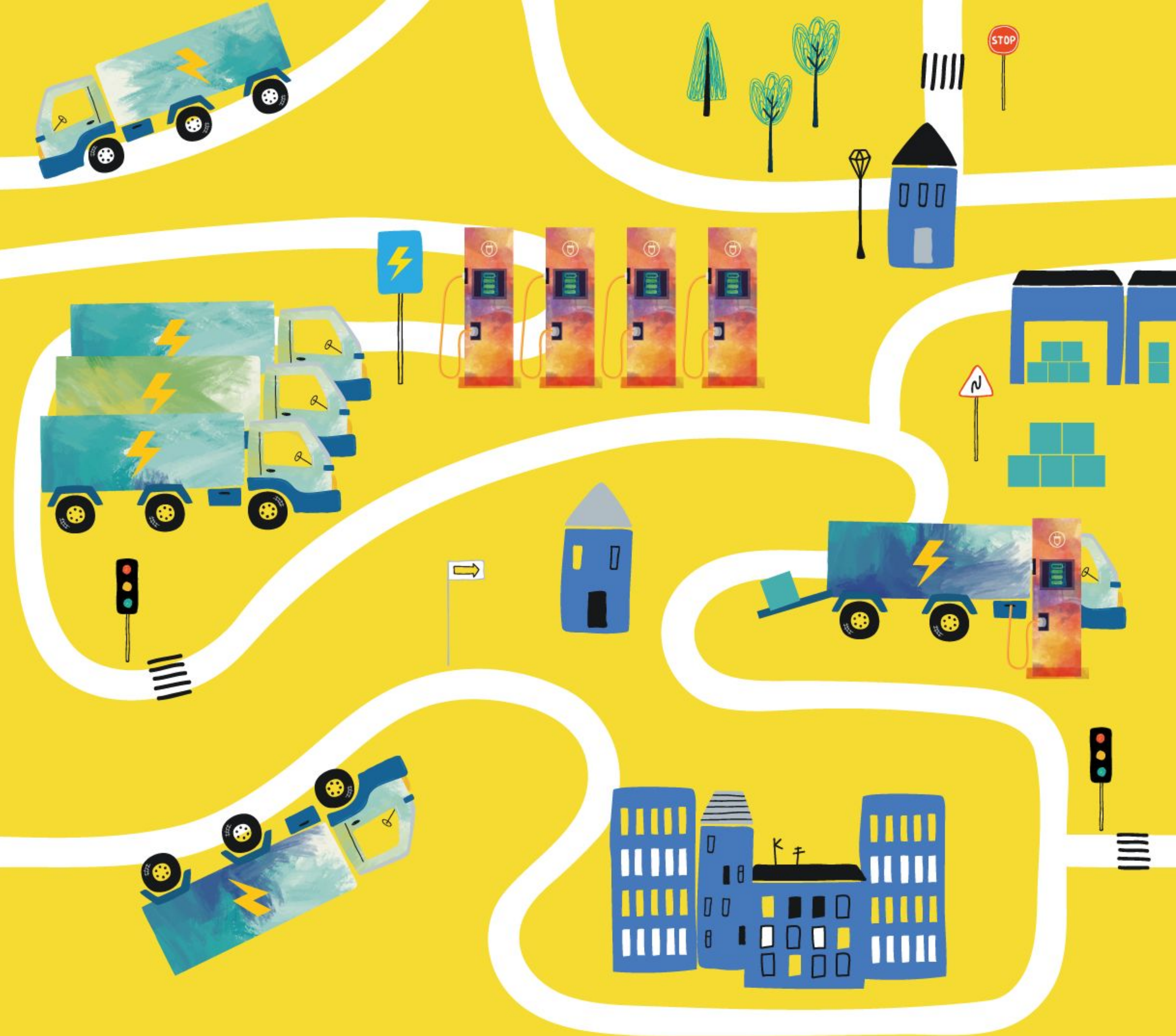

Unlocking electric trucking in the EU: recharging in cities

Electrification of urban and regional deliveries (Vol. 1)

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Executive Summary

The potential of electric commercial vehicles to mitigate climate change and reduce air pollution is commonly underestimated. The European Green Deal strategy has omitted zero emission trucks, and the current recovery programmes at national level wrongly assume that the only short term technology are new efficient diesel trucks. But for most of the urban and regional delivery applications, battery electric trucks are already commercially available, technically and economically attractive and bring broad environmental benefits making them the preferred technological pathway for these applications.

Half of EU's total truck activity (in tonnes.km, good proxy for CO_2 emissions) **is driven over distances of less than 300 km. These trips could be covered today by electric trucks,** thanks to new models currently coming to the market with about 300 km range (enough to cover nine trips out of ten). But limited supply and **lack of charging strategy currently slows down the uptake**. It is expected that the range of the electric trucks available will swiftly increase to 500 km, covering about two thirds of kilometers and 19 trips out of 20.

In this report, T&E breaks new ground and shows that, with the right policy and charging infrastructure, a large number of trucks can be electrified already now. It provides a quantitative analysis of how much charging infrastructure electric trucks will require in the next decade to electrify urban and regional delivery based on EU truck traffic flows.

Findings

The analysis finds that targeting the EU's largest urban areas is the optimal zero emission freight strategy for the next years. Based on a novel methodology, this report shows that electric truck adoption and deployment of associated charging infrastructure should be prioritised in 173 medium and large urban areas in the EU, called here 'urban nodes'. These urban nodes combine three factors that makes them a perfect focus:

- They are **'hotspots' for freight activity**: trips coming to or from the urban nodes make **up half of the total EU freight activity (tkm)** and 39% of trips.
- Trips include a large share of short trips: 15% of total freight activity occurs within urban nodes
- They tend to be the areas with the highest air pollution levels related to road vehicles

In this report, the 173 urban nodes are used and are a combination of the existing 88 urban nodes defined in the TEN-T Regulation, plus an additional 85 nodes which are the remaining areas with the most urban and regional truck activity across Europe. This extends the existing network of urban nodes to cover more road freight activity and thus increases the potential in replacing diesel trucks.

Three scenarios for electric truck uptake have been analysed: 'Industry-Baseline', the automotive industry's baseline scenario; 'EV-Leaders', based on announced plans from some of the leading truck manufacturers, and; Road-2-Zero, T&E's scenario compliant with mid-century climate neutrality. The two latter scenarios build upon the Industry-Baseline scenario with a stronger electric truck adoption at the urban nodes, a consequence of a zero emission city freight strategy.

	Baseline	EV-Leader	Road-2-Zero
Share of sales in 2025	1.3%	5%	10%
Share of sales in 2030	15%	20%	30%
Electric trucks in 2030	191,000	316,000	526,000
2030 CO2 reduction (%)	8%	13%	22%

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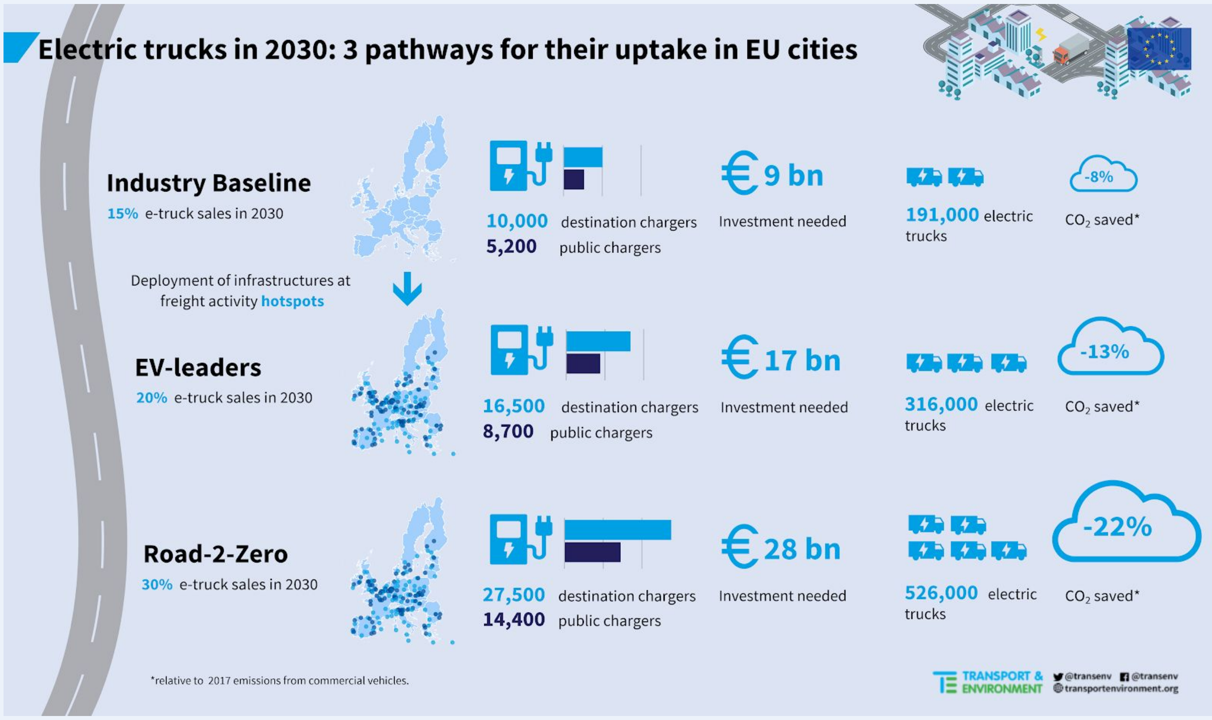
This report models charging infrastructure deployment needs in the urban areas to unlock electric trucking potential. Prioritising charging infrastructure roll-out at the 173 urban nodes is demonstrated to be a cost-effective strategy in which electric trucks cover 9%, 14% and 24% of the total EU road freight activity in 2030 respectively in the Industry-Baseline, EV-Leaders and Road-2-Zero scenarios (or 16%, 30% and 43% of the trips). As a result, CO_2 emissions from road freight would be reduced by 8%, 13% and up to 22% in 2030.

T&E calculates that in 2030 there should be a total of **27,500 destination chargers (at the distribution center) and 14,400 public chargers** in the EU in the Road-2-Zero scenario. This translates into a need of about **one destination charger for every 15 electric trucks** and **one public charger for every 30 electric trucks**. Total cumulative investment in destination and public chargers amounts to €28 billion over the next decade in the Road-2-Zero scenario, or an average annual investment of €2.8 billion, which is only 2.8% of the annual EU €100 billion investment in transport infrastructure. In 2021-2025, investment required is only 0.5% of the money available under the EU's recovery fund (€750 billion).

On average, each of the 173 urban nodes analysed would need 1,700 depot chargers, 90 destination chargers and 50 public chargers (largest urban nodes could have 3 times more electric trucks and chargers). The average electricity consumption of one urban node amounts to 29-166 GWh per year in 2030, or up to 50 TWh in total at EU level (or 1.6% of the current total electricity generation).



Recommendations

With the right policy and charging infrastructure, road freight can be decarbonised to a great extent in the 2020s. This report shows how smart infrastructure deployment in cities can set the stage for battery electric trucks to come to the fore. Diesel and natural gas truck sales must be phased out between 2035 and 2040 at the latest if the EU wants to be in line with its Green Deal objective of climate neutrality by mid-century. To achieve this level of decarbonisation, a number of legislative and policy changes will be necessary to accelerate both the production supply of electric trucks and to urgently deploy charging infrastructure at the depot (overnight charging), at the distribution center (destination charging) and at publicly accessible locations (public charging). Policymakers should start this today and bring about a comprehensive strategy to rapidly electrify all deliveries.

First and foremost, the revision of the Alternative Fuels Infrastructure Directive (AFID) planned for the first quarter of 2021 as part of the EU Green Deal, should finally cover electric trucks and recognise direct electrification as the dominant source to decarbonise urban and regional deliveries. The **AFI Directive should be turned into a Zero Emission Infrastructure Regulation (ZEIR)**, **focusing exclusively on electricity and green hydrogen**, thus removing natural gas from the scope of the 'alternative fuels' that currently get preferential EU treatment and funding. The new ZEI Regulation should urgently set **binding targets for destination and public charger**

roll-out, with a strong focus at the urban nodes. The number of destination and public chargers needed at the EU's urban nodes for each country is presented in this report (see Annex).

Secondly, the **revision of the TEN-T Regulation**, which is set to take place in Q1 2021 in parallel of the AFID revision, should double the number of TEN-T urban nodes (from 88 today) with another set of complementary ‘freight’ nodes. The revision should also strengthen the ‘low carbon urban delivery’ requirement at urban nodes to make them EU’s leaders for zero emission mobility.

Third, short and medium term EU and national **funding mechanisms** should be used to **accelerate the supply of electric trucks**. Indeed the demand from the logistics sector for electric trucks has been strong but low supply from truck makers and high purchase costs have been bottlenecks to adoption. The EU and Member States should allocate part of the **COVID-19 recovery fund** to support OEMs' transition of manufacturing platforms to electric with the aim of reaching 10% electric sales in 2025. The EU **CEF Transport Blending Calls** should also be redesigned as it currently fails to address properly the needs from electric trucks. The co-funding rates for the purchase of electric trucks should be streamlined to accelerate the handout of the financial support and widen the scope of the beneficiaries. T&E recommends that electric truck sales should receive a fixed **subsidy per km of range**. Co-funding rates for depot, destination and public charging infrastructure (currently 20%) should also be streamlined as much as possible (e.g. vouchers) and increased to 50% when not possible (e.g. for grid connection).

Fourth, the revision of the **EU's heavy duty vehicle CO_2 regulation**, planned for 2022, should be addressed as part of the EU Green Deal’s 2030 climate plan. Given the electrification trajectory already considered by the industry (15% sales in 2030), **ambitious zero emission vehicle mandates** should be set, in particular for not-yet regulated truck categories- such as the small rigid trucks below 16 tonnes - which have very high electrification potential. California has recently announced a Zero Emission Vehicle sales mandate which would be equivalent to 8% ZEV sales in 2025 and 37% in 2030 in the EU.

Finally, **local and national authorities** should set a clear path towards zero emission freight deliveries by extending vehicle **zero emission zones to freight** and engage the transition with the various stakeholders.

This report is the first part of a trilogy of reports providing a quantitative assessment looking into the potential of zero-emission trucks in the EU. The second report will assess the role of hydrogen trucks in port areas and the third report will compare the different zero-emission pathways for long haul trucks where hydrogen fuel cells will be compared alongside battery electric trucks.

Table of contents

Introduction

Trucks account for less than 2% of the vehicles on the road but 22% of CO_2 emissions from road transport[1] and the climate impact of the heavy duty vehicles is one of the fastest growing (9% increase over three years[2]). The EU CO_2 emission reduction targets for new heavy duty vehicles will increase the electrification of the new vehicles and will open new opportunities for the EU's industry to make up for the late start in the electric car revolution. Today, all key European truck-makers have started producing electric trucks but there are uncertainties over the expected production volumes, partly because of the current lack of a strategic approach to electric truck charging.

In February 2020, T&E published a roadmap for electric truck charging which outlines a policy strategy for the EU to decarbonise the freight sector and bring it in line with the EU's Green Deal commitments. This roadmap is summarised briefly in Section 1 (see original paper for more[3]).

In this report, T&E builds upon the earlier roadmap and carries out a quantitative analysis of the impact of the policy measures it outlines. The objective of this study is to provide analytical evidence on how much charging infrastructure is needed in the EU to support the deployment of electric heavy duty vehicles up to 2030. The analysis focuses on urban areas and electrification of city and regional logistic trips. The location of the main urban areas that should be targeted is also outlined. Such quantification based on heavy duty vehicle flow data at European level has not been done before. T&E hopes this new evidence will contribute to create a better understanding of what can be expected in the next decade with regards to the uptake of electric commercial vehicles as well as providing a solid basis for future policy and regulation, in particular for the revision of the Alternative Fuels Infrastructure Directive (AFID) in the first quarter of 2021.

Section 2 of this report gives an overview of the truck flow dataset and investigates the importance of the main urban areas while Section 3 presents three scenarios for battery electric truck adoption within those key urban areas along with the corresponding electrification assumptions. The three scenarios are: i) Industry-Baseline with low electric truck uptake ii) EV-Leaders, based on truckmakers' announcements, and iii) Road-2-Zero, aligned with the carbon neutrality Green Deal objective. Next, Section 4 presents the outcome of the analysis and assesses the impact of the electrification of freight trips in urban areas. Finally Section 5 lays out T&E's policy recommendations to accelerate the deployment of electric heavy commercial vehicles and the associated charging infrastructure, focusing in particular on the revision of the Alternative Fuels Infrastructure Directive planned for the first quarter of 2021.

