://transport.ec.europa.eu/news/how-design-tenders-e-charging-infrastructure-new-handbook-public-authorities-2021-02-16_en
[156] NACFE (website accessed May 2023). 10 Steps to Implement Truck Charging. https://nacfe.org/research/electric-trucks/
[157] TUD and SFC (2023) Guidelines – Charging Infrastructure for Truck Depots. https://smart-freight-centre-media.s3.amazonaws.com/documents/Guidelines-Charging-Infrastructure-for-Truck-Depots.pdf

Condition 5: Permitting for charging sites is accelerated

CONDITION 5: Permitting for public and private charging sites is accelerated, while maintaining environmental and social safeguards	
Needs	a) Coordinated and efficient permitting process covering zoning, assessments, consultation and issuance of permits b) Standardised / harmonised permitting approach for charging sites by municipalities c) Coverage of all relevant issues or give exemptions from standard permit procedures
Current situation	● Coordinated and efficient permitting processes o Fragmentation of permitting authorities and differences between countries. This is linked to fragmentation of municipalities and DSOs needed for the permitting: Netherlands is split across 6 regions that bring multiple municipalities under one umbrella with a dedicated authorisation body, Germany has 880 DSOs[158] (of which 80 larger ones), and in the US up to 27,000 each with their own permitting jurisdictions. o Multiple permits and regulatory requirements including (but not limited to): zoning, requirements for contractors, building/construction, environmental health, safety and social impact assessments, security, signage. o Lengthy administrative processes are causing significant delays as EV charging companies and local businesses seek to provide access to charging. Reasons cited for electric car charging may also apply to e-trucks, e.g. "multiple municipal agencies reviewing permit applications sequentially instead of simultaneously; the absence of a permitting checklist detailing the process; and even stalling approvals that have used electronic signatures instead of ink."[159] For example, ACEA cites 3-18 month lead times for DC 150+ kW construction work permit exist due to approvals from city planning and highway bodies and local energy/geology authorities, and performance of archaeological studies.[45] ● Standardised / harmonised permitting approach for charging sites by municipalities o There is a general lack of checklists or templates for municipalities to use. o The permitting approach is not always consistent between municipalities and between EU member states and the UK. o The focus tends to be on public sites, and permitting of private sites tends to be overlooked. ● Coverage of all relevant issues or give exemptions from standard permit procedures o Fire safety is a key issue for charging infrastructure and e-trucks on site, but national/EU regulations are lacking, and property owners, insurers and permitting agencies have limited knowledge on the topic. An example is the minimum distance between parked trucks for fire safety reasons. This results in permitting delays or incomplete permitting. o Complementary infrastructure is often forgotten such as roofs, buildings and transformers. o Permit success factors include features that apply to passenger vehicle charging sites but not to public truck charging sites, e.g. price display.
Checklist of possible action measures	● Coordinated and efficient permitting processes o Develop a centrally coordinated process at the municipal level to allow multiple municipal departments/agencies to work simultaneously and reduce the total time it takes for a permit to be issued, covering both public and private sites. o Group municipalities in clusters or regions to align permitting for multiple charging sites to achieve a base network coverage for charging. o Provide training for staff at municipalities and other relevant agencies on permitting of e-truck charging sites. o Plan ahead for time-consuming steps to accelerate the permitting process such as ▪ Adaptation of development plans and or zoning for the designation of charging infrastructure ▪ Environmental, health, safety, social impact assessments ▪ Consultation and/or settlements with communities for new sites. ● Standardised / harmonised permitting approach for charging sites by municipalities (these items could be part of one guide/handbook or portal)

[158] Simon Pearson, Sonja Wellnitz, Pedro Crespo del Granado, Naser Hashemipour (2020). The value of TSO-DSO coordination in re-dispatch with flexible decentralized energy sources: Insights for Germany in 2030. In: Applied Energy, Volume 326, 2022, 119905, ISSN 0306-2619, https://doi.org/10.1016/j.apenergy.2022.119905. https://www.sciencedirect.com/science/article/pii/S0306261922011655

[159] Protocol (2022). The EV charger permitting problem. https://www.protocol.com/newsletters/climate/ev-charging-permitting-infrastructure

CONDITION 5: Permitting for public and private charging sites is accelerated, while maintaining environmental and social safeguards	
	○ Recognise that easing permitting should focus on greater capacity by government authorities to speed up the process, but cannot come at the expense of environmental and social safeguards. ○ Develop a checklist for the entire permitting process, individual steps and what should be covered under each. ○ Prepare model layouts of charging sites (charging points, parking spaces, transformers) for pre-approval so that layouts of new charging sites do not always need to be evaluated in detail for each application. ○ Develop criteria for granting special use permission for the installation of charging points. ○ Use standard agreements between permitting local authorities and CPOs for the development and exploitation of public charging sites. ● Coverage of all relevant issues or give exemptions from standard permit procedures ○ Include complementary infrastructure (e.g. roofs, buildings, transformers) and elements (e.g. signage, site marking). ○ Determine what features that apply to passenger vehicle charging sites may not be needed for public truck charging sites. ○ Put more emphasis on fire safety in national/EU regulations on which local permitting procedures rely to ensure consistency across the EU. ○ Ensure that permits already include specifications for possible future expansions of charging sites and/or additional charging points. ○ Contractual agreements should guarantee that charging infrastructure operates according to the latest available standards while ensuring that upgraded or new standards will be integrated into the charging station's software as soon as they are available, either replacing the old standard or functioning in parallel.[160] ○ Private refuelling stations with public access can be zoned or permitted differently than normal public refuelling stations.
Examples / sources	● Netherlands developed several handbooks on charging infrastructure[151,152], a model collaboration agreement for permits between municipalities and CPOs[161], and a training for policy makers at local authorities involved in sustainable mobility on the logistics sector, charging infrastructure, and the role of government and policy.[162] ● Germany's Masterplan includes the development of a guide for municipalities aimed at optimizing and speeding up approval processes, and model layouts (charging points, parking spaces and transformers) to be included in relevant regulations such as for roadside rest areas.[105] ● California ○ Passed a law in 2021 to ensure that "local agencies [do] not adopt ordinances that create unreasonable barriers to the installation of electric vehicle charging stations."[163] It requires cities and counties to adopt a streamlining ordinance and checklist, and they are scored on 7 criteria to accelerate permitting of electric vehicle charging stations.[164] ○ Developed a (second edition) Electric Vehicle Charging Station Permitting Guidebook that includes planning and site selection; accessibility; permitting; energization; construction, commissioning and operation. The annex includes a checklist for each of these steps.[165] ● US has an online toolkit for EV infrastructure planning with guidance and tools on identifying needs for permitting and regulatory compliance[166]

[160] ECOS and RAP (Dec 2022). Standards for EV smart charging: A guide for local authorities. https://www.raponline.org/wp-content/uploads/2022/12/ECOS-RAP-standards-for-EV-smart-charging-2022-dec.pdf

[161] NKL Nederland (Netherlands Knowledge Platform for Charging Infrastructure, website accessed May 2023). Model samenwerkingsovereenkomst Vergunningen. https://nklnederland.nl/gemeenten/

[162] Nationale Agenda Laadinfrastructuur (NAL, 2023). Training logistiek laadbeleid voor beleidsmakers van gemeenten. https://www.agendalaadinfrastructuur.nl/nieuws/home+2+berichten+uitgelicht/2447080.aspx

[163] California Legislative Information (2021). AB-970 Planning and zoning: electric vehicle charging stations: permit application: approval. https://leginfo.legislature.ca.gov/faces/billCompareClient.xhtml?bill_id=202120220AB970&showamends=false

[164] California Governor's Office of Business and Economic Development (2021). Electric Vehicle Charging Station Permit Streamlining Fact Sheet. https://static.business.ca.gov/wp-content/uploads/2021/11/EV-Charger-Permit-Streamlining-AB-1236-Fact-Sheet-Version-1.pdf

