Unlocking Electric Trucking in the EU: Methodology

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1. Introduction

This is a methodological note to supplement the three reports in the *Unlocking Electric Trucking in the EU* Trilogy by T&E. Together, the three volumes in the trilogy cover urban and regional deliveries through the TEN-T core network urban nodes, EU maritime ports, and long haul land freight through TEN-T core network pathways. These three reports will be collectively called *the Trilogy* as shorthand in this document. The Trilogy set out to understand and advise on the location and timing of infrastructure deployment for the emergence of zero-emission heavy goods vehicles[1]. The Trilogy seeks to quantify and build upon on the ideas of T&E's Roadmap for Electric Truck Charging[i]. In particular, a focus was given on the TEN-T Core network and key European container ports to unlock the potential of zero emission trucks[2]. The TEN-T Core network map is shown in Figure 1, with the 88 Urban nodes shown with black dots, that form the basis of the initial infrastructure deployment. The geographical scope of the project encompasses the EU27 (less Malta, owing to a lack of data) and the UK, with recommendations on charging infrastructure for these regions. However, the freight flows to and from Norway and Switzerland are included as they represent significant trading partners.

[1] Heavy goods vehicles are trucks above 3.5t.

[2] Zero emission at the tailpipe, implying battery electric, overhead catenary, and hydrogen fuel cell powered trucks.