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[1] UNFCCC data from 2017 with a 85%/15% split between emissions from trucks and buses. Share of vehicles on the road is based on ACEA: 308.6 motor vehicles in circulation in the EU (source) and 6.6 million trucks (source).

[2] UNFCCC data, from 2014 to 2017. Heavy duty vehicles include trucks and buses above 3.5t

[3] Transport & Environment (2020). Roadmap for electric truck charging. Link

This project is based on a database of European freight movements which is the result of the ETISplus project[4], a European Commission DG MOVE research project. This database is currently used by T&E under three projects: first, this project (volume 1), focusing on regional deliveries and urban areas; second, the analysis of the role of hydrogen trucks in Europe's ports; finally, the longer-term assessment of different pathways to fully decarbonise the EU's long haul road freight transport. For more details on the database, the methodology and the modelling for the three projects, please see the separate methodology note[5]. This paper looks at goods vehicles above 3.5 tonnes.

1. Roadmap for electric truck charging up to 2030

This section is a summary of a previous T&E paper entitled 'Roadmap for electric truck charging[6]

1.1. Urban and regional deliveries: a low hanging fruit

Battery electric vans and trucks are currently seen as the most promising solution to decarbonise urban and regional deliveries. Indeed, road freight vehicles that come back to the depot overnight and travel a maximum of 300 km to 400 km per day are expected to electrify at a fast pace as their economic and environmental benefits can't be ignored much longer.[7] On the demand-side, the adoption of electric freight vehicles is driven mainly by competitive total-cost of ownership[8], better driver comfort, much lower noise levels (8 times lower according to Renault Trucks), reduced congestion[9] and air quality benefits in cities.

As a consequence, all truckmakers are starting to offer electric trucks with up to 300 km range today in the heavy weight category (above 26t) and most have committed to battery electric vehicles as the future for urban and regional deliveries[10]. The real world range of the current generation electric trucks is expected to increase up to 400 km to 500 km in the next few years and the gross weight (GCV) is expected to reach into the 44 tonnes segment which is by far the largest emitter of GHG for commercial use vehicles. For example, Nikola Motors has announced they will start producing the first long haul battery electric truck in Europe starting in 2021 in a joint venture with Iveco (range up to 400 km)[11].

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[4] https://www.tmleuven.be/en/project/etisplus

[5] Transport & Environment (2020). *Unlocking electric trucking in the EU: Methodology*. Link

[6] Transport & Environment (2020). *Roadmap for electric truck charging.* Link

[7] Auke Hoekstra (2019). *Electric trucks: economically and environmentally desirable but misunderstood.* Link

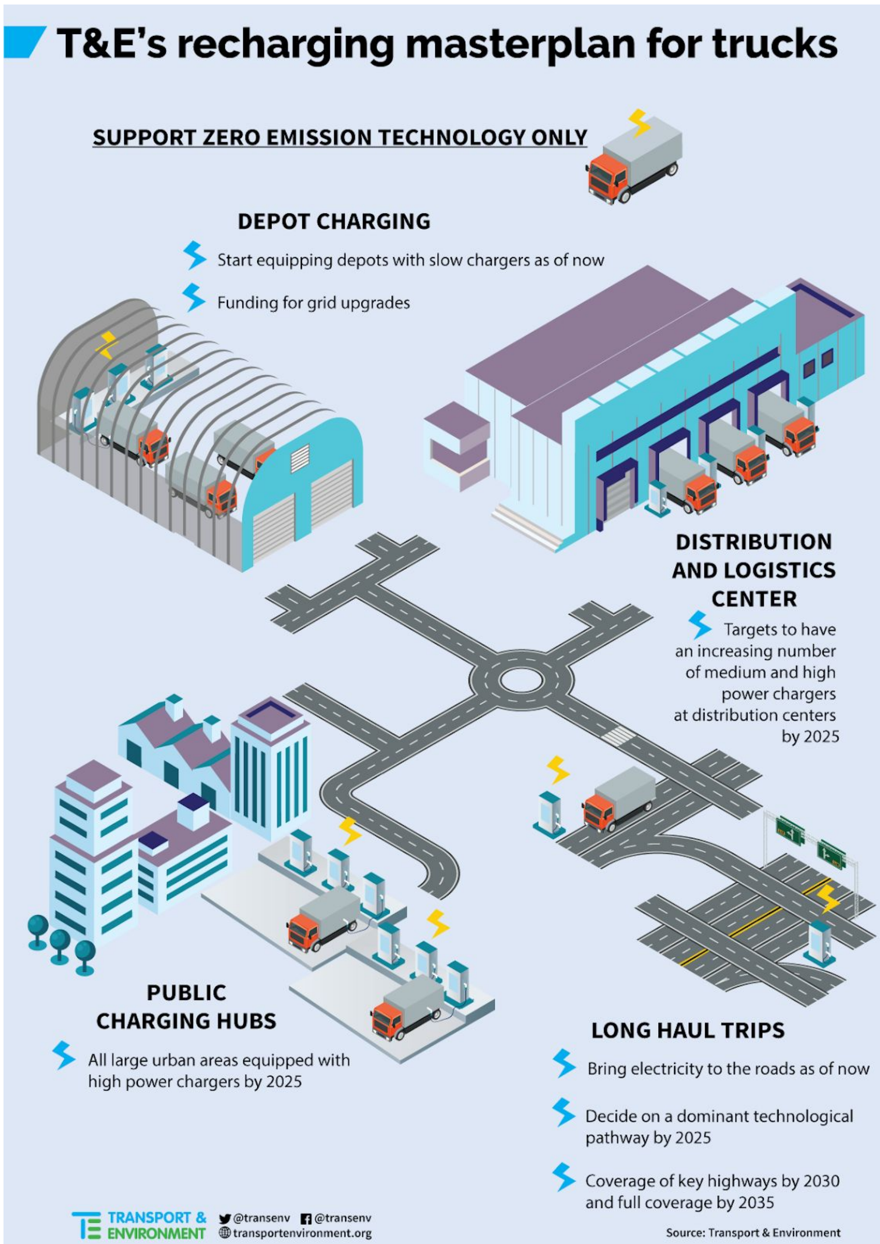
[8] ICCT (2019), *Estimating the infrastructure needs and costs for the launch of zero-emission trucks*. Link

[9] According to Renault Trucks, electric trucks lower congestion in cities because they can silently make deliveries at night time, thus shifting deliveries outside of peak hours. Link

[10] E.g. Volvo Trucks (link) and Daimler (link)

[11] Electrive (2020, February 20th). *Nikola Tre to build electric trucks at Iveco in Germany*. Link. Battery size up to 720 kWh, enabling a range of up to 400 km.

Requirements for e-truck charging should be tailored to their specific needs, which are threefold: **depot charging**, **destination charging** (shared infrastructure at the distribution centre or logistic hub while (un)loading) and **public charging**. It is estimated that for trucks coming back to the depot, about 80% of the energy recharged by electric trucks will be delivered while charging at the depot, while destination charging covers 15% of the total energy, and public charging about 5%[12]. To be effective, legislation on infrastructure for trucks should tackle all depot, destination and public charging with effective tailored measures (see on recommendations in Section 4).



[12] CE Delft (2019), *Charging infrastructure for electric vehicles in city logistics* (link) and preliminary findings from a major truckmaker on 'return-to-base' applications only

1.2. A three step approach starting with key urban areas

In the Roadmap for Electric Truck charging, T&E recommends to set up a comprehensive strategy for road freight electrification at the EU's main urban areas, where the deployment of depot charging, destination charging and public charging should be addressed simultaneously and in a coherent manner. This should be the first step of a broader road freight electrification strategy.

The EU TEN-T Regulation (1315/2013)[13] defines 88 urban nodes of the Core network which are important areas of interconnectivity between different transport modes (the full list of urban nodes is available in the Annex of this report). One of the objectives of the 2013 regulation was to 'promote low-carbon freight delivery' at these urban nodes. There is at least one urban node in each EU Member State and as many as 13 in Germany. The scope of this report is the EU27 and the UK.

The urban nodes are a logical starting point for electrification of road freight as a high share of truck traffic flows circulate through these nodes and they are hubs for urban and regional deliveries[14].

T&E recommends that depot charging and destination charging for electric trucks and vans should be deployed as soon as possible, especially in large urban areas (see Figure 1). The focus of this report is the 2nd step in the figure below. From 2025 at the latest, public chargers for electric trucks should be deployed at the urban nodes, which means that the deployment of public chargers should also start in the early 2020s. Importantly, the European TEN-T Regulation should identify a wider set of urban nodes (see Section 2 for more), to extend the scope of the 88 urban nodes and thus enhance the electrification impact in the second half of the 2020s. In this paper, the existing 88 urban nodes are also called 'primary' urban nodes, and the new set of nodes that we suggest in this paper is called 'secondary' urban nodes.

[13] European Commission (2013). TEN-T Regulation (EU) No 1315/2013. Link. Article 30 Regulation (EU) No 1315/2013 calls for the 'promotion of efficient low-noise and low-carbon urban freight delivery'.

[14] As the next step of electrification, public chargers located along key TEN-T Core networks could enable trips between key urban areas that are otherwise too distant from each other and also allow drivers to rapidly top-up during the day when necessary (similarly to EV drivers using fast chargers).

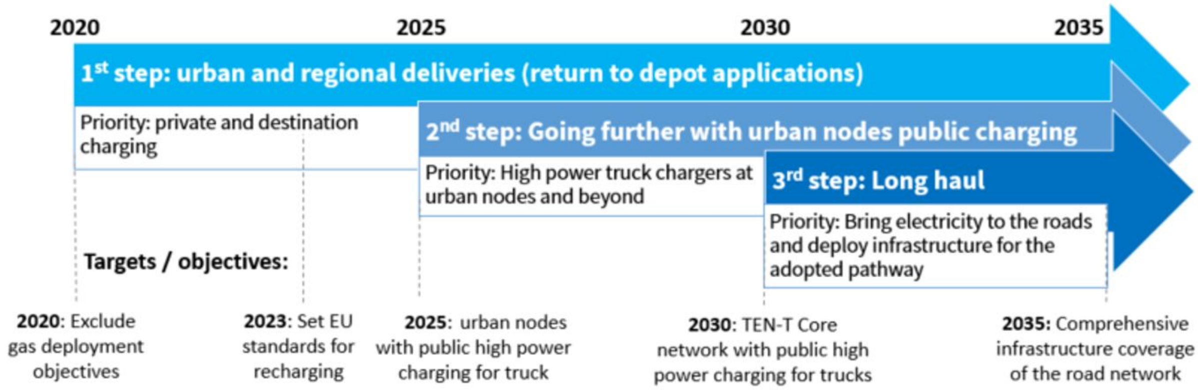


Figure 1: Summary of T&E vision for electric truck infrastructure deployment

From 2030, as electric truck range grows with improvements in battery technology, trucks will become more flexible and increasingly cost-competitive allowing electric trucks to go beyond urban and regional logistics, to medium haul and long haul operations covered. As journey profiles increasingly reach beyond the range of the vehicle, public charging (e.g. during driver's breaks) is increasingly necessary in order to reach the next destination or get back to the depot. This 'third step' will be the focus of an upcoming T&E report, the third volume of this series.

2. Analysis of freight flows in the EU

2.1 Brief overview of the database

This report builds on a modelled database of European freight movements that was the result of the ETISplus project[15] (see Info box). As the ETIS project was calibrated with 2010 data, T&E updated the freight volumes and trip lengths based on the latest Eurostat data, to the year 2018. The methodology that accompanies this report describes in greater detail how the calibration was undertaken, the data treatment utilised, and the scope of analysis[16].

[15] https://www.tmleuven.be/en/project/etisplus
[16] Transport & Environment (2020). *Unlocking electric trucking in the EU: Methodology*. Link

ETIS database: a brief overview

ETISplus was a research project in the 7th Framework Programme (DG MOVE) lasting from 2009 to 2012. The underlying database is a granular origin-destination (O/D) matrix of goods transported by road, inland waterways, and rail, by freight type[17]. It covers all countries of the European Union, at the NUTS3 region level (see below for more). The resulting map (see Figure 2) shows the traffic flows around Europe resulting from the freight flows. The roads with the busiest traffic matches closely with the TEN-T Core network and is heavily concentrated around and between the key urban areas[18]. The ETIS database is composed of traffic flow O/D matrix which is modelled based on a calibration on Eurostat data. More information on the database is available at T&E's Methodology note[19].

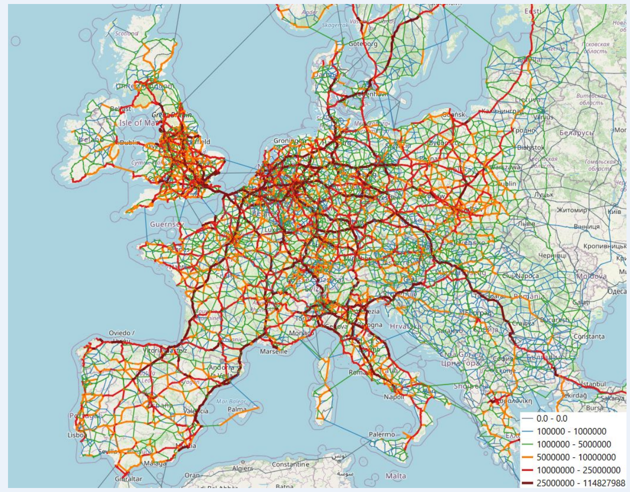


Figure 2: map of truck flows based on the ETIS project O/D matrix[20]

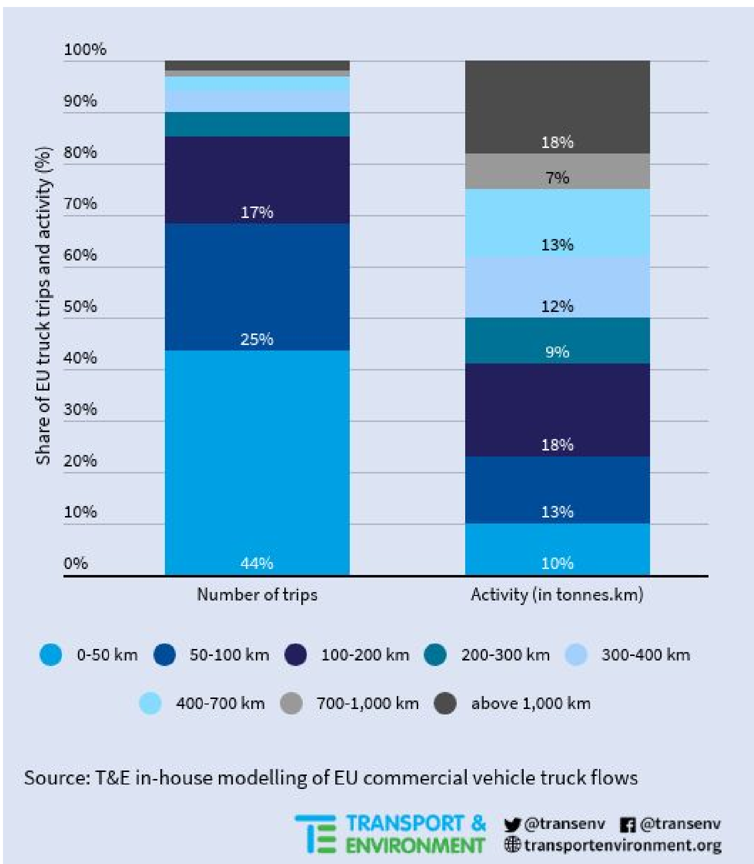
The geographical granularity of the data goes down to the level of a small region based on the Eurostat NUTS3 classification[21]. The origin and destination of trips are thus one of the 1,348 small regional level entities called NUTS3 regions, or simply referred to as 'regions' in this paper. Although the size of the regions can vary slightly from one country to another based on national administrative territorial division, the average size of a NUTS3 region is 3,500 km^2, which can be approximated by a disk with a radius of about 33 km.

[17] The O/D matrix is thus the minimum set of locations where charging can occur since a vehicle will always stop during loading and unloading. Additional occasions will occur along the way.
[18] The O/D data doesn't doesn't capture empty kilometres of a truck in the trip definition (calculates total tonnes). This is compensated for through a lower average payload of trucks.
[19] Transport & Environment (2020). *Unlocking electric trucking in the EU: Methodology*. Link
[20] Panteia, CERTH/HIT, DEKRA, CBRA, ESPORG and IRU (2019) Study on Safe and Secure Parking Places for Trucks MOVE/C1/2017-500. Link
[21] This Eurostat NUTS3 classification is designed as 'small regions for specific diagnoses'. NUTS is an acronym for nomenclature of territorial units for statistics. Eurostat

2.2 Truck trips and activity per distance bands

In this section 2.2 we present the share of trips and activity based on a simple distance bands breakdown. In the next section 2.3, we will consider another breakdown based on the profile (urban delivery, regional delivery and long haul) and in section 2.4, the breakdown will be made based if it connects urban nodes or not.