[165] California Governor's Office of Business and Economic Development (2023). Electric Vehicle Charging Station Permitting Guidebook – second edition. https://static.business.ca.gov/wp-content/uploads/2019/12/GoBIZ-EVCharging-Guidebook.pdf

[166] US Department of Transportation. EV Infrastructure Project Planning Checklist. https://www.transportation.gov/rural/ev/toolkit/ev-infrastructure-planning/project-planning-checklist

Condition 6: Charging infrastructure and services are operational

CONDITION 6: Charging infrastructure and services (physical and digital) are operational for well functioning charging sites	
Needs	a) Installation, operation and maintenance of key charging system components b) Customer access to affordable charging and associated services c) Standardisation, harmonisation and integration/interoperability of essential steps for charging sites
Current situation	● Key charging system components o These components typically include: hardware (physical charging stations); infrastructure (transformers, electrical switchgear, asphalt, concrete, trenching, conduit, writing, striping and landscaping); charging management systems (CMS, to ensure sufficient and efficient charging of e-trucks, integrate other energy sources, and manage grid services); networking (software/access cards to record use, cloud-based services to benefit the CPO, EMSP and customers); and maintenance and repair.[172] o Long waiting times to deliver charging infrastructure hardware, and for installation due to lack of experienced electricians.[104] o Hardware and software standardisation for e-cars can be a basis for e-trucks but must be more centralized and harmonised to avoid multiple charging systems that are not interoperable. o AFIR has limitations that affect the quality of charging infrastructure ▪ AFID set the standard for electric vehicle plugs (that will be included in AFIR), however AFIR does not yet include requirements for MCS and the full set of smart charging possibilities. ▪ AFIR smart charging proposals have limited flexibility, which may lead to outdated infrastructure. ▪ AFIR mandates a payment terminal with displays at single charge point level which increases costs while not adding value to the driver. ● Customer access to affordable charging and associated services o Availability of charging points across the network (interim charging, overnight charging). ▪ Charging infrastructure essential at warehouses/depots, and along highways essential for long-distance trucks. This is because freight companies want to charge trucks during normal operations without additional stops (i.e. same as current diesel trucks) otherwise it will cost more. Opportunities for charging are 45 min rest periods every 4.5 hours, depots/warehouse loading bays, overnight charging. ▪ Companies with regional/long-distance trips cite that for the availability of charging points they are highly dependent on charging infrastructure at premises of transport company, truck manufacturer, or customer.[89] ▪ Charging points are accessible and affordable for round-trips/last mile delivery and regional trips where trucks return to or arrive at another depot for (overnight) charging. ▪ User profiles must be known. These consist of the trip profile and need for charging, including trips without charging, extra charging stop, and charging at the end-customer or depot. Secondly, different sectors have specific logistics characteristics that influence charging needs, such as food and beverage, construction, chemicals, and fast moving consumer goods. o Access to charging points and services relate to smooth booking, guaranteed access, reliable operation, billing, parking, and on-site facilities. o SME freight carriers often park at third party premises (often customers such as retailers), which gives them less access to overnight charging points compared to large fleets. o An exploration study on booking systems in the Netherlands found that:[167] ▪ Booking systems are in an early stage of development, despite logistics players indicating this is a must-have for charging infrastructure. ▪ Different types of systems possible based on a) static or dynamic systems; b) targeted at private/non-public or public charging sites; and c) single user or multi-user. The “maximum model” is preferred that communicates widely and everyone can join.

[167] Nationale Agenda Laadinfrastructuur (2022). Marktverkenning reserveringssystemen logistiek laden https://www.agendalaadinfrastructuur.nl/werkgroepen/wg+logistiek/nieuws+werkgroep+logistiek/2347693.aspx

CONDITION 6: Charging infrastructure and services (physical and digital) are operational for well functioning charging sites	
	▪ There is a need for booking systems, including the flexibility to change booking slots based on trip changes, whereas CPOs see a risk of this flexibility contributing to under-use of certain charging sites/points. ▪ Truck manufacturers and freight companies wish for a booking system to be internationally integrated in existing logistics systems rather than creating a separate system and devices. o There are many complaints around EV cars and a lot to learn from those developments. Some OEMs have used private companies (e.g. ChargePoint, EVGO) while Tesla has its own charging network and thus control over costs and maintenance. ● Standardisation, harmonisation and integration/interoperability of essential steps for charging sites o Megawatt Charging System (MCS). The European Union and the United States agreed on a common international standard on MCS for the recharging of electric heavy-duty vehicles.[168] o The International Electrotechnical Commission (IEC) working group develops the Megawatt systems IEC-68123-3 standard. MCS technical specifications and any changes need to be considered by OEMs and CPO, which can affect e-truck and charging infrastructure development.[169] o Charin is a global association with over 320 members dedicated to promote standards on charging systems for EVs. It set up a Task Force on MCS and released a white paper with recommendations and requirements for MCS related standards bodies and solution suppliers.[170] o Harmonisation of signage for e-trucks and charging infrastructure, battery storage at charging sites, and data collection is not yet in place o Interoperability between charging sites of different CPOs/EMSPs is not yet assured / worked out. For EV cars, Tesla will give access to its charging infrastructure to Ford EV customers in the US and Canada[171] – this could be an example for truck charging infrastructure to look at. o RMI found that the greatest opportunity for cost reduction lies in 'soft costs': process, marketing, opportunity, delays in permitting. These are poorly understood and hard to quantify.[172]
Checklist of possible action measures	● Key charging system components installation, operation and maintenance o EU: AFIR amendments to consider ▪ Flexibility for upgradable hardware and software as much as possible. ▪ Recognition of the MCS (800kW+) as the minimum standard for public heavy-duty vehicle charging sites (currently capacity target thresholds of 1400kW by 2025 and 3500kW by 2030 are based on 350kW stations). Some noted that this should involve a validation whether CCS with higher charging speeds are insufficiently able to charge during driver breaks (usually 45 min minimum). ▪ Exemption of public heavy-duty vehicle charging sites from individual charging point pricing display, and put ad-hoc payment and automatic authentication requirements at charging pool level. ▪ Exemption of public charging cites from putting payment card readers on every charging point.[173] ● Customer access to affordable charging and associated services o Carriers/LSPs, truck manufacturers and customers to collaborate/coordinate on increasing access to non-public charging sites o Develop charging site maps like those for electric cars. o Develop booking systems at the EU level to avoid cues, which requires data sharing on the battery charge, real-time location, trip distances.

[168] European Commission (2023). EU-US Trade and Technology Council enhances cooperation in emerging technologies, sustainable trade and economic security. https://ec.europa.eu/commission/presscorner/detail/en/ip_23_2922

[169] International Electrotechnical Commission (IEC, website accessed September 2023). PT 61851-23-3 DC electric vehicle supply equipment for Megawatt charging systems https://www.iec.ch/ords/f?p=103:14:4940002324859::::FSP_ORG_ID:27936

[170] Charin (2022). CharIN Whitepaper Megawatt Charging System (MCS) https://www.charin.global/technology/mcs/

[171] Ford (2023). Ford EV customers to gain access to 12,000 Tesla superchargers; company to add north American charging standard port in future EVs. https://media.ford.com/content/fordmedia/fna/us/en/news/2023/05/25/ford-ev-customers-to-gain-access-to-12-000-tesla-superchargers--.html

[172] RMI (2019). Reducing charging infrastructure costs. https://rmi.org/insight/reducing-ev-charging-infrastructure-costs/

[173] EVBox, Zuzana Púčiková (March 2023). Getting the AFIR right to fuel Europe's bold climate ambitions. https://blog.evbox.com/getting-afir-right