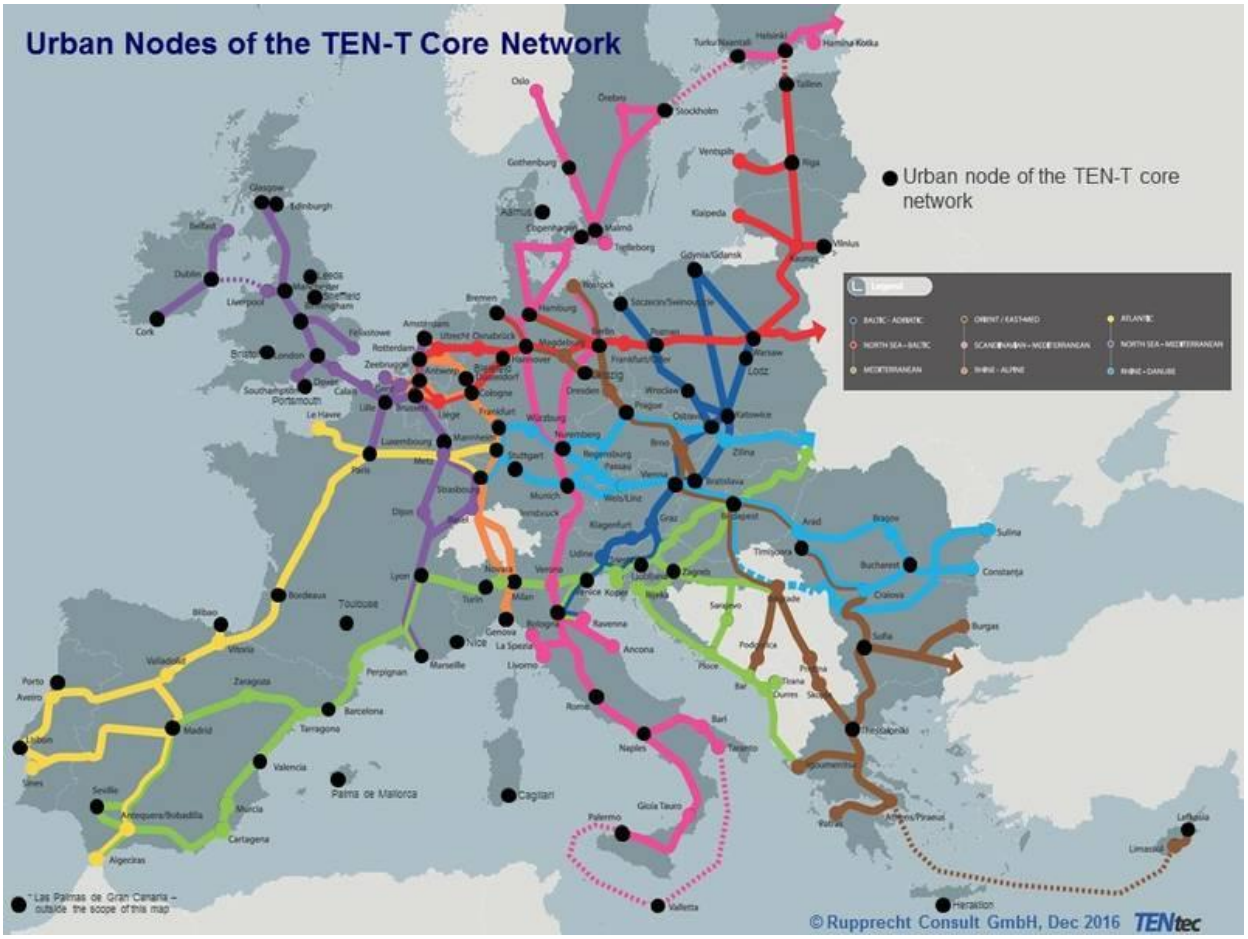

Figure 1: TEN-T Core network[ii].

In order to achieve the objectives of the Trilogy, we took a deeper dive into freight movements in Europe. Herein we describe the database used, data treatment, calibration of activity, data extraction to separate truck flow activity into each report's scope, scenario development, and sensitivity analyses.

2. Description of the ETIS project and NUTS3 database

The trilogy of reports is built on a modelled database of European freight movements that were the results of the ETISplus project[iii]. ETISplus was a research project in the 7th Framework Programme (DG MOVE). The main objective of the ETIS project was to develop a framework for the collection and dissemination of data and network information related to transport. It included the implementation and validation of a database, adding the new reference years 2005 and 2008, and including the newest member states and neighbouring countries in more detail.

The underlying database is a granular origin-destination (O/D) matrix of freight by road, inland waterways, and rail, by freight type. The O/D matrix was constructed based on several 2010 Eurostat databases[iv]. It covers all countries of the European Union, at the NUTS3 region level (more below). For the purposes of the Trilogy, we only use the O/D matrix at the NUTS3 region level, expressed in total annual tonnes for each O/D pair. The original project was able to extend the freight flows to the road network to calculate the resulting traffic flows. This in turn provided typical speeds and distances between the O/D pairs, the latter which were also utilised. The resulting map shows the traffic flows around Europe resulting from the freight flows, which matches closely with the TEN-T Core network.