The analysis of the dataset shows that the vast majority of the European truck trips[22] are short trips (see left column Figure 3). Close to half of the trips are under 50 km (mostly trips within one region, see section 2.3) and a total of 90% of the trips are under 300 km. However, this picture changes significantly when looking at the truck activity (in tonne.km) per distance band, which is a better proxy for CO_2 emissions (see right column): about 10% of the total EU truck activity (in tkm) are trips under 50km but **half of the EU truck activity is made over trips under 300 km (42% under 200 km).**



[22] The number of trips is related to tonnes carried between an origin and destination. An average payload of 10 tonnes is assumed here to translate the number of tonnes into a number of trips.

Figure 3: Breakdown of truck trips and activity per distance bands

2.3 Truck trips and activity: intra and inter-regional trips

In this section we analyse the EU truck trips and activity following a different breakdown, instead of looking at distance bands for the trips, we consider whether or not the trip stays within one region or connects two different regions.

In this report we consider the following trips and definitions:

- *Intra-region*: trips *within* one of the 1348 regions. In urban regions, these trips could be seen as urban deliveries (mostly trips under 50 km).
- *Inter-region* (or regional deliveries or medium-haul): one-way trips up to 400 km, from one region to another
- *Long-haul*: trips above 400 km

The trip distance is measured as the distance between the two region centers. For urban delivery trips within one region, the distance used is the square root of the region's surface area divided by Pi (i.e. an approximation of the radius of the region).

The freight flows reveal that half of the truck trips in Europe are intra-regional trips within one region (45%), which account for 16% of the activity in tonnes.km (see Figure 4). These trips have the most immediate market potential for electrification. Next, the inter-regional trips account for another half of the EU trips while the total cumulated activity of these trips is 59%. Finally long haul trips (defined here as trips above 400km), which are outside the scope of this report account for 4% of the trips and 26% of the activity. Together intra- and inter-regional deliveries make up for the lion's share of the trips (96%) and three quarters of the activity and are therefore an essential part of EU road transport emissions that can be tackled as of today.

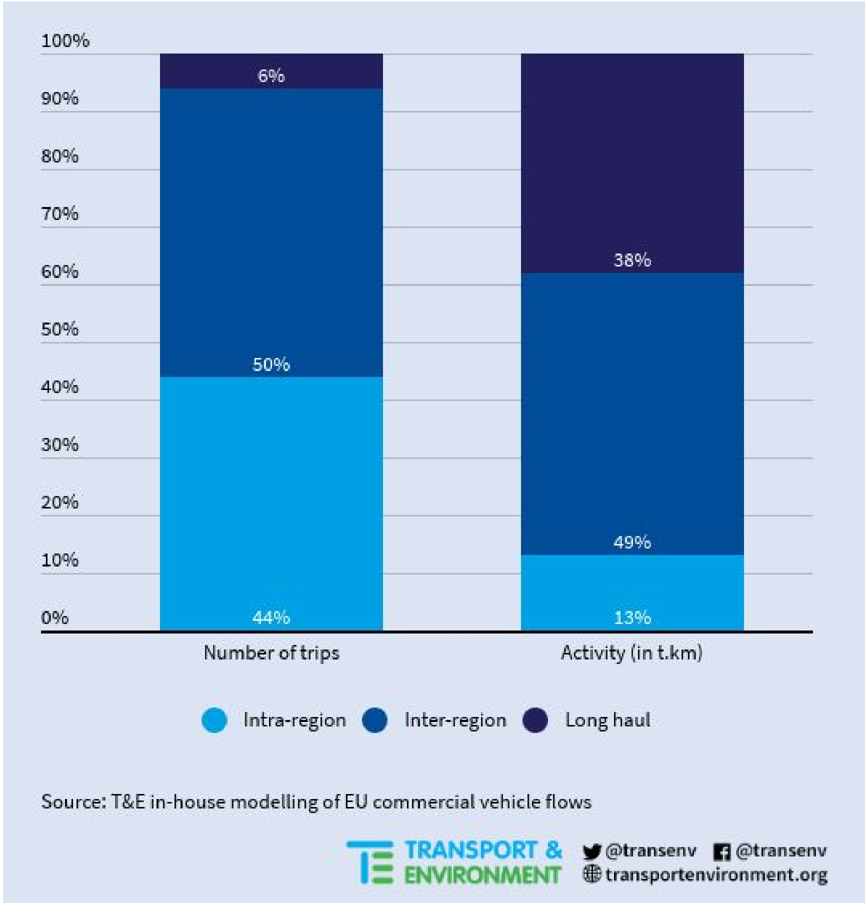


Figure 4: Breakdown of truck trips based on its type (urban, regional and long haul trips)

2.4 Urban nodes (or 'primary nodes')

In this subsection we analyse what is the share of the trips which arrive at and/or depart from one of the 88 urban nodes, as defined in Section 1.2 (available in the Annex of this report). These initial nodes are defined from now on as 'primary nodes'.

First, we will define three types of trips (also see Figure 5 for illustration):

- 'Node to Node': which are trips between two of the 88 urban nodes. The origin and the destination can be the same urban node, in this case we call them intra-node trips.
- 'X-Region to X-Region' (or X-X): which are trips between two regions which are not urban nodes (called 'X' in this report). X-X trips can be urban deliveries, regional deliveries or long haul.
- 'Node to X-Region' and 'X-Region to Node': as suggested by their name, these trips have an urban node as their destination or origin, with the other one being an X-Region. For simplicity, these trips will sometimes be called 'Node-X'.

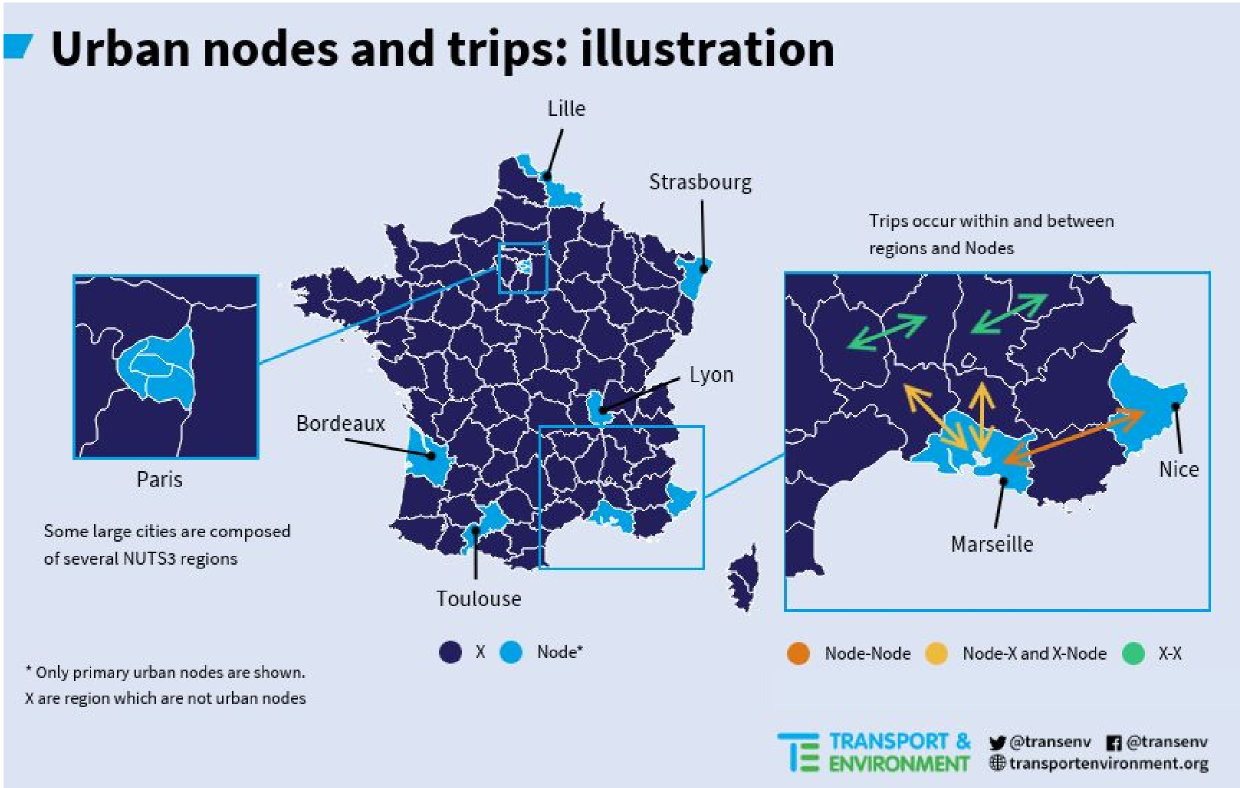


Figure 5: Urban nodes and trips: illustration

In this definition, all trip lengths are covered.

About one **trip** out of four in the EU either leaves or arrives (or both) at one of the 88 urban nodes. Trips connecting two urban nodes (Node-Node) account for about one trip out of 10. Because trips between two urban nodes are typically shorter than the EU average, they only make up 6% of the total EU activity (see Figure 6). On the other hand, trips between an urban node and a region which is not an urban node account for a quarter of the **activity** (between a Node and X-Region). In short trips 32% of the EU truck **activity** either leaves or arrives (or both) at one of the 88 urban nodes.

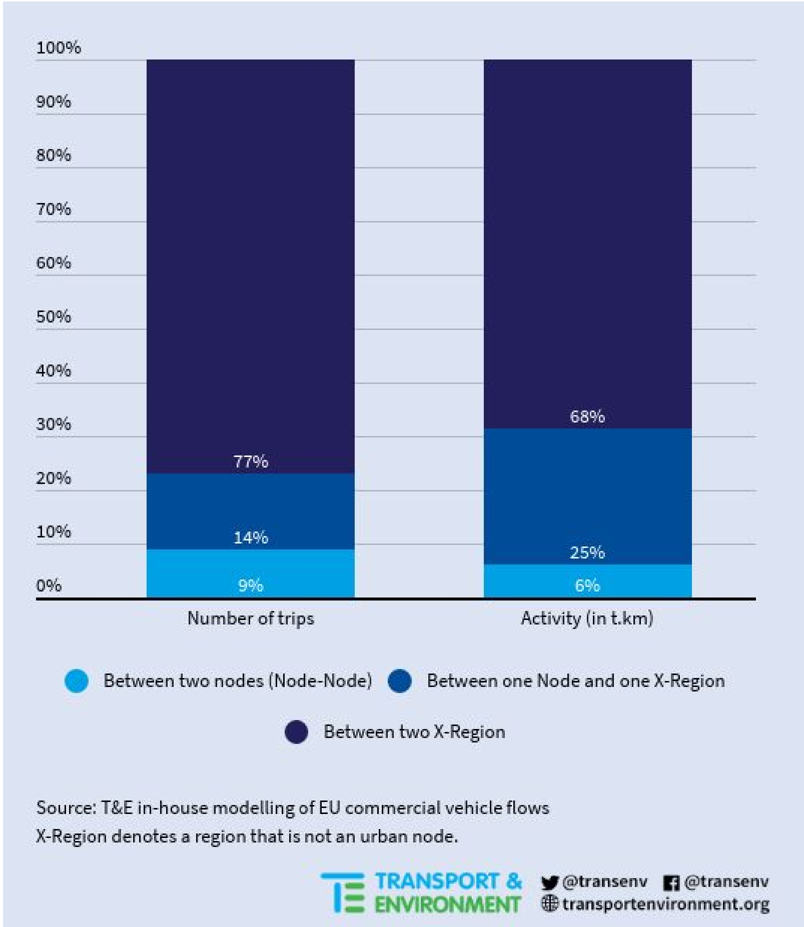


Figure 6: Breakdown of truck trips (primary urban nodes only)

Although there are only 88 urban nodes (totalling 95 regions[23] out of 1,348 regions), it can be noted that they attract a significant proportion of road freight traffic flows although the regions covering these urban nodes only cover 6% of the total EU surface. Urban nodes are hubs for urban and regional deliveries.

2.5 Addition of secondary nodes

In this analysis, T&E extends the scope of the 88 urban nodes defined in the TEN-T guideline regulation. The 88 urban nodes have been designed with the purpose to identifying urban area which are points of transfer between different transport modes (passenger terminals, airports,

[23] Some urban nodes are composed of more than one region due to the way NUTS3 regions are broken-down in each country. Five NUTS3 regions were combined to make one complete urban node based on the fact the city was not completely encompassed in a NUTS3 region. The five urban nodes are Brussels, Copenhagen, Paris, Manchester and London. See methodology note for more details.

railway stations, ports, logistic platforms and freight terminals)[24], not with the purpose of identifying 'hot spots' for regional delivery trips that can be easily electrified.

This new set of additional urban nodes are referred to as 'secondary' urban nodes in this report and allows for policymakers and EU legislation to go beyond the 88 primary urban nodes and thus cover a higher share of the urban and regional delivery trips in each country's decarbonisation strategy.

To select these secondary nodes, the number of urban nodes in each country is doubled to account for more regions with the highest freight activity that aren't already primary urban nodes (see the box below for more details on how the secondary urban nodes are selected).

How are the secondary urban nodes selected?

Secondary urban nodes are selected to best complement the primary urban nodes in order to optimise in the coverage potential of this network of nodes. In other words, they are placed to achieve maximum cost effectiveness of the urban and regional delivery electrification strategy by selecting a limited set of areas which would provide the highest reward in the number of truck trips potentially addressed.

The set of secondary urban nodes is a selection of the top urban areas (or NUTS3 regions here) with the highest road freight activity for trips below 400km. Regions which are already part of the 88 'primary' urban nodes are not included in the set of secondary urban nodes. To prioritise urban areas, the activity (in tkm) per area (km square) was computed, as 'denser' or more concentrated activity tends to yield urban regions. Without this step, activity is skewed by large regions that have large distances (i.e. rural areas). To ensure that the busiest secondary urban nodes were selected, we weighted the activity per region area with the normalised tonnes carried (tonnes per region divided by total tonnes per country). This was then used as a selection criteria for the secondary urban nodes. In some countries, secondary urban nodes were found to be on the outskirts of primary nodes, thus complementing these critical links in the TEN-T Core network.

The number of secondary urban nodes is equal to the number of primary urban nodes in each country (up to 13 in Germany). However, in countries with only one NUTS3 region like Luxembourg, Malta and Cyprus no further secondary set of urban node can be added. A total of 173 urban nodes are thus included in this analysis (88 primary urban nodes and 85 secondary urban nodes). The list of primary and secondary urban nodes can be found in Annex 6.1. This selection method is therefore not affected by the difference in size and shape of regions when

[24] Article 3, Regulation (EU) No 1315/2013: ''urban node' means an urban area where the transport infrastructure of the trans-European transport network, such as ports including passenger terminals, airports, railway stations, logistic platforms and freight terminals located in and around an urban area, is connected with other parts of that infrastructure and with the infrastructure for regional and local traffic'

comparing two different countries although it can have an impact on the selection within one country. However, without selecting a fixed pre-established number of nodes per country, the selection would be skewed to favour allocation of secondary urban nodes to countries with bigger regions which would have more activity.

As a result of the selection procedure presented above, we map below both primary and secondary urban nodes (see Figure 7). All nodes seem to be relatively well distributed across the EU, with very little gaps like in the middle of France or in the interior of Bulgaria which are regions with low population density and mountains.