CONDITION 6: Charging infrastructure and services (physical and digital) are operational for well functioning charging sites	
	○ CPOs to provide easy available, standardized and understandable price information based on Charger output, kW charged and time the charger is occupied[110], while recognizing that requirements for truck drivers/operators are different than for customers with electric cars. ○ Explore with customers (such as retailers) and other third-parties where SMEs park their trucks if charging infrastructure can be installed. This could help customers to achieve emission reduction targets and give other third parties a competitive advantage and an added revenue stream. ○ National regulatory authorities can help increase customer (freight operators) acceptance and protection (suggestions by CEER):[120] ▪ Encourage smart charging for example by raising awareness of the benefits of smart charging or encouraging the development of smart charging offers, particularly time of use tariffs. ▪ Fostering a market environment which encourages the emergence of innovative business models, e.g. smart meter rollout and settlement reforms to open a market for dynamic contracts; or review of existing regulations to identify and address potential blockers of innovation. ▪ Address barriers which may prevent freight operators from accessing charging services, for example through a survey. ▪ Monitor compliance with both existing and new regulations (case study 11 for Italy and case study 12 for Germany). ▪ Give guidance to industry in implementing the regulation in their national context (case study 14 for UK). ▪ Facilitate customer access to public charging points information through registers or maps (case studies 15 for Germany, 16 for Poland). ● Standardization, harmonization and integration/interoperability of essential steps for charging sites ○ Truck and equipment manufacturers, CPOs, EMSPs an standardization bodies to ▪ Support the development of standards for all essential steps in the charging process of heavy-duty e-trucks. This includes charging technology (e.g. overhead catenary hanging systems, location of charging sockets on the vehicle) and the MCS standards.[105] ▪ Provide sufficient specialised personnel as well as test and trial capacities for MCS standardization.[105] ▪ Harmonize charging passes across the EU network to allow freight companies to charge anywhere. ○ EU/national governments to ensure that national standards charging infrastructure design are consistent across Europe and internationally. ○ EU/national governments to coordinate and involve more proactively the standardisation bodies on standards, codes, test procedures and supporting technology requirements. This can build on the existing transatlantic agreement between the US government, EU institutions and stakeholders for a on the use of standards for public implementation specifications (IEC 61851, ISO15118, UN-ECE GTR 22).[174]
Examples / sources	● NACFE prepared detailed guidance with information and advice for fleets on how to charge their vehicles reliably and cost-effectively, focused on North American commercial BEVs. on charging infrastructure for electric trucks, including charger basics, charging system and charging business models, as well as information on financial assistance, implementation and other considerations, a bibliography of charging infrastructure works, and a list of charging infrastructure suppliers and utilities with electric truck charging programs in North America.[175] ● Germany will publish a guide for installation of charging infra at private company premises and charging at own/third-party company premises.[105] ● Norway's National Charging Strategy details customer solutions (payment solutions, price information, information concerning charging services), and national standards for design charging stations and equipment (entry/exit, payment solutions, physical design, signage) aligned with AFIR.[110] ● The city of Amsterdam requires charging points to be modular, facilitating the replacement of components. ● Chargemap pass for cars can be example for similar pass for e-trucks, for example as exists for Amsterdam.[176] ● Netherlands developed guidelines on security requirements for procuring EV charging stations.[177] ● RMI study of the costs involved in deploying charging infrastructure grouped into three categories: procurement, requirements, and soft costs.[172] ● US government developed an EV Charging Financial Analysis Tool (excel) for financial analysis of owning and operating EV charging stations[178]

[174] Hardy K. and Scholz, H. (2023).Transatlantic technical recommendations for government funded implementation of electric vehicle charging infrastructure. Publications Office of the European Union, Luxembourg. ISBN 978-92-68-04035-5, doi:10.2760/542957, JRC133895. https://joint-research-centre.ec.europa.eu/document/aeabfa59-7073-427d-8f92-75cfe5abfca5_en

[175] NACFE (2023). Charging forward with electric trucks. https://nacfe.org/research/electric-trucks/

[176] https://nl.chargemap.com/cities/amsterdam-NL

[177] https://elaad.nl/en/publications/

[178] US Department of Transportation. EV Planning Resources: Cost Analysis. https://www.transportation.gov/rural/ev/toolkit/planning-resources/cost-analysis

Condition 7: Data are available, accessible and shared

CONDITION 7: Data are available, accessible and shared to facilitate planning, construction and operation of charging sites and ensuring interoperability between market players.	
Needs	a) Data for planning and construction of charging infrastructure and related grid connections b) Data for charging sites operation and services, e.g. truck movements, charging points availability and grid usage c) Open digital infrastructure for data sharing and interoperability between market players
Current situation	● Data for planning and construction of charging infrastructure and related grid connections o Data is needed to determine future charging infrastructure demand (long-term and site-specific) and for subsequent planning and construction of charging infrastructure. o Truck manufacturers generally are seen as cautious to share data on truck numbers and movements that would allow for planning of charging infrastructure and efficient services to freight companies once sites are operational. o Data on traffic, as trucks need to operate among other vehicles, and traffic management is often overlooked when planning for logistics infrastructure, in particular in urban areas. o Utility data is important to plan and design charging infrastructure and related grid connections but detailed data from utilities/TSOs/DSOs is often lacking. ● Data for charging sites operation and services o Data needs are different for e-trucks compared to ICE trucks: ▪ Data on charging infra availability, occupancy, disruptions, price across sites (for drivers). ▪ Data on traffic density and flow to predict demand (for CPOs). ▪ Data about the weather if electricity for charging is sourced from solar/wind. ▪ Data on GHG emissions and mitigation (scope 1, 2 and 3) of charging sites. ▪ Data on green electricity to allow for emission credits/trading. o Truck manufacturers are by some seen as reluctant to share data on truck numbers and movements that would allow for efficient services to freight companies once sites are operational. o Freight companies are starting to adopt e-trucks but have generally not worked out how to integrate charging into their logistics systems, although this is essential for planning when trucks should be charged. For example, two suppliers wanting to charge at the same time at a retailer requires planning. o Utilities/TSOs/DSOs currently insufficiently share necessary data for CSOs to optimize charging, one reason is the lack of smart meters. o Capacity within the sector to work with data and IT is limited. A main reason is that the sector is not attractive for employees: driver shortage is already a problem due to employment success factors, and the sector struggles to attract young people for future roles such as IT specialists and platform operators. o Truck manufacturers developed data-driven systems to manage the supply of materials / semi-products and the dispatch trucks and components to retail outlets and customers. These could be a blueprint to develop systems for charging sites, involving suppliers of those IT solutions. ● Open digital infrastructure for data sharing and interoperability between market players o Digitalisation in the form of uniform, fast and automated exchange of data is critical for charging infrastructure rollout.[105] o Lack of information / registry of public and private charging points for trucks at EU and national levels. o Lack of standardised protocols for data access, sharing and interoperability between market players
Checklist of	● Data for planning and construction of charging infrastructure and related grid connections