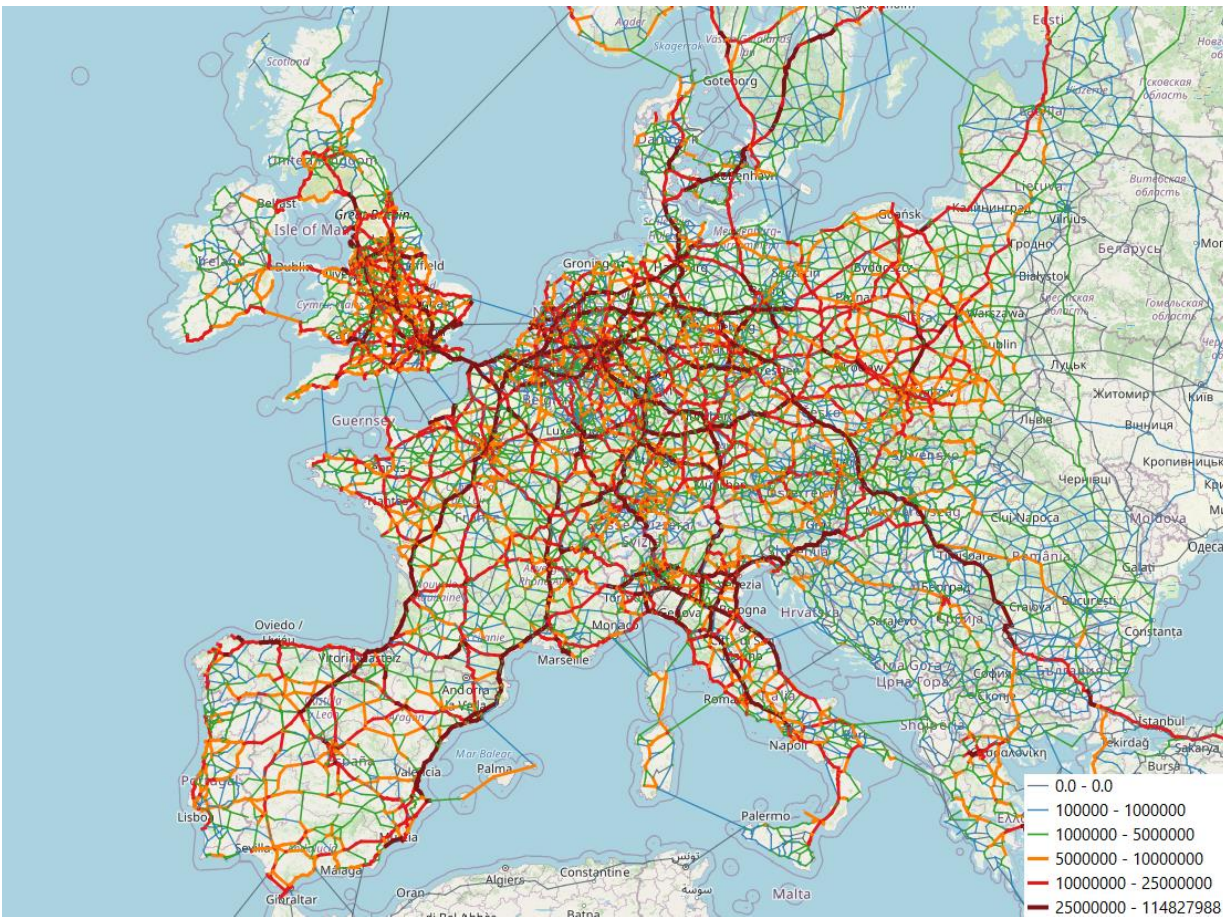

Figure 2: Heavy duty freight flows from the ETIS project with map assignment by Panteia[v], freight volumes in tonnes

The entities of the O/D matrix are known as NUTS regions, an acronym for *nomenclature of territorial units for statistics* and are official Eurostat geographical divisions of European member states[vi]. They come in 3 levels of granularity, where the smallest divisions are known as NUTS3. Eurostat has detailed information about the socio-economic data of each NUTS3 region, including population, tonnes of freight loaded and unloaded, number of business, amongst other rich statistics. The ETIS database uses the NUTS3 division of 2010.

3. Data Treatment

The O/D matrix is a large table listing all the modelled freight flows. Each NUTS3 is given a unique identification number. Each O/D pair has a corresponding distance, average truck speed, and freight volume (in tonnes). All data processing and analysis is based on a suite of in-house python[vii] programs. We defined NUTS3 regions that correspond with the urban nodes of the TEN-T network (see following section), and denote these regions as 'nodes'. All other regions that are not nodes are defined as 'X'.