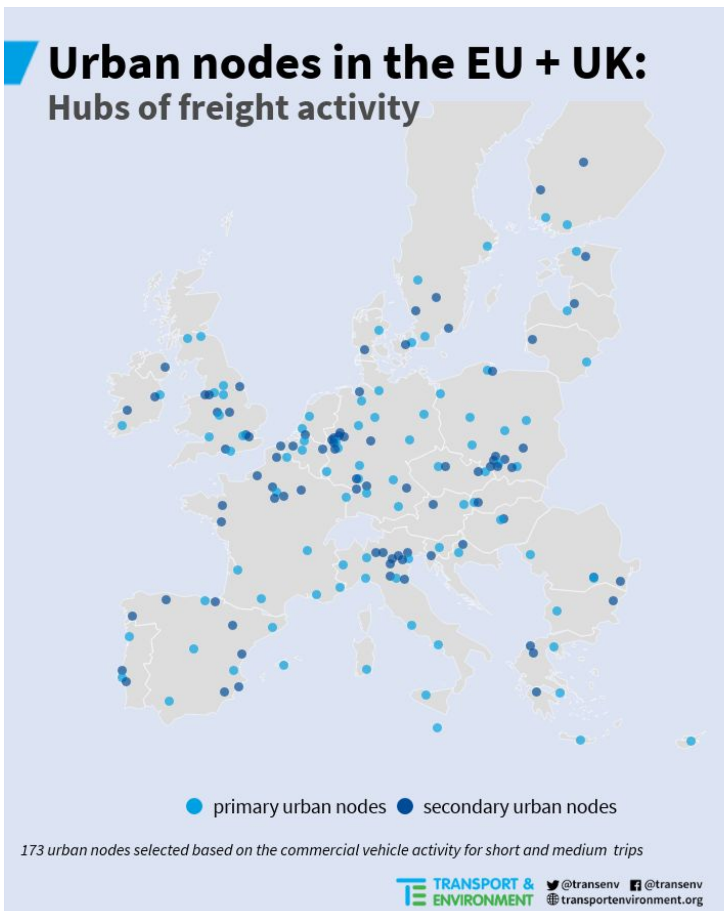


Figure 7: EU + UK map of primary and secondary urban nodes

The widening of the scope to secondary urban nodes increases the number of Node-Node and X-Node **trips** from 25% to 39% (and from 9% to 19% for Node-Node), see Figure 8. The share of the EU for Node-Node and Node-X **activity** increases from 32% to 49% with the secondary nodes (from 6% to 15% for Node-Node only).

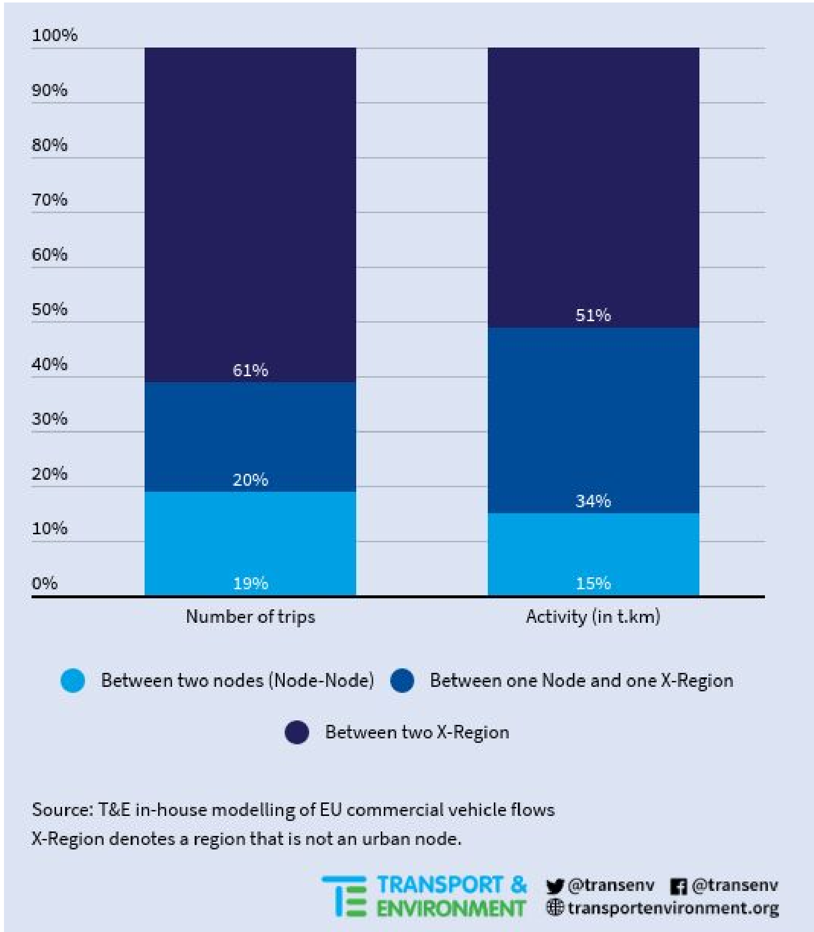


Figure 8: Breakdown of truck trips (primary and secondary urban nodes)

This preliminary analysis builds a solid basis for a truck electrification strategy that would prioritise electrification of the road freight 'hotspots' that we have identified in this section i.e. the 173 urban nodes. Indeed, about half of the EU truck activity has one of these 'hotspots' as the origin or the destination of the trip (any trip length) while the region covering these urban nodes only account for 12% of the total EU area.[25] A large share of these trips are within the same region (intra-Node) and are therefore short distance trips, which are today easily electrified.

3. Uptake of electric trucks in the EU

3.1 Three scenarios: Industry-Baseline, EV-Leaders and Road-2-Zero

[25] On average Eu regions are 5% smaller than the average EU NUTS3 region

In this section, T&E presents its three scenarios for battery-electric truck sales up to 2030 (the first two are based on industry announcements and the last one is based on a trajectory compatible with the EU Green Deal). As per the scope of this study, these trucks are urban and regional delivery trucks. The three scenarios are later used to compare charging infrastructure requirements.

Industry-Baseline scenario

Truckmakers will need to comply with the EU CO_2 emission reduction targets of -15% in 2025 and -30% in 2030. In this first scenario, Industry-Baseline, truck manufacturers would rely to a very large extent on efficiency gains from the vehicle and the diesel engine to comply with the CO_2 regulation which leads to lower uptake of electric trucks. This scenario is based on industry estimates of the number of electric trucks on the road in the next decade. According to ACEA, the automotive industry lobby group, there would be 20,000 battery electric trucks on the road in 2025 and 200,000 in 2030[26]. To achieve such figures, the EU average sales market share for electric trucks is estimated at 1.3% in 2025 and 15% in 2030. This is in line with statements supported by the CEO of Daimler Trucks stating that Daimler Trucks would only be able to improve the efficiency of conventional trucks by 15% by 2030 and would thus need to sales 15% zero emission trucks.[27]

EV-Leaders

Two key European truck makers have already made commitments to electric trucks: Renault Trucks predicts that electric vehicles will represent 10% of its sales volume by 2025[28] while IVECO expects to sell 8%-10% zero emissions trucks (>16t) by 2025 and 20% by 2030[29].

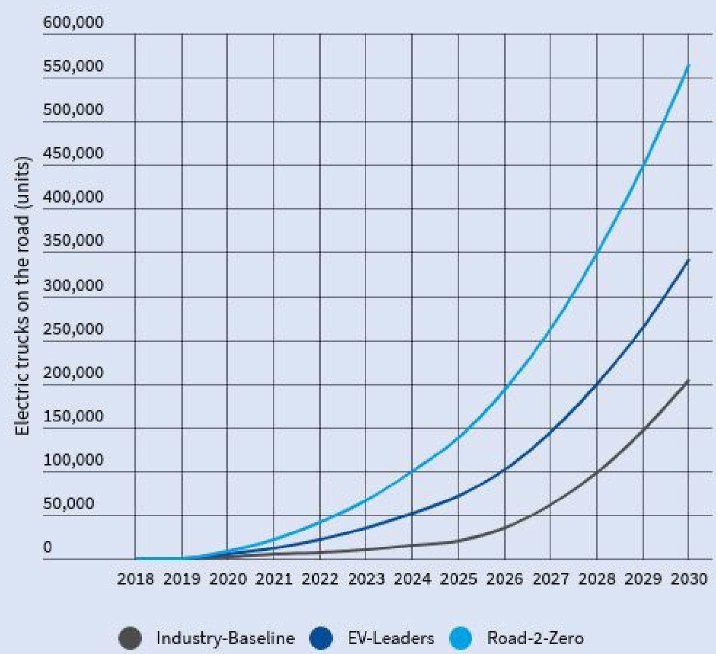
Although these announcements are quite recent, they are both driven by the EU CO_2 standards and can be expected to be duplicated to a similar extent in the sales mix of all other OEMs. In the EV-Leaders scenario, 5% of truck sales in the EU in 2025 would be battery-electric trucks, increasing to 20% in 2030 (see Figure 9). Cumulatively this would amount to 71,000 electric trucks in 2025 and 343,000 electric trucks in 2030.

Road-2-Zero

To be aligned with the Paris Agreement objectives and the Green Deal commitments, the EU should have a zero-emission road transport sector by 2050. The scenario modelled here is based on T&E's 2050 transport decarbonisation strategy, where the last conventional combustion truck (including PHEVs and HEVs) has to be sold between 2035 and 2040[30]. In this scenario, 10% of truck

[26] ACEA (June 2020). Position Paper: Review of the Alternative Fuels Infrastructure Directive. Link
[27] Financial Times, *Daimler Trucks chief backs higher taxes for commercial diesels (03/03/2019).* Link *"So there is physically no way that the diesel engine can reach 30 per cent," he added. "You make diesel 15 per cent better and then you have 15 per cent zero-emission vehicles — and then everything is fine."*
[28] Renault Trucks (10/03/2020). Renault Truck starts serial production of its electric trucks. Link
[29] IVECO. Presentation from an event on the 05/03/2020 in Brussels. Link
[30] Transport & Environment (2018). How to decarbonise European transport by 2050. Link

sales in 2025 would be battery electric, up to 30% in 2030. This scenario is less ambitious than the Californian ZEV mandate (see Section Cumulatively this would amount to about 139,000 electric trucks in 2025 and 566,000 in 2030. Figure 9 compares the battery electric truck uptakes for all scenarios.



Industry-Baseline scenario: based on industry position paper with 20,000 electric trucks in 2025 and 200,000 in 2030.
EV-Leaders scenario: estimate based on truck manufacturers announcements. Sales of battery electric trucks at 5% in 2025 and 20% in 2030.
Road-2-Zero scenario: compliant with the EU's climate ambitions for carbon neutrality by 2050. Sales of battery electric trucks at 10% in 2025 and 30% in 2030.
Scope: EU27 + UK

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Figure 9: T&E electric truck uptake scenarios

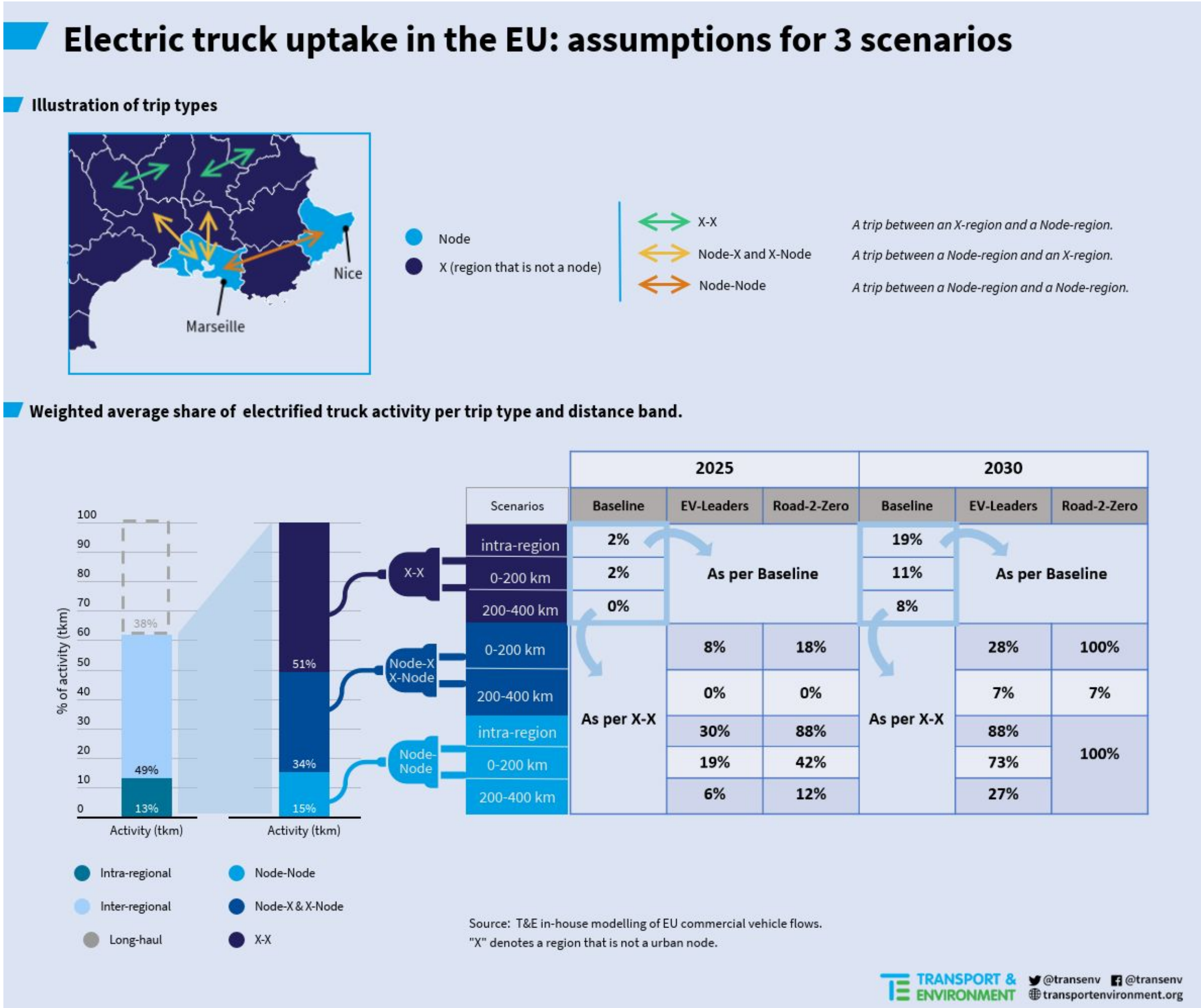
In the following sections, the number of electric trucks considered is about 5% lower to account for road freight activity which has been removed from urban nodes which are also important ports and are thus covered in the next report of this series.

3.2 Electrification assumption

In both Road-2-Zero and EV-Leaders scenarios, urban nodes have a higher uptake of electric trucks sales than other regions. In practice this means that urban nodes implement a strong and comprehensive policy and investment strategy to electrify urban and regional deliveries. Thanks to adequate support on the deployment of charging infrastructure at the depot, the distribution hubs and public locations, trucks operating or based around these urban nodes are able to rapidly shift to electric deliveries. High power commercial vehicle public charging is widely available at the urban nodes and destination and depot charging is adequately deployed at the relevant locations of the urban node. In this analysis, this means that trucks are assumed to always leave with a full battery (at least in the situations where the full capacity of the battery would be needed) because they are always able to charge during the night, or in between two trips while (un)loading or at public high power chargers (short top-up or during a break). Importantly, public charging also acts as a psychological safety net which facilitates the operation and business case of transport operators shifting to electric trucks. It is assumed here that the availability of charging infrastructure, in particular destination and public charging, is limited outside of the urban nodes.

Electrification scenario

The details of the truck electrification scenarios are presented below. The share of electrification is higher for shorter trips and trips within the same region (intra-region). Trips that connect an urban node with another region which is not an urban node (noted ‘X’ in Figure 10), are less likely to be electric because either the origin or the destination of the trips is lacking the sufficient charging infrastructure. Moreover, we assumed that a trip that departs from an urban node has a higher chance of being electrified than a truck arriving to an urban node to take into account the fact that there would be much less electric trucks departing from a non-urban node region since the urban area has not focused on the adoption of a comprehensive strategy for the deployment of charging infrastructure at the depot, the distribution center and public locations. Finally a limited amount of electric trips are assumed for X-X trips to model the ‘Industry-Baseline’ uptake of electric trucks (i.e. Not driven by higher uptake at urban nodes). The shares are the same as the ones calculated for the calibration of the Industry-Baseline scenario.



Scenarios	2025 Baseline	2025 EV-Leaders	2025 Road-2-Zero	2030 Baseline	2030 EV-Leaders	2030 Road-2-Zero
X-X intra-region	2%	As per Baseline		19%	As per Baseline	
X-X 0-200 km	2%			11%		
X-X 200-400 km	0%			8%		
Node-X X-Node 0-200 km	As per X-X	8%	18%	As per X-X	28%	100%
Node-X X-Node 200-400 km		0%	0%		7%	7%
Node-Node intra-region		30%	88%		88%	100%
Node-Node 0-200 km		19%	42%		73%	
Node-Node 200-400 km		6%	12%		27%	

Figure 10: Electric truck uptake in the EU: assumptions for 3 scenarios

The electrification scenarios in the table above have been calibrated to match the three electric truck uptake scenarios shown in Figure 9 with only a slight difference (about 5%) to account to the key sea port activity which is covered separately (see next report from this series). First, the Industry-Baseline scenario where only a limited number of shorter trips would be electrified. The percentages of electrification from the Industry-Baseline scenario are replicated for the trip to and/or from a non-urban node (or 'X'), as these regions would not be part of the wider electrification strategy of urban nodes. Finally the values for the Road-2-Zero scenario in 2025 and in 2030 are calibrated to keep the same 'distribution' as for the EV-Leaders scenario, only with higher values.