CONDITION 7: Data are available, accessible and shared to facilitate planning, construction and operation of charging sites and ensuring interoperability between market players.	
possible action measures	○ Consider cleanroom talks with industry to gather information from truck manufacturers, CPOs, utilities, grid operators and investors on future charging demand, private sector rollout activities, investments in charging infrastructure, and gaps ○ Utilities and grid operators to give minimum access to data on grid capacity and other grid usage data to allow optimal charging strategies, as well as local hosting capacity maps to inform logistics operators when building/upgrading depots ○ Truck manufacturers to give minimum access to in-vehicle generated data ○ Include all publicly accessible charging points in a central register ○ Create the legal basis for regular reporting by DSOs of non-public charging points (number geographical distribution) to support charging network planning ○ Request ACEA to complete as soon as possible the coordinates database[149] with the annual maximum number of simultaneous stops (trucks) by location, as best proxy of required power from the grid, and to share with DSOs the coordinates database.[179] ● Data for charging sites operation and services ○ Truck manufacturers to be incentivized, preferably through government policy, to give minimum access to in-vehicle generated data ○ Education of freight companies and drivers (see earlier) to include how to integrate charging in their logistics systems, combined with the development of showcases to understand what works and how to solve barriers ○ DSOs to digitalize smart meters on their grid to be able to share automated data with CSOs to optimize charging ○ Grid operators (DSOs/TSOs) to be required to share data on grid usage (available capacity) to facilitate optimised e-truck charging ○ National regulatory authorities can map data sharing issues and potential for harmonisation across EU member states.[120] ● Open digital infrastructure for data sharing and interoperability between market players ○ EU to (facilitate to) create a robust open EU data sharing framework of key data types between freight companies, truck manufacturers, grid operators and charging providers. A platform for data sharing could be integrated in the proposed European Mobility Data Space (EMDS) ○ All relevant stakeholders to contribute to a joint e-mobility and charging infrastructure data space (covering all transport, not only trucks). In particular, truck manufacturers and technology providers could share experience with their existing data-driven systems. ○ Develop standardized protocols for data access, sharing and interoperability between market players covering all relevant aspects of e-truck charging infrastructure ○ Open API-connection between CPO charging slot reservation systems and planning and travel tools of trucks and shippers
Examples/ sources	● Germany's Masterplan includes several measures on data that could also be applied across EU/by other countries:[105] ○ StandortTOOL 2.0 maps the installed charging capacity, the number of existing and expected vehicles, target forecasts of demand.[107] ○ Cleanroom talks with industry. ○ Transparency regarding all publicly accessible charging points (including consideration to amend Charging Point Regulations and improving data quality and access) as part of AFIR Implementation Regulation. ○ Create the legal basis for reporting by DSOs of non-public charging points (number geographical distribution) to support charging network planning. ○ Public heatmaps of DSO network capacity and planned upgrades.

[179] European Copper Institute (forthcoming publication). https://copperalliance.org/regional-hubs/europe/

Condition 8: Business and finance models support the transition

CONDITION 8: Business and finance models support the transition to e-trucks and matching charging infrastructure and services	
Needs	a) Financial support for freight companies to purchase e-trucks and adapt their business models b) Support for Charge Point Operators to develop charging infrastructure and attract private capital c) Change business models of truck and equipment manufacturers from selling trucks to selling services associated with e-trucks
Current situation	● Freight companies: o E-trucks are not yet affordable for many freight companies ▪ Purchase costs are cited at 2-4 times the costs of ICE trucks. ▪ A study for the EU found that 70% of urban delivery e-trucks currently have a favourable TCO over ICE trucks. E-trucks in the medium/high segment do not yet have a positive Total Costs of Ownership (TCO = purchase, residual value, energy, battery replacement, maintenance and repairs, other operating productivity), although based on passenger EV experience, the TCO could reach parity within a few years.[180] ▪ The majority of fleets have a 'wait-and-see' attitude – they don't want to be first movers but will wait for legal certainty and TCO parity before making the switch. Costs, ease of use and reliability are main criteria for freight companies. This especially applies to SMEs who consider "How much does it cost me now, and not how long does it last", making big freight companies dominate more. ▪ Some leading companies decide to invest in e-trucks despite higher purchase costs but incentivised by government subsidies. For example PepsiCo purchased an initial 18 Tesla semi-electric trucks for 250,000 USD each, but also received federal, state and local grants for the vehicles and charging infrastructure.[181,182] ▪ The changes in tolls for trucks on European highways under the Eurovignette Directive[29] will favour the TCO of e-trucks. For example, Germany will increase toll rates for diesel trucks from 1 December 2023, while electric and hydrogen trucks will remain exempt from tolls until December 2025 at the minimum, which for most vehicle combinations (including HD trucks) means an increase estimated at 86% or 35.4 Euro cents per km compared to 19 cents at present. The proceeds of which will be used to develop road and rail infrastructure.[183] o The logistics sector is transitioning to a completely new system through electrification and digitalisation/automation. ▪ Truck distances and charging patterns will be different for e-trucks and therefore a business model (capex/opex; TaaS), and planning system (when/how often to charge) are needed. ▪ Truck leasing or trucks as a service (TaaS, e-trucks at a per km rate that includes the truck, charging infra and maintenance) may be a solution but to switch from a high capex/low opex (truck purchase) to a low capex/high opex (truck leasing) model makes many uncomfortable. ▪ Charging as a service (CaaS, freight company owns the e-trucks and pays a monthly subscription fee or negotiated fee for charging to a charging provider) eliminates the need for freight companies to invest in own charging infrastructure. o Contractual terms between freight companies and their customers (shippers) need to be changed to de-risk the switch to e-trucks. Shippers (freight customers) are currently not willing to pay a sufficiently high premium or extend contract durations to help freight companies transition to e-trucks. Yet many have set ambitious targets and have a reputation to protect (greenwashing risk). ● CPOs and other investors in charging infrastructure o Several government funding schemes exists:

[180] TNO (2022). Techno-economic uptake potential of zero-emission trucks in Europe. https://www.transportenvironment.org/wp-content/uploads/2022/10/202210_TNO_-techno_economic_uptake_potential_of_zero_emission_trucks_in_Europe.pdf
[181] Electrek, Fred Lambert. (2023). Tesla delivers a new fleet of Tesla Semi electric trucks to PepsiCo. https://electrek.co/2023/04/12/tesla-delivers-fleet-tesla-semi-electric-trucks-pepsico/
[182] Electrive (2023). PepsiCo puts 18 Tesla Semis into company livery. https://www.electrive.com/2023/04/13/pepsico-puts-18-tesla-semis-into-company-livery/
[183] Envio (2023). Germany's toll rates from December 2023 – an 86% increase. https://enviogroup.com/en/germanys-toll-rates-from-december-2023-an-86-increase/

CONDITION 8: Business and finance models support the transition to e-trucks and matching charging infrastructure and services	
	▪ EU schemes mentioned include a) the Alternative Fuels Infrastructure Facility (AFIF), part of CEF Transport, is an ongoing financing instrument to support innovation and improvements in the European alternative fuels infrastructure, with the goal of decarbonising transport along the TEN-T network. A last funded round closes in November 2023.[184]; the Recovery and Resilience Facility[185]; the Just Transition Fund[186] ; the Green Deal Industrial Plan[187]. ▪ The European Investment Bank has an extensive range of instruments to mobilise public and private sector investors and fund projects of different risk levels: public sector financing, private sector/corporate/project finance direct loans, intermediated loans, project finance with direct project risk, equity type (direct and indirect), and risk sharing/blending.[104] This includes technical and/or financial support for their EV charging projects from the European Investment Bank - https://advisory.eib.org/ (STF Handbook).[155] ▪ At the national level different public funding schemes for e-trucks and supporting infrastructure in EU and UK exist.[188] o Private capital is less certain. ▪ There is venture capital for EV charging development but no guaranteed cash flow. ▪ It is unclear what the minimum threshold is to attract private capital for charging infrastructure, which is needed to set the right policy incentives for investments ▪ Truck manufacturers are co-investing, such as Daimler, Volvo and Traton investing in the joint-venture Milence to install public charging points for long-distance e-trucks across Europe.[189] o Political and policy uncertainty is a barrier to investing in charging infrastructure because plans need to give certainty to investors and companies that span a longer period that the average government term. An example cited was Sweden's policy on biofuels in transport: a) biofuels obligations were reduced as part of an election promise by the new Swedish government to cut the price of diesel at the pump.[190]; b) a 10 year tax exemption for biogas was removed after a German company challenged this in EU courts, and now companies that benefited fear that they need to pay the tax exemption back.[191] o Subsidies for e-truck charging infrastructure often do not consider the costs of grid connections/reinforcement, and therefore are in practice lower compared to subsidies provided for hydrogen refuelling stations. Allowing subsidies for hydrogen refuelling stations to also cover fossil-based hydrogen further undercuts the transition away from fossil fuels, even with EU plans to give more favourable subsidies for hydrogen produced from renewable energy.[192] o Governments pass regulations to advance e-trucks without necessary understanding the cost implications for freight companies to install charging infrastructure to operate these. An example cited is the Netherlands where as a result of local authorities introducing zero emission zones as a way to transition to zero-emission vans/trucks in urban areas, freight companies must invest €1.7 billion to build and maintain them, excluding the costs of charging trucks.[193] o Lessons from the Sweden scheme to improve future funding rounds are: (based on interviews and REEL publication[91])