3.1. Urban Nodes

As NUTS3 entities vary significantly between countries, with their size inversely proportional to the population living within the region, some urban nodes were made up of several NUTS3. Table 1 lists the 88 Urban nodes, and the NUTS3 entities that were used and/or combined to make them:

Country	Urban nodes	NUTS3 region(s)	Country	Urban nodes	NUTS3 region(s)
BE	Antwerpen	BE211	IT	Genova	ITC33
BE	Bruxelles/Brussel	BE100 , BE241	IT	Milano	ITC45
BG	Sofia	BG411	IT	Napoli	ITF33
CZ	Ostrava	CZ080	IT	Palermo	ITG12
CZ	Praha	CZ010	IT	Roma	ITE43
DK	Aarhus	DK042	IT	Torino	ITC11
DK	Kobenhavn	DK011, DK012	IT	Venezia	ITD35
DE	Berlin	DE300	CY	Lefkosia	CY000
DE	Bielefeld	DEA41	LV	Riga	LV006
DE	Bremen	DE501	LT	Vilnius	LT00A

DE	Düsseldorf	DEA11	LU	Luxembourg	LU000
DE	Frankfurt am Main	DE712	HU	Budapest	HU101
DE	Hamburg	DE600	MT[3]	Valletta	MT001
DE	Hannover	DE929	NL	Amsterdam	NL326
DE	Köln	DEA23	NL	Rotterdam	NL335
DE	Leipzig	DED31	AT	Wien	AT130
DE	Mannheim	DE126	PL	Gdansk	PL634
DE	München	DE212	PL	Katowice	PL22A
DE	Nürnberg	DE254	PL	Krakows	PL213
DE	Stuttgart	DE111	PL	Lodz	PL113
EE	Tallinn	EE001	PL	Poznan	PL415
IE	Dublin	IE021	PL	Szczecin	PL424
IE	Cork	IE025	PL	Warszawa	PL127
GR	Athina	GR300	PL	Wroclaw	PL514
GR	Heraklion	GR431	PT	Lisboa	PT171
GR	Thessaloniki	GR122	PT	Porto	PT114
ES	Barcelona	ES511	RO	Bucuresti	RO321
ES	Bilbao	ES213	RO	Timisoara	RO424
ES	Las Palmas de Gran Canaria Santa Cruz de Tenerife	ES705	SI	Ljubljana	SI021
ES	Madrid	ES300	SK	Bratislava	SK010
ES	Palma de Mallorca	ES532	FI	Helsinki	FI181
ES	Sevilla	ES618	FI	Turku	FI183
ES	Valencia	ES523	SE	Goteborg	SE232
FR	Bordeaux	FR612	SE	Malmo	SE224

[3] No data available for Malta

FR	Lille	FR301	SE	Stockholm	SE110
FR	Lyon	FR716	UK	Birmingham	UKG31
FR	Marseille	FR824	UK	Bristol	UKK11
FR	Nice	FR823	UK	Edinburgh	UKM25
FR	Paris	FR101, FR105, FR106, FR107	UK	Glasgow	UKM34
FR	Strasbourg	FR421	UK	Leeds	UKE42
FR	Toulouse	FR623	UK	London	UKI11, UKI12
HR	Zagreb	HR011	UK	Manchester	UKD31, UKD32
IT	Bologna	ITD55	UK	Portsmouth	UKJ31
IT	Cagliari	ITG27	UK	Sheffield	UKE32

Table 1: The 88 Urban nodes and the corresponding NUTS3 regions.

Figure 3 shows the five cities where NUTS3 regions were combined to make one complete urban node (the only cases where this was done). These were selected based on the fact the city was not completely encompassed in a NUTS3 region, which was not the case for the other urban nodes.