In 2030 in the Road-2-Zero scenario, the maximum potential for urban and regional delivery electrification is reached. This corresponds to ambitious measures to phase-out operations of diesel trucks within these areas, i.e. zero and low emission zones.

4. Results: assessment of the electrification

4.1 EU truck trips and activity covered

In this section we quantify the impact of our three electrification scenarios based on our EU road freight modelling.

T&E EU road freight modelling from ETIS database
For every two NUTS3 regions of the EU, the O/D matrix provides information about the flow (in tonnes) of goods transported between the origin region and destination region. T&E's model allocates to each of these pairs a given share of electrification (based on Table 1 above) depending on the distance between the origin and the destination while taking into account higher electrification shares when the origin or destination (or both) is an urban node. As a result of the model, the total volume of goods transported via electric trucks can be calculated as the sum of the volume of goods transported via electric trucks for all origin and destination pairs. This volume of good transported via electric trucks is then compared to the overall volume of goods transported and can be weighted by the distance of each trip.

In the **Industry-Baseline scenario**, the electric truck **trips** cover 1.8% in 2025 and 16.2% in 2030 of all EU truck trips (see Figure 11) while the EU share of electric truck **activity** is 0.9% in 2025 and 8.7% in 2030 (Figure 12). This corresponds to an average low level of electrification across the EU where electric truck uptake is the same at urban nodes and at non urban nodes region.

In the **EV-Leaders scenario**, urban nodes benefit from a higher uptake of electric trucks at the urban nodes as described in the scenario above. As a result, 7.6% of the all EU truck **trips** are electric in 2025 and 30.1% in 2030. On the other hand, 3.2% of the EU truck **activity** is electric in 2025 and 14.3% in 2030. When the 88 primary urban nodes are the only urban areas to address seriously the uptake of electric trucks (i.e. the remaining 'secondary' urban nodes follow the Industry-Baseline scenario), then the share of electric trips and activity is lower: 4.9% electric trips in 2025 and 23.3% in 2030, and 2.0% electric activity in 2025 and 11.2% in 2030.

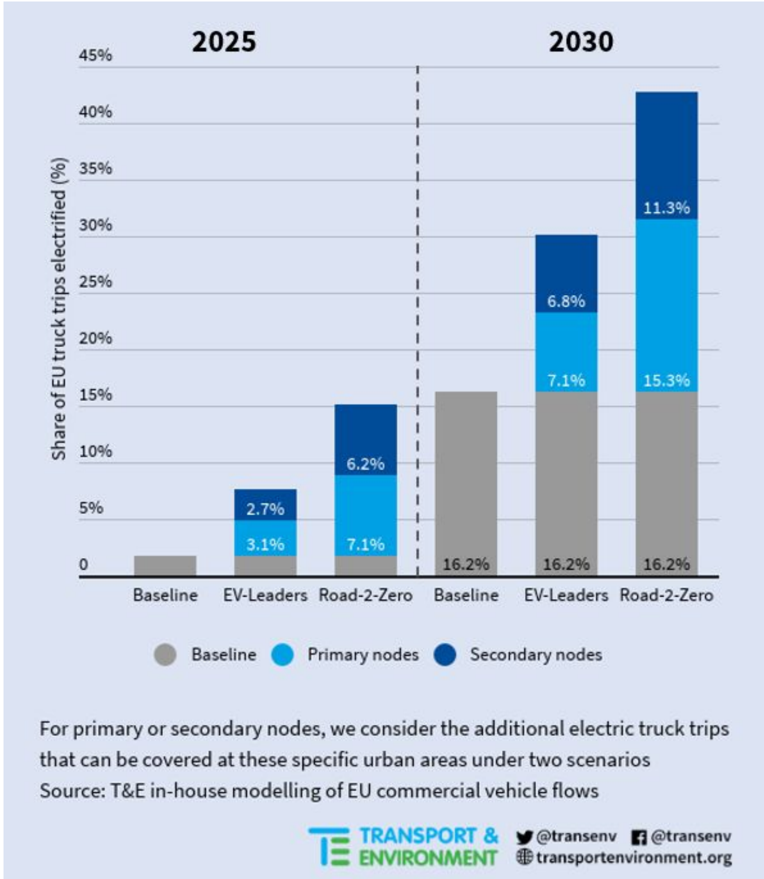


Figure 11: Share of electric truck trips in the EU

Similarly, the **Road-2-Zero scenario** is a more ambitious scenario where urban nodes move towards full electrification by 2030 for all **trips** connecting two nodes that are below 400 km as well as all trips of less than 200 km departing or arriving at an urban node. As a result we calculate that in 2030, 42.7% of all trips are electric (31.5% with primary nodes only). Also, about 15.1% of the trips would be electric in 2025 (vs. 8.9% only with primary urban nodes). In terms of **activity**, 6.2% of the EU truck activity would be electric in 2025 (3.5% with only the primary urban nodes), reaching 23.8% of the activity in 2030 (16.6% with primary nodes only).

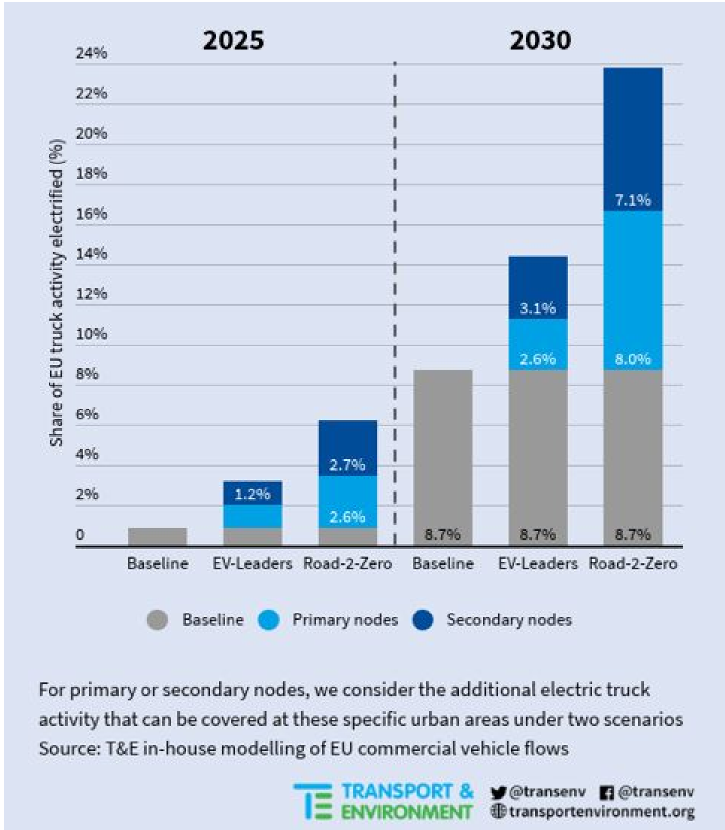


Figure 12: Share of electric truck activity in the EU

As urban nodes move more ambitiously on electrification of road freight, an increasing share of the trips coming and going in the urban areas are electric. See figures in Annex 6.5 for an overview of the total volume of road freight activity in each scenario.

4.2 Electric trucks at urban nodes

In the following sections, the total volume of activity is calculated at the level of each region by looking at the total activity of trucks arriving in one region. This is then used to estimate the respective number of chargers and trucks, which is proportional to the volume of activity arriving that given region[31].

[31] The average new truck activity is estimated to be about 800,000 tkm per truck and per annum (all trucks above 3.5t), which corresponds to an average energy consumption of 1,120,000 kWh per truck per year. Assumption: Average payload of 10t, vehicle efficiency of 1.2 kWh/km in 2030 and 1.3 kWh/km in2025 (including losses from the charger, the battery and the electricity distribution), average of 80,000 km per year (based on market data derived from a TU Graz report Lot2 and Annex of the heavy duty vehicle CO2 emission regulation). The average truck activity calculated from Eurostat is 446,000 tkm is significantly lower because it is an average over the whole truck fleet and thus includes an important number of trucks which are old and are not driven at all or only very little. New vehicles tend to drive much more than the

It is calculated that the average number of electric trucks per urban nodes would increase from 31 in 2025 to 306 in 2030 in the conservative Industry-Baseline scenario. In the EV-Leaders and Road-2-Zero, the average number of electric trucks would be respectively 269 and 581 in 2025 increasing up to 900 and 1,733 in 2030.

	2025			2030		
Number of electric trucks	Baseline	EV-Leaders	Road-2-Zero	Baseline	EV-Leaders	Road-2-Zero
Urban nodes	5,300	46,300	100,000	52,600	154,700	298,000
Others	14,000	23,900	37,600	138,900	162,000	228,200
Total	19,200	70,200	137,600	191,500	316,700	526,200
Urban nodes average	31	269	581	306	900	1,733

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Table 2: Number of electric trucks in the EU

It should be noted that not all urban nodes have the same size and the average value doesn't picture the diversity of needs for different urban nodes. Indeed, large urban nodes[32] would see values for the number of electric trucks (but also for the number of chargers) which are three times higher than the EU average value. Therefore in 2030, a large urban node could require up to 5,000 electric trucks in 2030 (2,800 in the 'EV-Leaders' scenario).

4.3 Electricity consumption at urban nodes

This section aims first to quantify how much energy will be required to recharge the electric trucks depending on the three uptake profiles outlined in the previous sections[33]. Later, the electricity requirements calculated are converted into charging infrastructure requirements.

As expected, an important share of the total energy recharged by electric trucks is recharged at urban nodes given that this is where the majority of the activity takes place. In 2030 in the most ambitious

average vehicle and we expect this to hold true especially for electric trucks since they have lower utilisation costs and the incentive to use them is therefore high.

[32] Calculated based on the average for the top 20 urban nodes

[33] Energy needs are calculated based on the requirements of trucks arriving at the given NUTS3 region. The distance travelled by the truck to arrive at the region is multiplied by an average efficiency of 1.2 kWh/km in 2030 (1.3 kWh/km in 2025).

scenario, total energy consumption from electric trucks would reach about 50 TWh in 2030, which compares with about 1,000 TWh of renewable electricity generated in the EU in 2017[34], or about 5% of the total renewable electricity produced (1.6% of the total 3,100 TWh of electricity produced in the EU in 2017[35]). In the EV-Leaders scenario, the total demand in 2030 would amount to 30 TWh, or about for about 3% of 2017 renewable electricity generation.

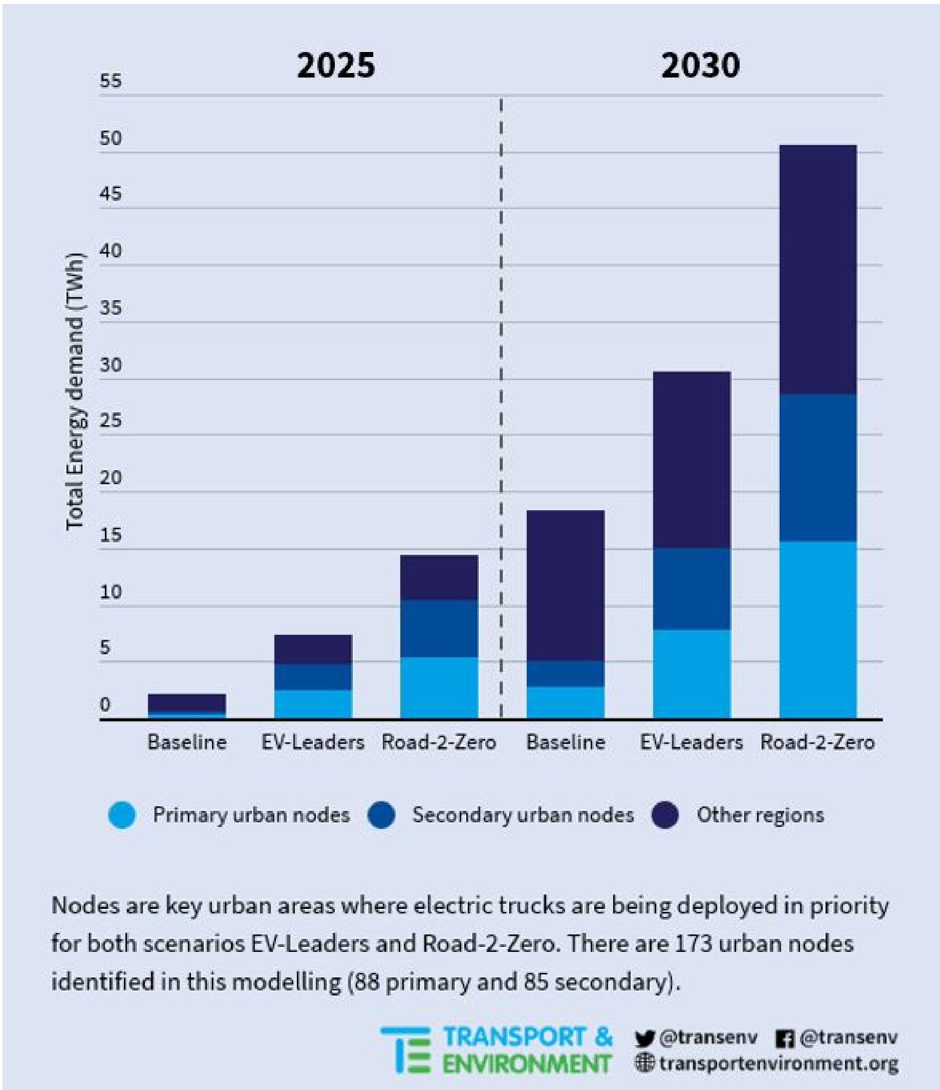

Figure 13: Energy demand from electric trucks in the EU

On average, in each urban node, the energy demand from electric trucks would increase up to around 86 GWh in the EV-Leaders scenario and to 166 GWh in the Road-2-Zero scenario in 2030.

[34] Eurostat, Gross electricity production by fuel, EU-28, 2000-2017, consulted in May 2020. Link.
[35] Eurostat, Electricity production, consumption and market overview, consulted in May 2020. Link

Large urban nodes would have an energy consumption about three times higher than the average presented in the table above. The large urban nodes could indeed reach up to 500 GWh of electricity delivered annually in 2030.

4.3 Charging infrastructure requirements

In this section we calculate the number of chargers of each type required: depot charger, destination charger, and public charger (see summary Table 3). The details of the assumptions and the calculations are presented in this section below the table.