[184] EGEN (website accessed May 2023). CEF Transport – Alternative Fuels Infrastructure Facility (AFIF). https://www.egen.green/grants/cef-transport-afif/
[185] European Commission. The Recovery and Resilience Facility (website accessed May 2023). https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility_en
[186] European Commission. Just Transition Fund (website accessed May 2023. https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/just-transition-fund_en
[187] European Commission. The Green Deal Industrial Plan (website accessed May 2023). https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/green-deal-industrial-plan_en
[188] Transport and Environment (T&E, 2022). How to buy an electric truck. https://www.transportenvironment.org/wp-content/uploads/2022/11/TE-Briefing-2022-ZET-funding-FINAL.pdf
[189] https://milence.com/
[190] The Local (2023). Government parties agree to slash biofuels obligation to 6 percent. https://www.thelocal.se/20230508/government-parties-agree-to-slash-biofuels-obligation-to-6-percent
[191] Riedia (2023). Biogas gets some breathing room while waiting for the commission https://www.riedia.com/article/en/biogas-gets-breathing-room-waiting-commission-2023-05-04/
[192] Reuters (2023). EU plans subsidies for hydrogen made using renewable energy -draft document. https://www.reuters.com/business/energy/eu-plans-subsidies-hydrogen-made-using-renewable-energy-draft-document-2023-03-16/
[193] Ploos Van Amstel, Walther (Feb 2023). Wordt de laadinfrastructuur voor zero emissie zones onbetaalbaar voor ondernemers en overheden? https://www.waltherploosvanamstel.nl/wordt-de-laadinfrastructuur-voor-zero-emissie-zones-onbetaalbaar/

CONDITION 8: Business and finance models support the transition to e-trucks and matching charging infrastructure and services	
	▪ Timeline of fund allocation should be shorter (was almost a year) ▪ Companies applied for funding for infrastructure but some are slow to access the allocated funding, and until they do no new calls are possible (140 public charging, 12, hydrogen fuelling stations) ▪ Quotes change from the application date and the actual commissioning/construction, for example if may take 8 months to get a permit, or inflation causes labour and material costs to rise, and then a new application is needed. ▪ Calls attracted untested companies because 100% subsidies are provided, and the main criteria related to location, traffic flow and other technical specs, but there was too little consideration of experience/proven record and own funding. ▪ One agency to be in charge of funding schemes for e-trucks and charging infrastructure. ▪ SMEs need support with applying for funding and they often don't have the skills/knowledge needed for preparing the applications. ▪ EU rules (GBER 36A and 36B) that deal with government support create obstacles to national funding schemes. ● Truck manufacturers o Have set 2030 sales/manufacturing targets for 2030, but it is often not clear what investments they have committed to, which is critical because of the lead time for new e-trucks to be available on the market in large numbers. o Explore leasing and 'truck as a service' (TaaS) for freight companies to overcome investment barriers for e-trucks and charging infra. o May hesitate to make the full switch to e-trucks including investments because their business models rely on a sizeable income from maintenance and repair services which would be significantly reduced. o Invest/co-invest in e-trucks, charging infrastructure, alternative fuels, batteries.[194]
Checklist of possible action measures	● Financial support for freight companies:[68,175,195] o Subsidies/rebates by governments or regulatory authorities subsidies for e-trucks based on the differential with ICE trucks to overcome investment costs so that subsidies phase out as e-trucks reach TCO parity; higher subsidies for SMEs; subsidies financed through levies fossil fuel trucks; subsidies for charging infrastructure that keeps up with e-truck growth; organised as rolling calls to make applications easier to plan and process. o Government loans to asset purchasers to reduce vehicle purchase and insurance costs. o Truck manufacturers to offer "Truck as a Service" (TaaS), such as Volta[196], combining truck leasing with charging and other services. o Truck manufacturers or institutional investors/green banks to offer guarantee on the (minimum) residual or resale value. o Shippers (freight customers) to adjust contractual arrangements to provide longer term contracts, lease or buyback solutions. o DSOs/utilities to drop requiring proof of e-truck acquisition before new grid connections for charging infrastructure are approved.[76] ● Charging Point Operators and other investors in charging infrastructure o Governments and regulatory authorities to ensure that government funding/subsidies for infrastructure are wisely allocated, for example ▪ A condition for companies applying for funding/subsidies for charging infrastructure is that they provide co-funding. ▪ Grants/subsidies for infrastructure are subject to applications for corresponding trucks as well (i.e. BEV for charging infra, FCEV for hydrogen refuelling stations) to avoid 'stranded infrastructure'. ▪ Public service obligation or packages for public tendering that include profitable and less profitable sites, but as a package are profitable. ▪ Consider grants for e-truck charging infrastructure and grid upgrades equally to e-truck purchase subsidies.[104] ▪ Grants for high capacity chargers / fast charging stations to cover the costs gap during early years when chargers are still under-utilized. ▪ National regulatory authorities to use their regulatory functions to deliver investment to infrastructure, such as Ofgem does in the UK.[120]

[194] ICCT (2021), Race to Zero: Zero-emission Commercial Trucks and Buses in Europe. https://theicct.org/publication/race-to-zero-ze-hdv-eu-dec21/
[195] Smart Freight Centre, CALSTART, Transport and Environment (2023). Financing the transition to electric trucks. https://globaldrivetozero.org/publication/financing-the-transition-to-electric-trucks/
[196] Hill, Joshua (2023). Volta Trucks receives €40 million boost to electric truck as a service model. https://thedriven.io/2023/03/30/volta-trucks-receives-e40-million-boost-to-electric-truck-as-a-service-model/

CONDITION 8: Business and finance models support the transition to e-trucks and matching charging infrastructure and services	
	○ Create a level playing field for subsidies for e-truck charging infrastructure and hydrogen refuelling infrastructure by including grid connections into subsidies for truck charging infrastructure and by excluding fossil-based hydrogen from subsidy schemes. ○ Explore combining financial support to CPOs with demand charge pricing scheme for customers, whereby the price for a charging session is determined by the costs of energy, demand charge and infrastructure congestion.[197] ○ Use regulatory tools and incentives to address charging gaps and improve the business case for private investment. Policy mechanisms that encourage efficient and faster deployment of private capital will help limit long-term public funding.[104] These may cover: ▪ Investment costs and TCO of charging sites. ▪ Financial support for construction of charging sites and support infrastructure. ▪ Financial incentives to make costs EV charging comparable with fossil fuels, either by subsidizing charging service costs for freight. companies combined with increasing fossil fuel costs. ▪ Financial support for financially less viable sites to ensure network coverage. ▪ Possibility of bidirectional charging. ▪ Avoided emissions from green electricity supplied by charging sites can be monetised through emissions credits/trading. ▪ Issuance charging cards by companies to truck drivers. ▪ Harmonised regulation on collection of turnover tax for charging transactions. ● Truck and equipment manufacturers to ○ Adapt business models to changing needs of freight companies as they switch to e-trucks. ○ Track and disclose investments in e-truck models, batteries and manufacturing and ensure alignment with 2030 commitments. ○ EU/national governments to support truck manufacturers in the EU to make the transition, including through a response to US IRA.
Examples / sources	● T&E prepared an overview of public funding schemes and recommendations for e-trucks and infrastructure in EU and UK.[188] Examples are: ○ Netherlands subsidies for purchase/leasing of e-trucks (BEV/FCEV) of up to 40% of the differential with ICE trucks for large businesses and 60% for SMEs (<10 employees), and subsidies for infrastructure only apply if accompanying trucks are purchased as well.[198] ○ Germany's funding scheme 'Climate-friendly commercial vehicles and infrastructure' or in German the Klimaschonende Nutzfahrzeuge und Infrastruktur (KsNI).[199] The Federal Ministry for Digital and Transport provides around €1.3 billion in subsidies for the procurement of climate-friendly commercial vehicles and €6.3 billion for the construction (or expansion) of refuelling and charging infrastructure for cars and trucks.[200] It covers up to 80% of the differential between ICE and e-trucks. A third call will be held in 2023. ○ Poland set aside over PLN 125 million (about €28 million) in a national for subsidies aimed at stations of at least 150 kW to cover up to 50% of eligible costs and help cover the cost gap associated with under-utilisation in early years when e-vehicles are still ramping up.[201] ● CALSTART developed a Funder Finding Tool for California to help stakeholders search and filter for Medium-and-Heavy-Duty Alternative Fuel Vehicle and infrastructure programs in the state of California.[202] ● Smart Freight Centre, CALSTART and T&E developed an overview of options to overcome the financing barrier for electric trucks.[195]