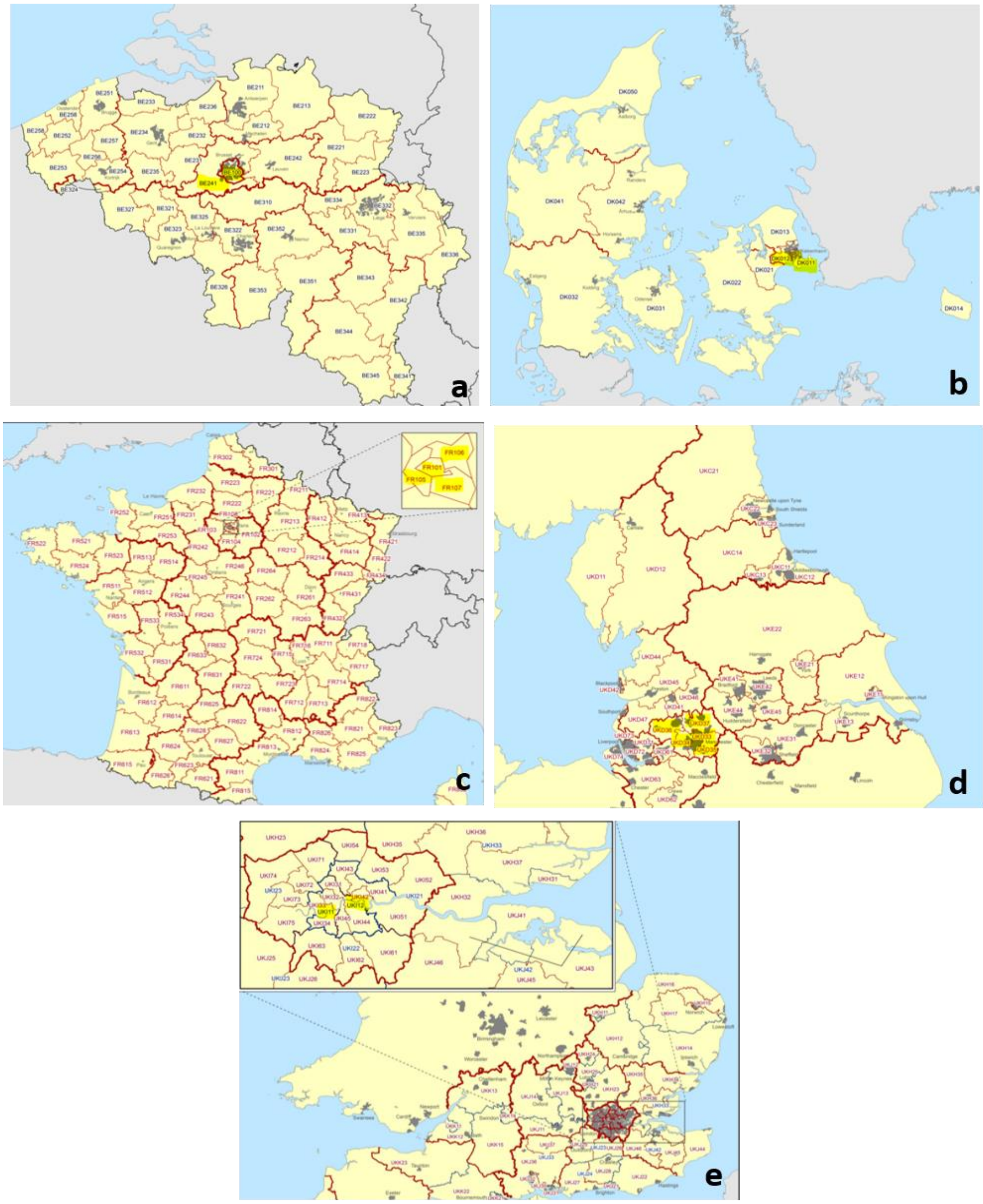

Figure 3: Combination of NUTS3 defined as a urban node highlighted in yellow (a: Brussels, b: Copenhagen, c: Paris, d: Manchester, e: London), Eurostat NUTS3 regions 2010[viii]

3.2. Intra region distance

As the O/D matrix did not provide a distance for intra region transport, we defined a characteristic distance as an equivalent radius. The region's area was calculated from the area bound by the border of the region, provided as a multi-point polygon. This enabled the intra-regional tonnes of freight transport to be converted into activity, i.e. tonne-kilometres (tkm).