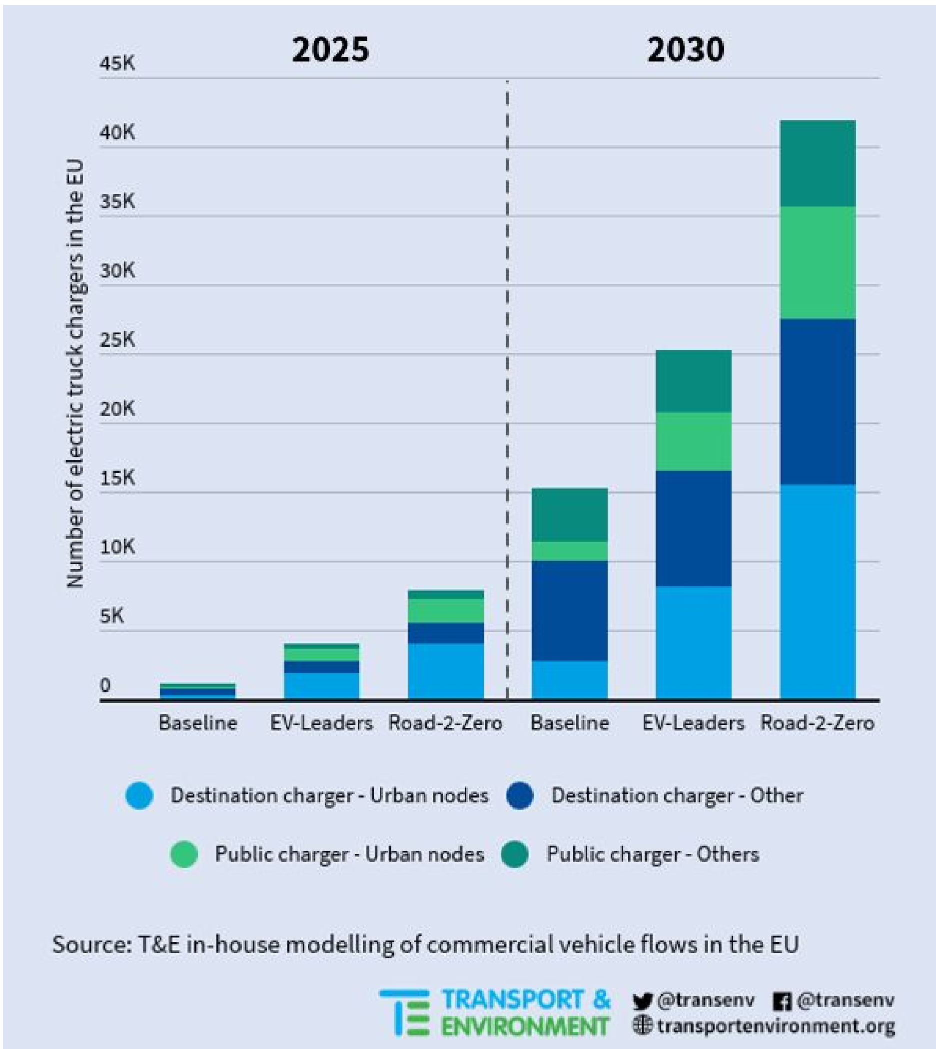

Figure 14: Electric truck chargers in the EU in 2030

	2025			2030		
Number of electric truck chargers	BaU	Current Policies	Road 2 Zero	BaU	Current Policies	Road 2 Zero
Private	19,200	70,200	137,600	191,200	316,300	525,600
Destination	800	2,800	5,400	10,000	16,500	27,500
Public	300	1,200	2,500	5,200	8,700	14,400

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Table 3: Number of electric truck chargers in the EU

Towards at higher share of opportunity charging

Following the study by CE Delft[36] and preliminary findings from a major truck maker, 80% of the total energy consumed by electric trucks would be charged at the depot (15% for destination charging and 5% for public charging). This is expected to be the situation in the early 2020s. Over time and with the introduction of other applications the share of depot charging will reduce in favour for public charging and destination charging. In particular experts have reported that it is expected that destination charging may become more important over time as there is ample time to charge beyond 15% in the operations schedule. Based on expert consultation we assume a 65% depot, 25% destination and 10% public charging split on average at EU level in 2030.

In the table below the key charging infrastructure assumptions used in this section are presented.

Key infrastructure assumptions	2025	2030
Energy split depot/destination/public	80/15/5	65/25/10
Daily utilisation destination / public (average)	4h / 2h	4h / 2h
Charging Power destination / public	300/500 kW	350/600 kW
Cost depot/destination/public (averages, installation + CAPEX + grid connection)[37]	12k / 136k / 226k €	20k / 143k / 245k €

Table 4: Summary of key infrastructure assumptions

[36] CE Delft (2019), *Charging infrastructure for electric vehicles in city logistics* (link) and preliminary findings from a major truckmaker on 'return-to-base' applications only

[37] Assumptions: 300€/kW for AC charging and 500€/kW for DC charging. Depot charging is mainly AC in 2025 while it is mainly DC in 2030

Depot chargers
Each electric truck will require a depot charger to recharge overnight as it comes back every night. Therefore the number of depot chargers is equal to the number of electric trucks in each category as laid out in Table 4.

We calculate that on average (based on the EU average tkm activity), in an theoretical situation where all trucks would be the same and would be used the same way, 30 kW of power delivered overnight for each truck would be sufficient. However, in reality, the needs will vary greatly from one truck to another: a large share of small and medium electric trucks could charge with tri-phase AC chargers of 11 or 22 kW overnight. On the other hand larger heavy trucks with larger batteries need up to 80 kW overnight charging[38].

Destination charging
Trucks frequently spend two hours or more per day[39] at the distribution center (or logistic hub) to load and unload cargo. T&E assesses that **one destination charger would be required for every 15-20 electric trucks** (one for 25 electric trucks in 2025 and one for 19 electric trucks in 2030)**.** This is based on assuming 300 kW charging in 2025 and 350 kW in 2030, 90% real world charging efficiency, and a utilisation rate of 4 hour per day.

As a result, in the Road-2-Zero scenario a total of 5,000 destination chargers would be needed in 2025 and 27,500 in 2030. In the EV-Leaders scenario this amounts up to 2,600 chargers in 2025 and 16,500 in 2030 and in the Industry-Baseline scenario, only 700 and 10,000.

Public charging
In the early market phase where most trucks will come back to the depot, public charging will be used as a necessary safety net, allowing a top up of the battery when operations require a bit more range. Assuming about 5% of the total energy is delivered at public chargers in 2025 and 10% in 2030, that public charging points have a power of 600 kW in 2030 (500 kW in 2025), an 80% real world charging efficiency[40], and that the charger is used two hours per day on average[41], there would be a need for **one public charger for every 50 electric trucks on the road in 2025 and one for every 30 electric trucks on the road in 2030**.

[38] Assuming a maximum real-world usable range of 400 km, 1.5 kWh/km, 8 hours charge and 5%-10% for real world charging efficiency.
[39] Businessinsider, consulted in May 2020. Link
[40] Today the average real-world charging power of a 50kW charger is 36kW (or 72%), and would reach 40kW on average in the best case scenario (80%)
[41] We assume a lower utilisation rate for public chargers than for destination chargers because the destination charging is the preferred opportunity charging solution for transport operators as it fits best operational schedules. Public chargers, as for fast chargers for cars, act as a safety net and see lower utilisation rates especially in the early market phase.

The number of public chargers necessary in the Industry-Baseline scenario in the EU is around 300 in 2025 and 5,200 in 2030. In the EV-Leaders and Road-2-Zero scenarios, T&E calculates 1,200 and 2,300 public chargers in 2025 respectively and 8,700 and 14,400 public chargers in 2030.

Total opportunity charging: an achievable level of supply
In total the number of destination chargers required is about two times higher than the number of public chargers. Thus when combining public and destination charging, one third of the chargers are needed for public charging. We calculate that, on average, each urban node would require about **70 chargers in our middle scenario** (25 public and 45 destination) **and 140 chargers in our climate-compatible scenario** (90 public and 50 destination chargers). At large urban nodes, the number of chargers could be three times higher, or more than 400 chargers in 2030 in the Road-2-Zero scenario.

T&E's take for AFID targets
An early charging system which is not fully mature will require a level of redundancy to ensure the security of the charging needs and to reduce early phase congestion risk which could have some deterrent effect on the adoption. As the market matures and charging optimisation services as pre-booking of chargers becomes available, the ratio of chargers per electric trucks is likely to fall within the baseline scenario described above.

Therefore, the optimal rate for the early market phase in the 2020s is expected to be closer to the lower-end values in the table above. In other words T&E recommends: **one destination charger for every 15 electric trucks and one public charger for every 30 electric trucks. Combined they amount for about one (public or destination) charger for every 10 trucks.**

A sensitivity analysis if provided in Annex ('6.4 Sensitivity analysis: sufficiency of chargers'), where various scenarios are tested for high and low electric truck activity, high and low charging power, and high and low charger occupancy. The number of electric trucks per destination charger ranges from 7 to 33 while the number of electric trucks per public chargers ranges from 16 to 63. Combined, this would amount for up to one public or destination charger for somewhere between 5 and 33 electric trucks.

Overall, including depot chargers, 1.1 electric truck chargers would be required per electric truck in the EU.

4.4 Costs of charging infrastructure

Substantial investment will be needed in public charging infrastructure to serve the growing EV market. Annual investments in the deployment of all charge points (depot, destination and public, includes equipment, installation, and grid upgrades) would increase from close to zero today, up to about 1.4-2.7 billion euros in 2025, increasing further to €11-18 billion in 2030 (see Figure 15).

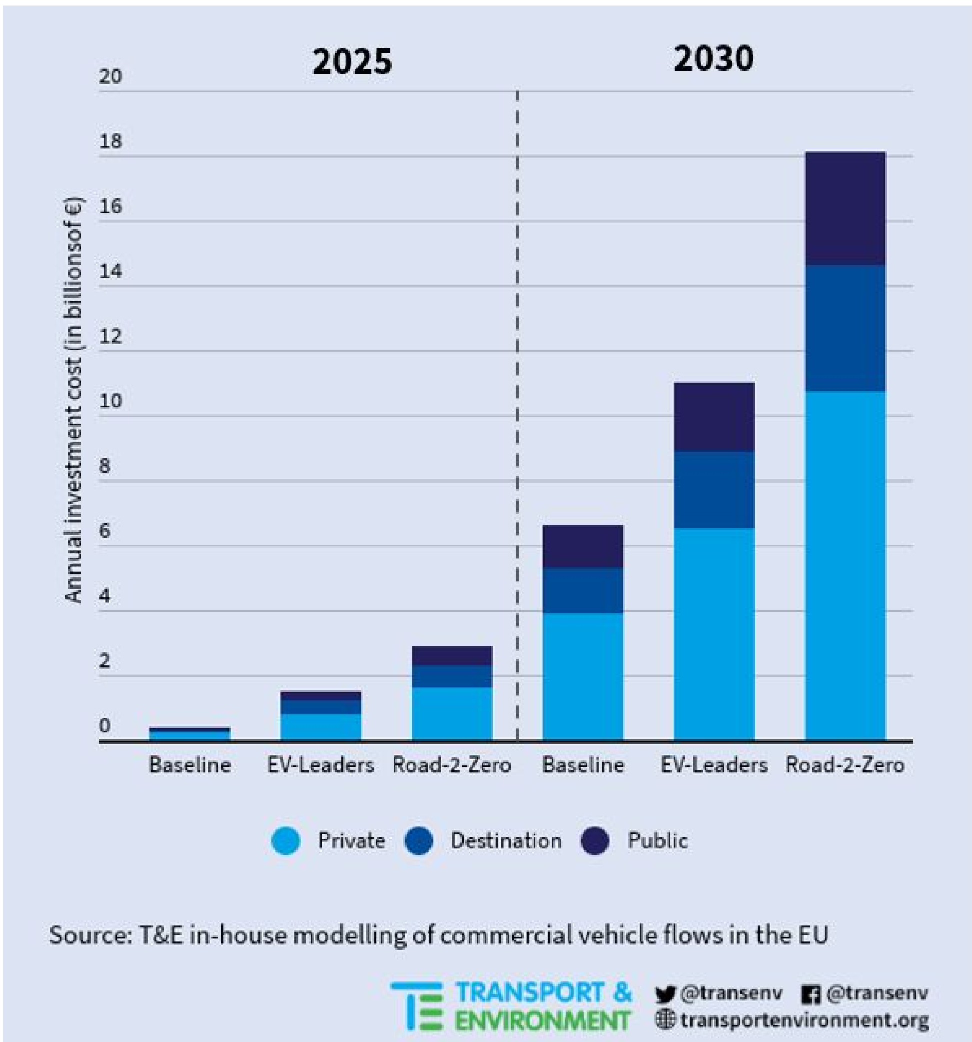

Figure 15: Annual costs for electric truck charging in the EU

Cumulatively, this would amount to €22, €40 and €68 billion respectively in the Industry-Baseline, EV-Leaders and Road-2-Zero scenario over the next decade. Destination and public charging could account for about 40% of the total cost under our assumptions. It is worth noting that in the most ambitious scenario, the total cost of €68 billion by 2030 for both private and public e-truck charging, is only slightly lower than the total calculated by T&E for investment in passenger car charging infrastructure by 2030 which was estimated at €80 billion (€20 billion for public charging and €60 billion for private charging)[42].

Compared to the current rate of investment in transport infrastructure (about €100 billion per year[43]), investment in charging infrastructure would represent a mere 0.4%-2.7% of the total in 2025, increasing to 6.6%-18.2% in 2030[44].

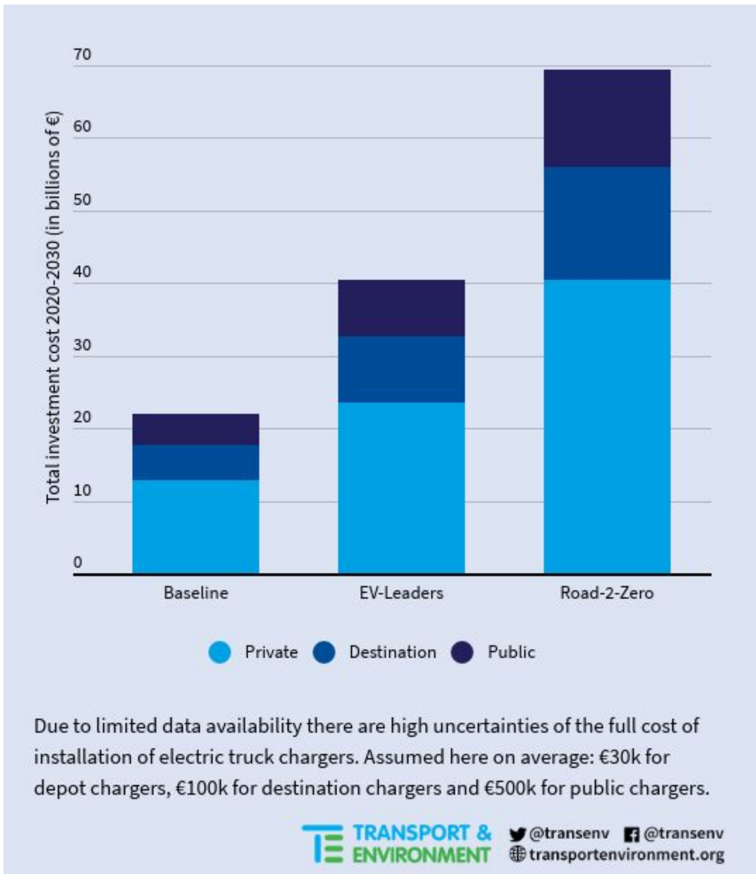

Figure 16: Total cumulative costs for electric trucks charging in the EU (2020-2030)

[42] Transport & Environment (2020). RechargeEU: How many charge points will EU countries need by 2030. Link

[43] EEA (2016). Investment in transport infrastructure. Link

[44] Similar calculations can be made with EU annual spending in fossil fuel subsidies which was estimated by the European Commission in 2018 to be €55 billion. European Commission (2019). Energy prices and costs in Europe. Link

4.5 CO_2 savings

With GHG emissions from medium and heavy duty commercial vehicles totalling 200 Mt CO_2 in 2017, commercial vehicles emit roughly 100 gCO_2e/tkm (Tank-to-Wheel [TtW] emissions) on average in the EU[45]. Thanks to diesel truck efficiency improvements mainly driven by the truck CO_2 regulation, CO_2 emissions per tkm of the truck fleet would improve by 5% in 2030 and 1.5% in 2025. Based on this we calculate the total direct CO_2 savings from shifting a given part of the road freight activity from diesel to electric.

In the Road-2-Zero scenario in 2030, the annual TTW savings are equivalent to the higher than the total heavy commercial vehicle emissions from Germany in 2017 (44 Mt CO_2-eq.). In the EV-Leaders scenario, the TtW emissions savings are roughly equivalent to truck GHG emissions from the UK and the Netherlands combined (20.6+6.0 Mt CO_2-eq.).

In the climate-compatible scenario where electric delivery trucks would be deployed ambitiously at EU's key urban nodes, up to 22% TTW CO_2 emission reduction can be achieved together with great benefits for air quality in urban areas.

When taking into account indirect emissions from diesel extraction and processing as well as the GHG emissions from the electricity generation, then total GHG emissions increase from 43 Mt to 45 Mt, meaning that the **upstream emissions from the fuel production (diesel and electricity) roughly cancel each other out.**

	2025			2030		
	Industry-Baseline	**EV-Leaders**	**Road-2-Zero**	**Industry-Baseline**	**EV-Leaders**	**Road-2-Zero**
TTW CO_2 emissions avoided (Mt)	2	6	11	16	26	43
TTW CO_2 savings (vs. road freight emissions)[46]	-1%	-3%	-6%	-8%	-13%	-22%

[45] In 2017, medium and heavy duty commercial vehicles emitted 200 Mt CO_2 according to UNFCCC, and the total activity of goods vehicles in the EU in 2018 was 1,920,000 million tkm (Eurostat). A 85%/15% split is applied to emissions from commercial vehicles and buses.
[46] Compared to 2017 GHG emission level of trucks

Net CO_2 emission avoided (Mt)[47] (no biodiesel)	2	6	11	17	27	45
Net CO_2 emission saving (no biodiesel)	-1%	-3%	-5%	-8%	-14%	-23%

Table 5: Total TTW avoided emissions from electrification of commercial vehicles

Importantly, this research does not take into account the electrification of trips beyond 400 km before. It is reasonable to assume that by that period, battery and charging technology improvements will allow long haul electric trucks to compete cost-effectively with diesel counterparts and thus reduce much further CO_2 emissions than what has been calculated in this paper. The upcoming third volume of this series will look beyond 2030.