[197] Lee at all (2020). Pricing EV charging service with demand charge. In: Electric Power Systems Research, Volume 189, December 2020, 106694. https://www.sciencedirect.com/science/article/abs/pii/S0378779620304971
[198] RVO (updated April 2023). Aanschafsubsidie Zero-Emissie Trucks (AanZET). https://www.rvo.nl/subsidies-financiering/aanzet
[199] German Federal Logistics and Mobility Office (accessed May 2023). Climate-friendly commercial vehicles and infrastructure (KsNI). https://www.balm.bund.de/EN/FundingPrograms/KSNI/Ksni_node.html
[200] Germany NOW (2022). BMDV supports ramp-up of climate-friendly road freight transport. https://www.now-gmbh.de/en/news/pressreleases/bmdv-supports-ramp-up-of-climate-friendly-road-freight-transport/
[201] Polish Alternative Fuels Association (PSPA, 2023). https://pspa.com.pl/2023/information/the-budget-for-grants-for-the-fastest-charging-stations-was-fully-allocated-in-less-than-an-hour/?lang=en
[202] CALSTART (website accessed May 2023). Funder Finder Tool. https://fundingfindertool.org/

CONDITION 8: Business and finance models support the transition to e-trucks and matching charging infrastructure and services	
	● ICCT determined purchase premiums for electric delivery vehicles (or emission charges if apply to diesel delivery vehicles) until 2023 required to cover the TCO gap. An example cited is Germany where a 6000 Euro bonus would suffice.[203] ● ICCT made an overview of European truck manufacturers in e-trucks/buses, infrastructure, batteries and alternative fuels.[194] ● The Netherlands conducted a study that includes an overview of purchase prices before and after subsidies ranging from 42-57% for different e-trucks to ensure that the TCO is at parity with equivalent ICE trucks.[204] ● France: EDF (shareholder of DSO Enedis that manages the power distribution network in 95% of France) took €800 million loan from the European Investment Bank to pay for the connection of decentralised renewable energy production facilities / microgrids, and electric vehicle charging stations in metropolitan France over the period 2022-2024.[205] ● Norway: a support scheme "Dedicated charging for heavy vehicles" operated by state enterprise Enova is set up as a competition for funding where projects are selected based on cost efficiency (financial support per kW), support is 40% of approved additional costs with a maximum of NOK 5 million (approximately €440,000).[110] ● US: the California Public Utilities Commission provided a $750 million budget in 2019 for the Charge Ready Transport program run by utilities, to install infrastructure to support charging stations at no charge and rebates for charging equipment, showing that utilities can take a pro-active role in financing of charging infrastructure.[206] ● RMI study looked at the three EV charging infrastructure cost types including a) procurement costs (charger hardware, managed charging capability, contracts, software, grid-hosting capacity, make-ready infrastructure), b) compliance/requirement costs (payment system, measurement standards compliance, ADA compliance and parking requirements, dual plug types, cost standards), and c) soft costs (communication between utilities and providers, future-proofing, easement processes, complex codes and permitting processes.[172] ● Regulatory Assistance Project made a Roadmap that includes financial incentives for electric transportation.[207]

[203] Hildermeier J and Basma H in Energy Monitor (2022). Making the last mile electric. https://www.energymonitor.ai/sectors/transport/making-the-last-mile-electric-battery-trucks/

[204] Panteia (2021). Ingroeipad zero emissie trucks (table 4.1). https://open.overheid.nl/documenten/ronl-4ace3ab3-c916-4f30-aaa5-3bcd0a45d7cb/PDF

[205] European Investment Bank (May 2022). France: EIB and EDF announce the signing of an €800 million loan contract to finance the energy transition of the power distribution network managed by Enedis. https://www.eib.org/en/press/all/2022-243-edf-et-la-bei-annoncent-la-signature-d-un-contrat-de-pret-de-800-millions-d-euros-au-service-de-la-transition-energetique-du-reseau-de-distribution-electrique-gere-par-enedis

[206] Utility Dive (2019). SCE rolls out $356M charging program to spur electric trucks, buses and other large vehicles https://www.utilitydive.com/news/sce-rolls-out-356m-charging-program-to-spur-electric-trucks-buses-and-oth/555175/

[207] Regulatory Assistance Project (RAP, 2020). Roadmap for Electric Transportation: Policy Guide. https://www.raponline.org/knowledge-center/roadmap-electric-transportation-policy-guide/

Condition 9: Broader effects of e-trucks are managed

CONDITION 9: Social, economic and environmental effects are managed covering the entire value chain of e-trucks	
Needs	a) Just transition to address the social and economic effects of the switch to e-trucks b) Circular economy system for e-trucks, batteries and equipment c) Supply chain resilience to geopolitics, climate impacts and other disruptions
Current situation	● Just transition to address the social and economic effects o Potential injustices across the EV lifecycle, locally and internationally, cover resource extraction and processing, manufacturing, distribution and operation, and waste and disposal.[208] o The impact on automotive jobs is a key issue, and it is clear that there will be winner and losers that makes a just transition essential. ▪ Industry associations lobbying tends to be conservative towards climate policies, but there is greater unity on lobbying for a Just Transition for automotive workers, although some associations also use just transition to delay the EV growth.[209] ▪ Ambiguity exists around jobs lost and created, depending on the scope. For example, the European Association of Automotive Suppliers (CLEPA) reported a loss of up to 500,000 jobs at automotive suppliers in the EU by 2040, combined with 226,000 new positions in EV components, resulting in a net loss of 275,000 jobs.[210] This does not include new jobs for example in mining or infrastructure. ▪ In Europe both non-governmental organisations and industry associations called for the EU to develop a Just Transition framework for automotive workers, arguing that "Alongside higher climate ambition, we want to see industrial transformation and innovation in Europe rather than deindustrialisation and social disruption".[211] Car manufacturing regions also want to collaborate.[212] ▪ Multinationals will be better able to respond to the transition than SMEs.[213] ▪ Workers and their unions fear of factories being pitted out against each others by automotive companies switching to EVs, for example Ford factories in Spain and Germany, which resulted in a decision to close the German factory.[214] ▪ Protection of labour success factors are also covered by regulations such as the UK Modern Slavery Act 2015 and EU due diligence directive.[61] o Many companies are insufficiently prepared. For example, a survey of 90 transport companies (including freight companies) found that[215] ▪ None of the 90 companies cover planning for a just transition with time-bound targets, putting an estimated 10 million workers at risk. ▪ 13% (12 companies) commit to social dialogue with workers, unions and other groups. ▪ 38% (34) of companies undertake measures for skills, training, and education, including job opportunities for women and vulnerable groups (13%, 12 companies) and reskilling (7%, 6 companies).