3.3. Data calibration

See Section 6 for more discussion on Eurostat definitions. The ETIS project had freight flows calibrated for the year 2010. To update the data, we undertook a calibration of the O/D matrix to the latest available Eurostat data at the time of analysis, i.e. the year 2018. The calibration relied on the Eurostat tables:

International freight activity, which exclude cross-trade (see definitions in Section 6)

- **Road_go_ia_ltt** and **road_go_ia_lgtt**: All EU reporting countries were extracted. These tables give the total freight activity, showing which country the freight was *loaded* and arrived in the reporting country, in activity (million tonne-km) and thousand tonnes of total freight. Here, the reporting country is the destination.
- **Road_go_ia_utt** and **road_go_ia_ugtt**: All EU reporting countries were extracted. These tables give the total freight activity from the reporting country to where the reporting country freight was *unloaded*, in activity (million tonne-km) and thousand tonnes of total freight. Here, the reporting country is the origin.

National (or domestic) freight activity.

- **Road_go_na_dctt** and **road_go_na_tgtt**: This gives the national domestic freight activity, in activity (million tonne-km) and thousand tonnes of total freight, by trucks of the same registration as the reporting country.
- **Road_go_ca_c**: This gives the cabotage (i.e. the national transport performed by a foreign vehicle) in activity (million tonne-km) and thousand tonnes of total freight. These data were added to the national totals which would otherwise only have included freight movements from trucks registered in the reporting country.

As cross-trade flows (9.3% of total activity in the EU27 and UK) are not included in the international databases mentioned above, the international freight flows were scaled so that the total activity would be equal to the total reported in Eurostat[ix]. This thus assumes that the cross-trade flows are the same as the international flows. This resulted in total national freight flows (including cabotage) of 1313 Gtkm in the EU27 (less Malta), the UK, Norway and Switzerland and international (scaled to include cross-trade) at 602 Gtkm, for a total of 1915 Gtkm[4].

The distribution of freight in the original O/D matrix from the ETIS project was then used as a proxy for the distribution of the 2018. For example, the freight between Italy and France in 2018 was found to be higher in 2018 than 2010. To obtain the new O/D matrix at the NUTS3 level, the 2010 shares were scaled proportionally, so that the freight share between Lyon to Rome would be the same in 2018 as in 2010. Therefore, we assume that the proportion of trade between NUTS3 regions remains constant, but the total activity increased or decreased to match the calibrated data. Figure 4 shows the freight activity for each country from the original ETIS model (ETISPLUS), the Eurostat database (based on a collation of Eurostat tables listed above) and the calibrated model that is used for the Trilogy, denoted T&E 2018. No projections of activity were undertaken. This is largely due to the difficulty of keeping the assumption of freight proportions constant and the uncertainties from the COVID19 crisis, which would likely make most projections of freight activity out of date. Furthermore, the total road freight per member state is quite stable over time, thus a typical year is considered a reasonable proxy for any future projections. All analysis thus relies on this 2018 baseline. The largest differences between the ETIS project and the calibrated data is Italy, which had a large drop in freight. This is in part due to a reduction of truck activity and possibly also differences in methodology for collating these statistics over time in Italy. Thus the original ETIS project had modelled slightly higher activity for Italy than what is shown in Eurostat, which has now been corrected to official statistics. On the other hand, Germany, Spain, and Poland have increased freight activity compared to 2010, which may be due to increase economic activity, and are reflected in official territoriality statistics from Eurostat[x].

[4] When ETISPLUS database has no flows between NUTS3 regions of a country pair (see explanations in the following paragraph), the flows from Eurostat were not attributed. It represents 0.005% of total activity.