[47] Based on a projection of the average EU carbon intensity of the electricity grid from 2020 to 2030 from T&E's 2020 EV lifetime (Transport & Environment (2020). *How clean are electric cars?* Link) and adding an increase in emissions by 28% to account from upstream emissions of diesel (extraction and processing). Knobloch et al. (Nature, 2020). *Net emission reductions from electric cars and heat pumps in 59 world regions over time.* Link

5. Policy recommendations

Diesel and natural gas truck sales must be phased out between 2035 and 2040 if the EU wants to be in line with its Green Deal climate objective of climate neutrality by mid-century. To achieve this a significant number of policy tools and measures will be necessary to accelerate both the roll-out of electric trucks and the associated charging infrastructure.

5.1 Revision of the AFID (Q1 2021)

5.1.1 Zero Emission Infrastructure Regulation (ZEIR)

The Directive on the deployment of Alternative Fuels Infrastructure, or AFID, sets a regulatory framework for the roll out of public recharging and refuelling infrastructure for the following alternative fuels in transport: electricity, CNG, LNG and hydrogen. The current directive dates back to 2014 and it's revision is part of the European Green Deal which makes it a key element of the EU's decarbonisation strategy for the road transport sector.

The Directive however doesn't cover charging infrastructure for electric trucks and only sets targets for natural gas refuelling infrastructure when it comes to heavy-duty vehicles. This conflicts with the European Green Deal as evidence shows that there are no significant climate benefits in shifting from diesel to fossil gas and that neither will not decarbonise road freight[48]. In relation to biomethane, the latest evidence shows that volume of renewable gas that can be sustainably and cost-effectively produced is limited, and that it would not be sufficient to meet the relevant demand from transport (the total renewable methane potential in the EU in 2050 is only 11% of the total demand from heavy duty vehicles and ships, see section 1.3 of the RechargeEU trucks report for more[49]).

It is high time that the revised AFID framework starts taking electric trucks seriously by including them in the scope of the technologies and setting appropriate binding targets. This opportunity can not be missed as it would put a halt to the development of a new market where European industry stands a chance for global leadership[50].

First and foremost the revision of the AFID should be coherent with the European Green Deal: **Targets on gas refuelling infrastructure should be taken out of the revised legislation** as they are not a solution to decarbonise road freight transport. All natural gas refuelling infrastructure will

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[48] Transport & Environment (2018). Natural gas-powered vehicles and ships – the facts. Link
[49] Transport & Environment (2020). Roadmap for electric truck charging. Link
[50] E-trucks: European automakers' third and final chance to get electrification right. E-trucks are the third chapter of vehicle electrification – European automakers lagged far behind in the first two: electric cars and e-buses. Link

rapidly become stranded assets as there is increasing pressure for cities to go zero emission and increasing supply of cost-effective electric trucks. The focus needs to shift exclusively to zero emission technologies: electricity and hydrogen. As such, the **AFI Directive should be turned into a Zero Emission Infrastructure Regulation (ZEIR)**, **focusing exclusively on electricity and hydrogen.**

The definition of what qualifies as an 'alternative fuel' (or zero emission one) is of paramount importance because it shows what fuels the EU considers to be compatible and coherent with it's Green Deal ambition. This definition is also at the heart of many EU and national funding programmes (including regional and structural funds). For example CEF Transport Blending calls, which are the main tools to finance alternative fuels infrastructure and vehicles links directly the definition of alternative fuels eligible to funding with the AFID definition[51].

The AFID should be **changed from a Directive to a Regulation**, in line with the EU proportionality principle, to allow for a swift adoption and implementation. If the revised framework stays a Directive, it is unlikely that any target would be set before 2025 as it would take an additional 2-3 years to translate the directive into national law. A regulation also allows for a more harmonised implementation as current national plans have led to a fragmented approach with regards to road freight fuels, putting some regions at risk to be left behind in the e-mobility transition and greatly reducing the business opportunities.

Finally a regulation opens the possibility for the EU to set requirements and targets on market players like shippers operating distribution centres. The scope of the revised AFID can then be widened to address **destination charging of electric trucks** (located on private premises at distribution/logistics centers or industrial premises and are used during loading or unloading of trucks) at medium and large distribution centers. When relevant, it should be made possible that these chargers can be shared between the different transport operators accessing the delivery center.

5.1.2 Bindings targets for destination and public charging

The revised framework should set **binding targets** for the deployment of **public and destination** charging infrastructure at **urban nodes for 2025 and 2030**.

A minimum of two public charging stations per urban node in 2025, increasing to 10 public charging stations in 2030.

[51] European Commission (2019). ANNEX to the Commission Implementing Decision amending the multiannual work programme 2014-2020 on the financing of the Connecting Europe Facility - Transport sector. Link (page 3)

National level deployment targets should be set in the new ZEI regulation. These targets should be aligned with our Green-Deal compatible scenario and an overview of the targets in EU's key Member States is given below. Table 9, 10 and 11 in Annex provides additional details.

E-trucks in 2030	EU	Germany	France	Spain	Italy	UK	Poland
Electric trucks	526,000	111,000	75,000	67,000	46,000	49,000	43,000
Destination charger	32,000	7,000	5,000	4,000	3,000	3,000	3,000
Public charger	17,000	4,000	2,000	2,000	1,000	2,000	1,000

Table 6: Summary finding for the top 6 countries

In addition to the supply target for the number of electric truck chargers, there should also be a **sufficiency** requirement which allows to monitor to what extent the total number of electric truck chargers available is sufficient for the fleet of electric trucks on the road. There should be at least **one public charger for every 30 electric trucks and one destination charger for every 15 electric trucks**. With public and destination charging combined, there should be **one charger for every ten electric trucks on the road at national level.**

$^

The coverage of the **TEN-T Core network** is not analysed in this report (part of a subsequent report), but the new ZEI Regulation should mandate full coverage of the Core network by 2030. This would enable longer electric truck trips by offering charging options to truck drivers during their operational breaks.

5.2 Revision of the TEN-T Regulation

The Trans-European Transport Network (TEN-T) Regulation addresses the implementation and development of a Europe-wide network of railway lines, roads, inland waterways, maritime shipping routes, ports, airports and railroad terminals. The current TEN-T policy is based on TEN-T Regulation (EU) No 1315/2013 which is planned to be revised in 2021 under the European Commission's Action Plan on the European Green Deal. Both the revision of AFID and the revision of the TEN-T Regulation should be addressed in a coherent manner as they are both part of the same action point in the EU Green Deal planning[52].

Article 30 of the 2013 TEN-T Regulation called for the *'promotion of efficient low-noise and low-carbon urban freight delivery'* at the urban nodes of the TEN-T Core network, but so far very little has been done to promote electric urban deliveries. T&E asks for the revision of the TEN-T Regulation to make this one of the key objectives of the new regulation and to strengthen it by **championing urban nodes as EU's leaders for zero emission mobility**. The sentence in Article 30 should then read *'promotion of efficient low-noise and* ***zero tailpipe emission urban and regional freight delivery****'.*

To achieve the significant reduction of emissions as demonstrated in this paper, the revised TEN-T Regulation should widen the scope of the urban nodes to a **secondary set of freight nodes, effectively doubling the number of urban nodes** and roughly doubling the potential of urban nodes to electrify trucks as demonstrated in this paper. These freight nodes should be selected with the specific aim to cover as much of the EU's urban and regional road freight activity, thus maximising the CO2 emission reduction and air quality benefits in cities.

5.3 Finance: Accelerating the uptake of electric trucks

As of today, the two main barriers to adoption of electric trucks are the high upfront costs and the very limited supply of vehicles. These two factors are intrinsically linked as current low production volumes entails high unit production costs on the one hand and high purchase prices reduces the demand on the other hand[53].

In May, the European Commission presented a new €750 billion recovery instrument, Next Generation EU[54] (on top of the €1.1 billion revamped seven year budget). The spendings on EU's main fund for transport infrastructure projects, Connecting Europe Facility or CEF, have been increased to €14.5 billion[55]. If this money is well spent, the market for electric trucks can be kick-started in the next few years and break the self-sustaining cycle of high-costs and low-volumes.

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[52] Annex of the European Green Deal Communication: *'Review of the Alternative Fuels Infrastructure Directive and the Trans European Network – Transport Regulation'* planned for 2021 under 'Sustainable and smart mobility'. Link

[53] This is observed through high battery costs for electric heavy duty vehicles (373$/kWh outside of China) which compares with the average for electric heavy duty vehicles produced in China and the average for BEV which are respectively at 140$/kWh and 150$/kWh. Source: BNEF 2020 EV Outlook

[54] European Commission, (2020). Europe's moment: Repair and Prepare for the Next Generation. COM(2020) 456 final. Link.

[55] European Commission, (2020). The EU budget powering the recovery plan for Europe. COM(2020) 442 final. Link. The previous budget proposal from 2018 was for €11.4 billion.

5.3.1 EU Recovery Fund

Financial support from Next Generation EU to the trucking sector should be targeted to support the transition away from diesel and gas as well as for the deployment of charging infrastructure.

In the coming months, EU countries will submit their national Recovery and Resilience Facility (RRF) plans. These plans should in part set up financial support programmes to help truckmakers scale up manufacturing of zero-emission trucks and commit to reach 10% of sales production by 2025. This short term recovery fund would help support OEMs' transition of manufacturing platforms and help them navigate through the economic crisis.

Member States should also include a clear charging infrastructure plan in their RRF plan. In this report we show that up to €28 billion would be necessary to support the roll-out of destination and public chargers for trucks in the next decade and an additional €40 billion would be necessary for depot charging.

Finally, during the upcoming discussions in Council, EU Member States should amend the Recovery and Resilience Facility (RRF) Regulation, the lion's share of the €750 billion programme, to ensure that no financial support can be granted to fossil fueled vehicles and infrastructure.

5.3.2 CEF Transport Blending Calls

To achieve this, T&E recommends to **redesign the CEF transport blending calls** as to have an adequate and streamlined funding mechanisms to accelerate the uptake of electric trucks while addressing the three different use cases:

- **Transport companies**: a fixed amount of money should be made available for the purchase of the electric truck and the associated depot charger. This amount could be fixed per truck size/weight category, or better, it could increase in line with the range of the vehicle (e.g. 100-200€/km for heavy trucks, which would fund 20%-40% of the additional cost)[56]. The latter solution is preferable as it incentivises vehicle efficiency improvements and longer range vehicles.
- **Shippers** owning and operating medium and large **distribution centers**: streamlined financial support should be provided to install the necessary high power opportunity charging infrastructure at the distribution centers. These destination chargers can be shared by several transport companies that load or unload cargo at the distribution center and a booking system would maximise utilisation while eliminating charge anxiety for transport operators.

[56] The marginal cost of adding one km of range to a heavy duty truck is about 500€/km (373$/kWh or 338€/kWh for e-HDVs outside of China according to BNEF and efficiency around 1.5 kWh/km). This simplified calculation excludes the cost difference of the diesel engine and electric motor.

- **Charge point operators** should benefit from a high co-funding rate for the deployment of public charging infrastructure at the urban nodes and along the TEN-T Core network. As the market maturity for electric trucks is lower than for electric cars, the co-funding rates should be adjusted accordingly and increased from the current 20% co-funding rate applied to public charging networks for cars (e.g. Ionity) to 50% co-funding rate, as the new CEF regulation (art 14) allows it. .

5.4 Increasing the supply of electric trucks

The revision of the EU's commercial vehicle CO_2 regulation should be addressed as part of the EU Green Deal's 2030 climate plan. Given the electrification trajectory considered by the industry, clear and ambitious **zero emission commercial vehicle mandates** should be set.

Infobox: California ZEV mandate[57]
California has recently approved an increase in the targets for the ZEV mandate under which truck manufacturers have to sell 7% of zero emissions trucks in 2025 and 30% in 2030 for small trucks (below 6.35t) and large tractor-trailers (above 12t), while rigid trucks above 6.35t have a target of 11% in 2025 and 50% in 2030. Overall this would translate into 8% of sales at EU level in 2025 and 37% in 2030 when weighted for electric truck sales per category in the EU.

The EU is expected to review the truck CO_2 standards towards the end of 2022. The current regulation which sets targets for 2025 and 2030 only covers regulated trucks which are heavy trucks cover the lion's share of the trucks sales and emissions. For the **regulated trucks** the existing zero and low emission benchmark -or voluntary target- of 2% in 2025 should be changed into a much more binding and effective incentive scheme for zero emission trucks.

The truck categories which are **not yet regulated** mainly cover **medium trucks** below 16t and are not likely to face any reduction targets before 2030. Given the higher technological, operational and economic feasibility of electric trucks in the medium size categories over the heavy categories, the EU regulation should not waste time into setting gradual CO_2 reduction targets but should rather set a strong **mandate for the sales of zero emission trucks**. Indeed, if CO_2 reduction targets were to be set for 2030, it could take five to ten years for truck manufacturers to exploit all of the technically feasible incremental efficiency gains before the level of sales of zero emission vehicles rises sharply (once the fleet of diesel trucks can not be improved any further). Considering that the sales of medium duty combustion engine commercial vehicles should be phased out between 2035 and

[57] Transport Environment, June 2020. *California sets world's first sales target for emissions-free trucks.* Link

2040, the timeline and climate urgency doesn't allow for anything else than a strategy based on a rapid shift to zero emission trucks.

5.5 Local and national authorities

National and local measures aiming to tackle both carbon and pollutant emissions are increasing the pressure urban deliveries to electrify. Setting a clear path towards zero-emission, several European countries have already announced their plan to phase out petrol and diesel car sales, notably Sweden, the Netherlands, Ireland by 2030, the UK by 2035 at the latest, and France by 2040[58]. At local level, more than 250 cities across Europe already have low and zero-emission zones in place in order to reduce air pollution caused by traffic. This mounting pressure for delivery vehicles to electrify means the transition to electric trucks will be inevitable.

As recommended in the the Transport Decarbonisation Alliance white paper on zero emission urban freight[59], cities, companies and governments should act now to design tailored solutions.

The objective should be to set a clear goal of zero emission freight zones in all frontrunner cities by 2025 (i.e. identified as urban nodes here). Not only will this decrease pollution levels, it will also be a strong signal to the automotive industry to produce clean freight vehicles in larger quantities and would set the right momentum to fully decarbonise regional deliveries and then long haul trips.

In the light of our recommendations, T&E recommends that the 173 key cities identified in this report should set a clear path towards zero emission freight deliveries by implementing zero emission zones and engage the transition with the various stakeholders.

Best practice: Zero emission city logistics in the Netherlands
In 2019, the Dutch National Climate Agreement defined a series of measures to be taken in the Netherlands to reduce CO_2 emissions by at least 49% by 2030, compared to 1990 levels. The Agreement set out key actions on sustainable mobility and logistics, including a requirement that by 2025 the **30-40 largest cities in the Netherlands introduce zero emission zones for freight**. The Dutch government is working with municipal authorities to provide clarity on how the introduction of the zero emission zones would take place, to allow Dutch businesses to make preparations in a good time. Importantly, the Dutch government is also elaborating a national incentive program offering grants for the purchase of electric trucks and vans.