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[211] https://www.transportenvironment.org/wp-content/uploads/2021/08/Letter-to-Mr-F.-Timmermans-Urgent-need-for-a-Just-Transition-framework-for-Europes-automotive-workforce.pdf

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CONDITION 9: Social, economic and environmental effects are managed covering the entire value chain of e-trucks	
	○ Communities are affected in different ways from this shift to e-trucks: low-income and disadvantaged communities often bear the burden of air pollution from freight transportation and could benefit from e-trucks,[216] but residents living close to charging sites or roads leading to those sites can be affected by increased traffic, noise and accidents. ● Circular economy system ○ The drivers for a circular economy system are ecological (natural resource depletion and ecological damage), economical (jobs, costs of materials and products), social (labour success factors linked to mining) and geopolitical (dependency on few countries for products and materials). ○ Climate goals require that in parallel to the transition to e-trucks the power sector also transitions to renewable energy. ○ Climate goals require a whole-life approach to e-trucks: the transition to EVs could lead to 60% of electric car's emissions to come from materials, especially steel and aluminium, although it needs to be confirmed if the percentage would be similar for e-trucks.[217] ○ Materials are the key focus: the automotive industry in the EU is the N°1 consumer of aluminium (42%), magnesium (44%), platinum group metals (63%), natural rubber (67%) and rare earth elements (30% in 2025, and growing exponentially).[26] ○ Financial feasibility is a key factor for truck manufacturers and suppliers. WEF research suggest that "circular economy approach enables automotive companies to increase revenues per vehicle by 15-20 times the sales price and significantly improve profitability by maximizing lifetime performance."[218] ○ Challenges with circularity: conflicting eco-design policies; omission of role of software in predominant hardware product policies; extended producer responsibility and waste management policies include recycling targets that sometimes incentivise recycling over reuse and quantity over quality of recycling; export of second-hand vehicles and waste to lower-income countries; environmentally sound/hazard-free recycling.[219] ● Supply chain resilience ○ Globalisation, facilitated by the removal of trade barriers, has led to companies concentrating their production to fewer countries/regions where cheap labour and raw materials are abundant and economies of scale make production more efficient. Today the world is increasingly exposed to shocks that affect the supply chain: pandemics, weather events exacerbated by climate, and geopolitics / trade wars. ○ For e-truck and infrastructure the main supply chain challenge is shortages of or dependency on a few countries on e-trucks, components (especially batteries and semi-conductor chips) or raw materials (e.g. lithium, cobalt and nickel). ○ Countries and companies respond with reshoring or homeshoring (back to own country) or friendshoring (away from geopolitical rivals to a reliable like-minded country) of parts of the supply chain is already happening, for example, the movement of production going from China to Mexico or Vietnam to avoid US tariffs.[232, 220] ○ Governments increasingly introduce policies to reduce dependency on few countries combined with trade barriers to protect national industry, which affect e-trucks, batteries and charging equipment. For example, the EU Critical Minerals Act for a secure and sustainable supply of critical raw materials for the EU[45]; the EU Chips Act to strengthen its own semiconductor ecosystem[46]; the US Inflation Reduction Act to stimulate manufacturing of green products and components within the US, further strengthened by the Bipartisan Infrastructure Law (BIL), the CHIPS & Science Act[64]; China introduced export limits to rare earths raised concerns that export restrictions may be widened to other materials.[221]

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[221] Reuters (2023). China's rare earths dominance in focus after it limits germanium and gallium exports. https://www.reuters.com/markets/commodities/chinas-rare-earths-dominance-focus-after-mineral-export-curbs-2023-07-05/

CONDITION 9: Social, economic and environmental effects are managed covering the entire value chain of e-trucks	
	○ The IEA notes that "While more diverse and resilient supply chains are highly desirable, the pace at which clean energy must be scaled up will be even harder to achieve without open supply chains."[222] ○ The EU Directive on corporate sustainability due diligence[61] requires companies to audit their supply chains can create transparency to address social and environmental impacts, but can also help build supply chain resilience.
	● It is noted that just transition, a circular economy system and supply chain resilience are interlinked and if implemented together could strengthen the social, economic and environmental benefits for the EU. For example, a just transition could lead to new jobs in the circular economy that are closer to home and therefore make supply chains more resilient. ● Just transition to address the social and economic effects ○ Governments to integrate just transition into policies and associated funding schemes that promote e-trucks and charging infrastructure, and communicate the benefits for workers in the automotive industry and at the levels of individual provinces/states within a country/the EU. ○ Truck manufacturers and freight companies to step up their role in the just transition through Just Energy Transition Partnerships (JETPs) or other country-level just transition frameworks. ○ Truck manufacturers, freight companies, CPOs and EMSPs to adopt a corporate strategy on just transition covering the four components of climate leadership: Ambition, Action, Advocacy, Accountability.[223] ● Circular economy system ○ Truck manufacturers/suppliers and governments to adopt circular strategies and policies across all life-cycle stages (material extraction, material production, product manufacturer, transport, sale, use): recycling, remanufacture, refurbish, reuse, repair.[219] ○ EU to consider the applicability and feasibility of the ELV Directive to also cover medium and heavy-duty trucks, as well as the suggestions of Transport & Environment to improve the current ELV Directive regarding low-carbon materials in new vehicles, preventing vehicles and the valuable materials in them from being exported, and improving both the quantity and quality of recycling.[224] ○ Governments, IGOs, industry and civil society to collaborate on introducing harmonised policies that favour circularity of e-vehicles and batteries around the world, that combine climate, circular economy and broader sustainable development goals, covering:[219] ▪ Extended producer responsibility and waste management (including materials passports) ▪ Supply chain transparency and visibility ▪ Phase-out of fossil fuels and ICE vehicles ▪ Demand management for freight, multi-modal optimization and other measures to precent rebound effects ▪ Costs and distribution of costs and value ▪ Leakage to lower-income country by limiting cross-border flows of used and waste vehicles. ● Supply chain resilience ○ Companies to map supply chains to increase visibility and transparency. This can be used to regionalise and restructure/simplify supply chains including number of tier 2 and 3 suppliers, locations and product lines, and identify other measures to increase flexibility and resilience.[232] ○ EU/Governments to develop policies to improve raw materials supply: improving mining processes to extract more materials in an environmentally friendly way; promoting circular economy principles; and using fewer critical materials.[225] ○ EU/Governments to explore, as part of homeshoring/reshoring/friendshoring policies, collaborating with partner countries on how to avoid competing on subsidies that will chase after the same companies to invest in their countries and could lead to excess capacity.[232]

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CONDITION 9: Social, economic and environmental effects are managed covering the entire value chain of e-trucks	
Examples / sources	• The German government and several European organisations established the Just Transition in the European Car Industry project to support the sector in the just and climate-friendly transition.[226] • South Africa: the National Business Initiative led the development of just transition and climate pathways for transport together with the South African private sector and other relevant stakeholders.[227] • European Business Toolkit for Just Transition[228] and the Just Transition Resource Platform[223] provide resources for companies on how to act. • International Labour Organisation developed an infographic to explain the connection between just transition and green jobs.[229] • EURACTIV started a series of articles to explore the EU policies that aim to make the green transition a "just transition", including automotive.[230] • EU explains the relevance of the Just Transition Fund to circular economy systems.[231] • Trade Bites podcasts discuss supply chain challenges, including supply chain resilience and example of semi-conductors during Covid.[232] • US Inflation Reduction Act Fact Sheets for workers and families[233] and for individual US states explain the benefits to families and communities.[234] • Circular Cars Initiative of the World Economic Forum.[235] • Stellantis (constellation of 14 automotive brands and two mobility arms) established a dedicated Circular Economy Business Unit in support of its net-zero by 2038 climate target.[236]