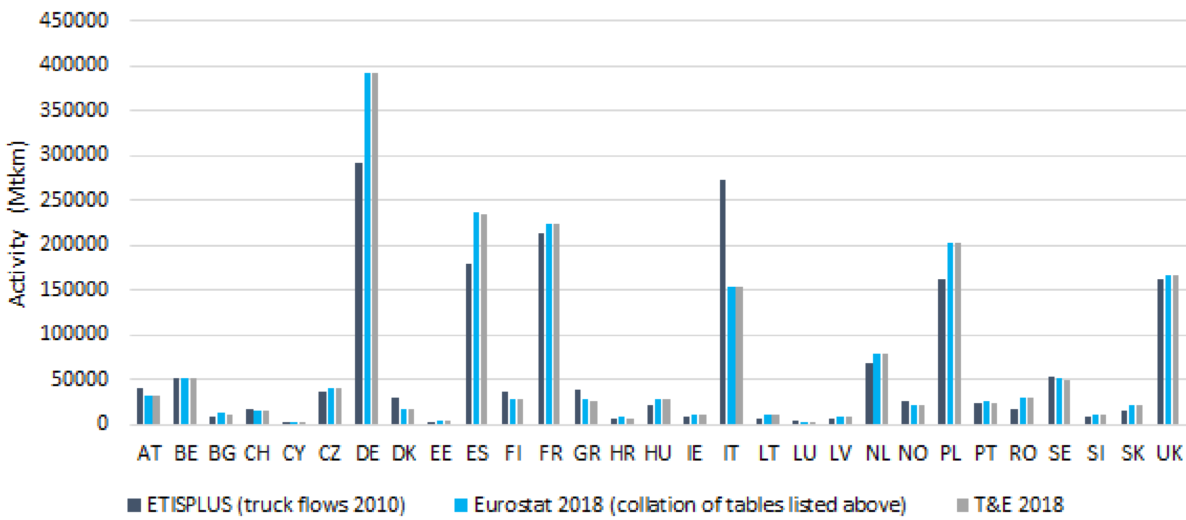

Figure 4: Result of calibrating the freight activity from 2010 ETIS model to 2018 Eurostat.

While the international traffic gave a good match in terms activity (tkms) and the tonnes per distance band, an additional step was required to harmonise the national data. As the ETIS project appeared to give significantly more freight flows to shorter distances (see Table 2 below), freight was redistributed so that there was a closer match with Eurostat table *road_go_ta_dctt 2018*. To get a finer split between the distance band 150km to 500km of this table, we used table *road_go_ta_dc 2018* to get the share between 150 km to 300 km and 300 km to 500 km for each country. This table may not be as applicable to the way a trip is defined in the ETIS project (see Section 6), particularly for small countries. The key example is Luxembourg, where there are national (domestic) trips logged that are greater than 150 km, despite the country being 75 km along its longest axis. This implies that these longer journeys were multistage trips, where the first loading event and final unloading until empty event define a total trip (see section 6 for definitions of trips used in Eurostat). So while the first loading and last unloading were in Luxembourg (so national transport), a big part of the journey could have been undertaken in neighbouring France, Germany, or Belgium. These types of trips do not take up a large share of total activity, however, on average in the EU it is 12%.

Table 2 shows a comparison of the freight movements by distance band for the EU and 4 major EU countries. This shows that the modelled and calibrated O/D matrix gives transport flows that match official Eurostat data. AS explained further in Section 6, the definition of a trip in Eurostat is not completely aligned with the definition in the ETIS project. For example, an inter Luxembourg trip of

>150 km is not possible in the O/D matrix, however Eurostat has recorded activity in this distance band. The calibration was therefore not adjusted to Eurostat to the same level as total activity, but rather to halfway between the activity distance bands of ETIS and Eurostat. This was also undertaken in order to not have too many trips below 150km, and thus potentially overestimating the potential of electric trucks in the short term. Table 2 shows the summary of the original ETIS data, the equivalent Eurostat data and the final calibrated data.