[58] Transport & Environment (2020). Why Uber should go electric? Link
[59] Transport Decarbonisation Alliance (2019). *Zero Emission Urban Freight.* Link

6. Annex

6.1 List of primary and secondary urban nodes

Country	Primary urban node	Secondary urban node
Belgium	Arr. Antwerpen, Arr. de Bruxelles-Capitale / Arr. van Brussel-Hoofdstad	Arr. Veurne, Arr. Gent
Bulgaria	Sofia (stolitsa)	Varna
Czech Republic	Moravskoslezsky kraj, Hlavni mesto Praha	Stredocesky kraj, Olomoucky kraj
Denmark	Ostjylland, Byen Kobenhavn	Ostsjaelland, Sydjylland
Germany	Berlin, Bielefeld, Bremen, Dusseldorf, Frankfurt am Main, Hamburg, Region Hannover, Koln, Leipzig, Mannheim, Munchen, Nurnberg, Stuttgart	Duisburg, Dortmund, Kassel, Bremerhaven, Karlsruhe, Ludwigshafen am Rhein, Rhein-Erft-Kreis, Regensburg, Heilbronn, Gelsenkirchen, Rhein-Kreis Neuss, Recklinghausen, Krefeld
Estonia	Pohja-Eesti	Kesk-Eesti
Ireland	Dublin, South-West (IRL)	Mid-East, Mid-West
Greece	Attiki, Irakleio, Thessaloniki	Kozani, Florina, Achaia
Spain	Barcelona, Vizcaya, Gran Canaria, Madrid, Mallorca, Sevilla, Valencia / Valencia	Pontevedra, Alicante / Alacant, Murcia, Zaragoza, Asturias, Castellon / Castello, Guipuzcoa
France	Gironde, Nord, Rhone, Bouches-du-Rhone, Alpes-Maritimes, Paris, Bas-Rhin, Haute-Garonne	Pas-de-Calais, Seine-et-Marne, Ille-et-Vilaine, Seine-Maritime, Loire-Atlantique, Essonne, Val-d'Oise, Marne
Croatia	Grad Zagreb	Varazdinska zupanija
Italy	Bologna, Cagliari, Genova, Milano, Napoli, Palermo, Roma, Torino, Venezia	Bergamo, Brescia, Vicenza, Treviso, Verona, Padova, Modena, Mantova, Ravenna

Cyprus	Kypros/Kibris	None
Lavia	Riga	Pieriga
Lithuania	Vilniaus apskritis	Klaipedos apskritis
Luxembourg	Luxembourg (Grand-Duche)	*None*
Hungary	Budapest	Pest
Malta	Malta	None
Netherlands	Groot-Amsterdam, Groot-Rijnmond	Zuid-Limburg, West-Noord-Brabant
Austria	Wien	Linz-Wels
Poland	Gdanski, Katowicki, Miasto Krakow, Miasto Lodz, Miasto Poznan, Miasto Szczecin, Miasto Warszawa, Miasto Wroclaw	Trojmiejski, Gliwicki, Krakowski, Rybnicki, Sosnowiecki, Tyski, Kielecki, Bytomski
Portugal	Grande Lisboa, Grande Porto	Peninsula de Setubal, Oeste
Romania	Bucuresti, Timis	Constanta, Ilfov
Slovenia	Osrednjeslovenska	Obalno-kraska
Slovakia	Bratislavsky kraj	Trnavsky kraj
Finland	Uusimaa, Varsinais-Suomi	Satakunta, Keski-Suomi
Sweden	Vastra Gotalands lan, Skane lan, Stockholms lan	Jonkopings lan, Hallands lan, Blekinge lan
United Kingdom	Birmingham, Bristol, Edinburgh, Glasgow City, Leeds, Inner London - West, Greater Manchester South, Portsmouth, Sheffield	Thurrock, Southampton, Outer London - East and North East, Kingston upon Hull, Leicester, Walsall and Wolverhampton, Liverpool, Belfast, Halton and Warrington

Table 7: List of primary and secondary urban nodes

6.2 Detailed electric truck uptake assumptions

Shares of electrification		Industry-Baseline		EV-Leaders		Road-2-Zero	
Origin/destination	Distance	2025	2030	2025	2030	2025	2030
Intra Node	All	2%	19%	30%	88%	64%	100%
Node-Node	0 - 100 km	2%	19%	30%	88%	64%	100%
Node-Node	100 - 200 km	1%	15%	18%	70%	38%	100%
Node-Node	200 - 300 km	1%	11%	12%	53%	26%	100%
Node-Node	300 - 400 km	0%	4%	4%	18%	8%	100%
Node-X	0 - 100 km	2%	19%	15%	44%	32%	100%
Node-X	100 - 200 km	1%	15%	9%	35%	19%	100%
Node-X	200 - 300 km	1%	11%	1%	11%	1%	11%
Node-X	300 - 400 km	0%	4%	0%	4%	0%	4%
X-Node	0 - 100 km	2%	19%	7%	22%	16%	100%
X-Node	100 - 200 km	1%	15%	4%	18%	10%	100%
X-Node	200 - 300 km	1%	11%	1%	11%	1%	11%
X-Node	300 - 400 km	0%	4%	0%	4%	0%	4%
Intra-X	All	2%	19%	2%	19%	2%	19%
X-X	0 - 100 km	2%	19%	2%	19%	2%	19%
X-X	100 - 200 km	1%	15%	1%	15%	1%	15%
X-X	200 - 300 km	1%	11%	1%	11%	1%	11%
X-X	300 - 400 km	0%	4%	0%	4%	0%	4%

Node are urban nodes and X are all other regions. Shares of electrification related to the share of electric trips covering the type of trip as defined in the first two columns.

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Table 8: Detailed electric trucks uptake assumptions

6.3 Country details

Electric trucks per country

	2025	2025	2025	2030	2030	2030
Country	Baseline	EV-Leaders	Road-2Zero	Baseline	EV-Leaders	Road-2Zero
Austria	362	804	1,415	3,503	4,481	7,027
Belgium	399	1,104	2,081	4,229	5,817	10,363
Bulgaria	146	335	589	1,355	1,783	2,500
Czech Republic	539	3,165	6,550	5,043	11,669	17,477
Germany	4,783	11,055	19,807	47,611	61,452	110,712
Denmark	140	817	1,715	1,629	3,487	6,986
Estonia	38	322	684	355	1,075	1,475
Spain	2,165	12,494	25,760	20,135	46,300	67,236
Finland	412	2,104	4,269	3,776	8,128	12,111
France	2,574	11,002	21,958	25,092	46,566	74,653
Greece	236	1,504	3,149	2,135	5,219	7,380
Croatia	58	151	276	597	806	1,322
Hungary	267	750	1,393	2,655	3,831	5,924
Ireland	205	1,404	2,951	1,873	4,958	7,319
Italy	1,218	5,537	11,296	13,312	24,650	45,771
Lithuania	66	223	432	632	1,016	1,754
Latvia	73	348	713	723	1,403	2,818
Netherlands	679	1,636	2,977	6,748	8,843	15,834
Poland	1,448	4,931	9,641	15,582	24,020	42,892
Portugal	180	751	1,503	1,734	3,139	5,867
Romania	224	543	972	2,139	2,890	4,492
Sweden	585	3,380	6,958	5,569	13,004	18,034
Slovenia	49	187	371	480	804	1,321
Slovakia	163	485	911	1,590	2,385	3,739
UK	2,200	4,796	8,506	22,578	27,844	49,277
Cyprus	-	-	-	-	-	-
Luxembourg	37	330	709	378	1,146	1,954
Norway	327	327	327	2,922	2,922	2,922
Switzerland	278	280	283	2,511	2,516	2,535
EU	**19,246**	**70,158**	**137,585**	**191,453**	**316,717**	**526,238**
EU+NO+CH	19,851	70,765	138,196	196,886	322,156	531,695

Table 9: Number of electric trucks per EU country

Public chargers per country

Country	2025 Baseline	2025 EV-Leaders	2025 Road-2Zero	2030 Baseline	2030 EV-Leaders	2030 Road-2Zero
Austria	6	14	25	96	123	193
Belgium	7	20	37	116	159	284
Bulgaria	3	6	10	37	49	68
Czech Republic	10	56	117	138	320	479
Germany	85	197	353	1,304	1,684	3,033
Denmark	2	15	31	45	96	191
Estonia	1	6	12	10	29	40
Spain	39	222	459	552	1,269	1,842
Finland	7	37	76	103	223	332
France	46	196	391	687	1,276	2,045
Greece	4	27	56	58	143	202
Croatia	1	3	5	16	22	36
Hungary	5	13	25	73	105	162
Ireland	4	25	53	51	136	201
Italy	22	99	201	365	675	1,254
Lithuania	1	4	8	17	28	48
Latvia	1	6	13	20	38	77
Netherlands	12	29	53	185	242	434
Poland	26	88	172	427	658	1,175
Portugal	3	13	27	48	86	161
Romania	4	10	17	59	79	123
Sweden	10	60	124	153	356	494
Slovenia	1	3	7	13	22	36
Slovakia	3	9	16	44	65	102
UK	39	85	151	619	763	1,350
Cyprus	-	-	-	-	-	-
Luxembourg	1	6	13	10	31	54
Norway	6	6	6	80	80	80
Switzerland	5	5	5	69	69	69
EU	**343**	**1,249**	**2,450**	**5,245**	**8,677**	**14,418**
EU+NO+CH	354	1,260	2,461	5,394	8,826	14,567

Table 10: Number of public chargers per EU country

Destination chargers per country

	2025	2025	2025	2030	2030	2030
Country	Baseline	EV-Leaders	Road-2Zero	Baseline	EV-Leaders	Road-2Zero
Austria	14	32	56	183	234	367
Belgium	16	44	82	221	304	541
Bulgaria	6	13	23	71	93	130
Czech Republic	21	125	259	263	609	912
Germany	189	438	784	2,485	3,207	5,778
Denmark	6	32	68	85	182	365
Estonia	2	13	27	19	56	77
Spain	86	494	1,019	1,051	2,416	3,509
Finland	16	83	169	197	424	632
France	102	435	869	1,309	2,430	3,896
Greece	9	60	125	111	272	385
Croatia	2	6	11	31	42	69
Hungary	11	30	55	139	200	309
Ireland	8	56	117	98	259	382
Italy	48	219	447	695	1,286	2,389
Lithuania	3	9	17	33	53	92
Latvia	3	14	28	38	73	147
Netherlands	27	65	118	352	461	826
Poland	57	195	382	813	1,253	2,238
Portugal	7	30	59	91	164	306
Romania	9	21	38	112	151	234
Sweden	23	134	275	291	679	941
Slovenia	2	7	15	25	42	69
Slovakia	6	19	36	83	124	195
UK	87	190	337	1,178	1,453	2,572
Cyprus	-	-	-	-	-	-
Luxembourg	1	13	28	20	60	102
Norway	13	13	13	152	152	152
Switzerland	11	11	11	131	131	132
EU	**762**	**2,776**	**5,445**	**9,991**	**16,528**	**27,462**
EU+NO+CH	786	2,800	5,469	10,275	16,812	27,747

Table 11: Number of destination chargers per EU country

6.4 Sensitivity analysis: sufficiency of chargers

Sensitivity analysis

Average activity: Most of the results in this section come as a consequence of the total energy average activity of a truck according to Eurostat. This average activity (800,000 tkm/truck/year) is a weighted average over all vehicle categories (from large vans over 3.5t to 40t heavy duty trucks). More refined analysis would be required to model the infrastructure requirements per vehicle category rather than an average. Heavy trucks operating on regional trips could have a higher activity of about 1,200,000 tkm/truck (100,000 km per year and 12t average payload), while smaller urban trucks in urban activity could be at half of the average value (about 400,000 tkm/truck). We summarise below:

- High activity: 1,200,000 tkm/truck
- Low activity: 400,000 tkm/truck

Charging power: For sensitivity analysis we assume:

- High power: destination: 450 kW, public: 800 kW
- Low power: destination: 150kW, public: 400 kW

Charger occupancy: For sensitivity analysis we assume:

- High: destination at 6h, public at 3h
- Low: destination at 2h, public at 1h

We calculate values in 2030, where the split between depot, destination and public is 65%/25%/10%

# E-trucks per charger	Baseline	High activity	Low activity	High power	Low power	High occupancy	Low occupancy	High depot
Destination charging	19	13	38	25	8	29	10	25
Public charging	36	24	73	49	24	55	18	56
Destination + public	13	8	25	16	6	19	6	17

Table 12: Sensitivity analysis for the number of electric truck per charger

6.5 Total activity as per trip type

As shown in the Figure 17 , in the Road-2-Zero scenario, the quantity of electric truck activity increases significantly for all trips coming or going to an urban node. As a result, in 2030 in the Road-2-Zero scenario, 77% of all the electric truck activity in the EU either departs or arrives at an urban node.

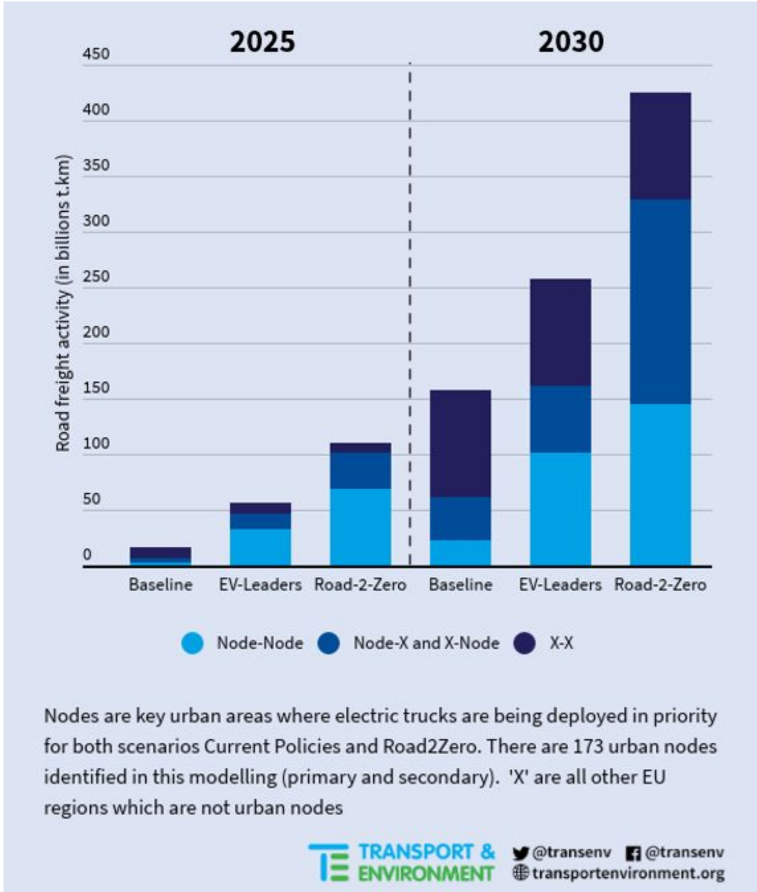

Figure 17: Electric road freight activity in the EU, per trip type

In Figure 18 below, we note that the huge majority of the electric truck activity is covered by trips which are less than 200 km (85%)

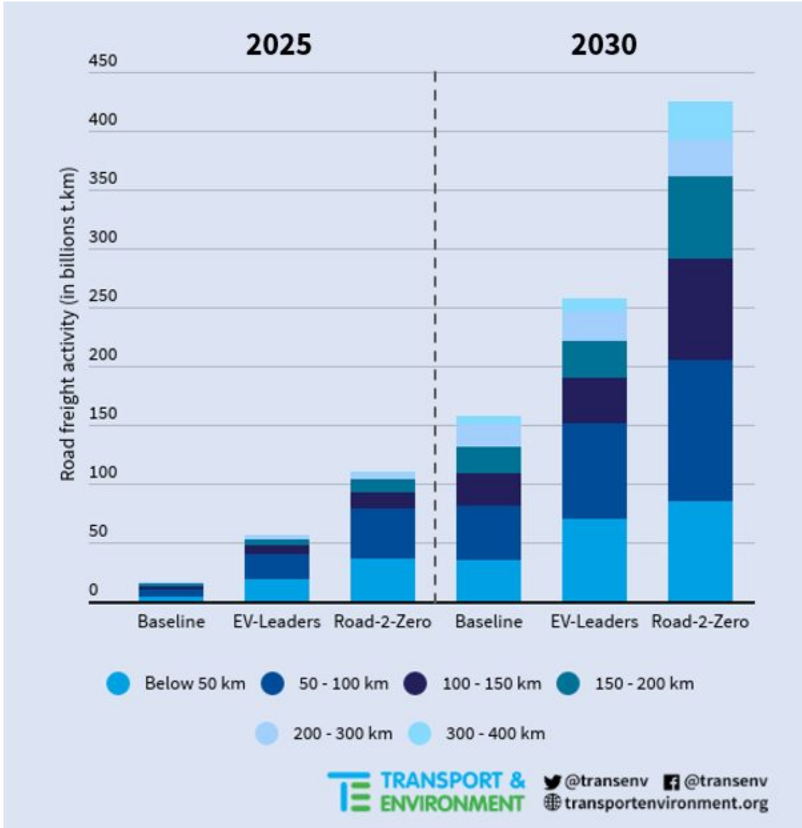

Figure 18: Electric road freight activity in the EU, per trip distance