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[229] International Labour Organization (ILO, 2023). Infographic - Just transition and green jobs. https://unece.org/sed/documents/2023/08/infographic-just-transition-and-green-jobs
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[236] Stellantis (2022). Stellantis Fosters Circular Economy Ambitions with Dedicated Business Unit to Power New Era of Sustainable Manufacturing and Consumption. https://www.stellantis.com/en/news/press-releases/2022/october/stellantis-fosters-circular-economy-ambitions-with-dedicated-business-unit-to-power-new-era-of-sustainable-manufacturing-and-consumption

Condition 10: Stakeholders are informed, coordinated and collaborate

CONDITION 10: Stakeholders with different roles in e-trucks and charging infrastructure are coordinated and collaborate with each other.	
Needs	a) Key stakeholders understand their roles and are supported to execute these b) National coordination bodies collaborate with key stakeholders to advance e-trucks and charging infrastructure in their countries c) EU network of national authorities/focal points and platform for collaboration and exchange
Current situation	● Key stakeholders understand their roles and are supported to execute these o Very few stakeholders, if any, have a full picture of what needs to be done, yet they cannot advance e-trucks and charging infrastructure on their own. *"NO ONE CAN DO IT ALONE!"* (mentioned by virtually all interviewees) o Stakeholders tend to be aware of their direct roles, but not across all success factors for e-trucks and charging infrastructure. They also are not fully aware of the roles of other stakeholders. o There is no single NGO that can put the puzzle together. Foundations fund many NGOs to advance e-trucks but what seems lacking is an assessment if they collectively cover all the success factors and bottlenecks for e-trucks and associated charging infrastructure. *"Funders and NGOs seem to collectively hop from issue to issue, and that will take too long."* ● National coordination bodies collaborate with key stakeholders to advance e-trucks and charging infrastructure in their countries o There seem to be central coordination points for some countries but not all. *"It is a black box."* Examples are: ▪ Austria: Österreichs Leitstelle für Elektromobilität (OLE, https://www.austriatech.at/de/leitstelle-elektromobilitaet/) ▪ Germany: Nationale Leitstelle Ladeninfrastruktur (https://nationale-leitstelle.de/en/) ▪ Italy: Motus-E (https://www.motus-e.org/) ▪ Netherlands: E-Laad (Rijkswaterstaat), with a dedicated working group on logistics (https://elaad.nl/en/) ▪ Poland: Polish Alternative Fuels Association (https://pspa.com.pl/?lang=en) ▪ Sweden: CLOSER (https://closer.lindholmen.se/en) ▪ UK: Freight Energy Forum (https://www.gov.uk/government/groups/freight-energy-forum) o A one-size-fits all approach for e-trucks and charging infrastructure will not work across European countries. In particular, the situation in Eastern European countries is very different from Western European countries. Poland was cited as an example: ▪ Important for the EU with the largest fleet of >13T trucks in Europe (1.2 million compared to 960k Germany, 600k Spain and Italy and 500k France) carrying nearly 300 million tonnes of goods or 30% of total freight in the EU, and with 7,500 km of Ten-T roads ▪ Bigger need: import of second-hand ICE cars and trucks means old and polluting fleets, air pollution is a bigger trigger for change (29 of 100 Europe's most polluted cities are in Poland), 80% electricity generation using coal, GHG emissions rose 200% from 1990-2020 (EU 30%) with a 24% share from transport (EU 20%) ▪ Less favourable success factors: demand from freight companies for BEVs is much lower, there is no subsidy scheme for e-trucks and infra like the one in Germany, less likely to implement EU 'directives' than 'regulations' as only the latter is binding (and Germany negotiating exemptions for e-fuel ICE phase out creates a disincentive for Eastern European countries to adhere to EU regulations), the dependency on corporations to influence government to act is more important, capacity is low (need help, not just funding). ● EU network of national authorities/focal points and platform for collaboration and exchange o Lack of understanding of who are the relevant authorities or coordination points in different EU countries, making collaboration and exchange between them more difficult. o Facilitation/coordination is critical because the sector has not seen much change: highly inefficient, outdated, conservative/risk-averse o Existing international/EU-wide platforms tend to be conservative and dominated by lobbying, protective of jobs, an engrained attitude against change and new technologies that undercut the status quo. It was also noted, however, that on the topic of charging infrastructure the industry associations and NGOs tend to be more aligned.

CONDITION 10: Stakeholders with different roles in e-trucks and charging infrastructure are coordinated and collaborate with each other.	
Checklist of possible action measures	● Key stakeholders understand their roles and are supported to execute these o Further work out the Actionable Framework for each key stakeholder separately (while making sure that their collective actions cover everything that is needed off). o Provide detailed guidance for key stakeholder that may need this, e.g. freight companies, DSOs/TSOs or local governments, building on what exist in Europe as well as drawing from other guidance (e.g. guidance for fleet managers on charging infrastructure developed by NACFE[175]) o Establish a searchable database structured based on what stakeholders need to do in practice, with resources that are not pdf documents. ● National coordination bodies collaborate with key stakeholders to advance e-trucks and charging infrastructure in their countries o Develop criteria and a terms of reference for a national coordination bodies together with existing focal points in EU countries. One suggestion is that due to the tight implementing schedule of AFIR, a joint task force of transport and energy ministries could coordinate the implementation of charging infrastructure where grid assessment and reinforcement is the more critical step. o Map key stakeholders for each EU member state covering the nine stakeholder types in this framework (and others if there are gaps). o Get freight companies, fleet managers and drivers on board and involve them early on as they are the primary users of both e-trucks and charging infrastructure. Cleanroom Talks between government and industry may be one way to increase industry involvement. o Develop a tailored Actionable Framework and supporting plan at the national level. ● EU network of national authorities/focal points and platform for collaboration and exchange o Mapping of stakeholders at EU level covering the nine stakeholder types identified in this framework (and others if there are gaps). o Establish network of authorities and national focal points (sometimes these are the same) in different EU countries with representatives directly involved in EV trucks and charging. o Form a platform or consolidate behind an existing platform(s). This should be a platform to exchange to avoid instant confrontations. o Take into consideration the specific needs of Eastern European countries. o Focus on a corridor in the EU that has the capacity to transition at least 20% of the truck fleet to e-trucks, so that all countries can learn.
Examples / sources	● Germany Charging Infrastructure Masterplan II includes relevant measures on cooperation and coordination: Interministerial Steering Group on Charging Infrastructure (ISLa), a National Centre for Charging Infrastructure (NLL), exchange views with EU Member states, involvement of the automotive industry through “cleanroom talks”, involvement of the oil sector, and a monitoring strategy (see condition 1) ● Netherlands: organisational set up includes a National Knowledge Platform Charging Infrastructure (NKL) focused on charging infra, logistics and policy; the National Agenda Charging infrastructure with a “flying brigade” that brings specific knowledge and tools on charging technologies, entrepreneurs, industry parks and related policy; ElaadNL as a partnership of DSOs is the knowledge and innovation centre in the field of smart charging infrastructure; and the Centre of Expertise City Net-zero with a stronger focus on training. ● Platform for Electromobility was set up for passenger EVs and could be an example for or replicated for e-trucks.[237] ● The Alliance for Logistics Innovation and Collaboration (ALICE) is an existing EU platform for the freight and logistics sector bringing industry, research/civil society, and governments together, and could potentially be a host for such a platform.[238] In particular, the ZEFES project (Zero Emissions flexible vehicle platforms with modular powertrains serving the long-haul Freight Eco System project is relevant).[239] ● Collaboration on mapping and giving greater access to relevant policies across the EU could involve the Climate Policy Radar.[240] ● ACEA lists several collaboration programs/set ups, including the EU DSO entity, which could be used as an example to set up coordination efforts among other key stakeholders.[104]

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