Distance band \ Activity	ETIS	Eurostat (1)	T&E calibration (2)
<50 km	11.9%	7.2%	10.2%
50 to 149 km	27.3%	16.3%	22.9%
150 to 299 km	22.2%	20.7%	17.3%
300 to 499 km	9.6%	17.7%	16.3%
500 to 999 km	13.4%	20.5%	16.0%
1000 to 1999 km	12.4%	13.0%	13.3%
2000 to 5999 km	3.1%	4.6%	4.0%
>6000 km	0.0%	0.0%	0.0%

(1) Eurostat, 2015

(2) T&E in-house analysis from an update of the ETISPLUS European project database (2012)

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Table 2: Comparison of Eurostat distance bands and the model before and after calibration procedure

4. Data extraction

All trilogy reports are based on the same database. This section gives more details on how the data was split based on the scope of each project. Figure 5 shows a flow chart of the data processing generalising this allocation, with an approximate indication of the intended time frame for each. The ports project has a strong link with freight coming off ships, essentially the interface of European global trade. Thus in this section we describe how we define the truck activity linked exclusively to the port. The regional deliveries covered in the Urban Nodes project are intended to cover shorter trips with a policy focus on supplying electric charging infrastructure to the urban nodes of the EU TEN-T Core network (see Section 3.1 for list). Finally the Pathways project aims to tackle long haul and international trucking along the key corridors of the TEN-T network.

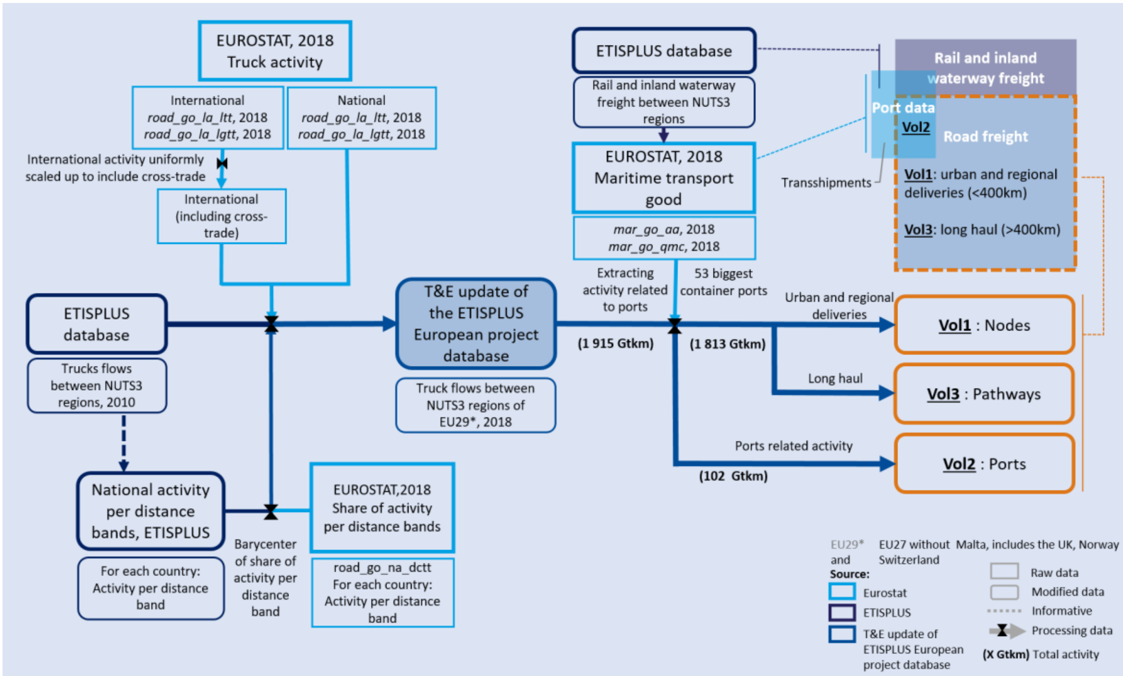

Figure 5: Flowchart showing data processing and activity split into the three reports of the Trilogy.

Section4.1 describes how the port activity was selected and extracted from the dataset. The remaining dataset is then used for both the Urban Nodes and Pathways project, whereby the scope is defined by distance band.

4.1. Ports

The aim of this section is to describe how truck activity exclusively related to ports was extracted from the calibrated O/D matrices of truck flows. The first step was to determine the candidate ports based on freight volumes, and the second step was to remove these tonnes from the database. Port data from Eurostat table *mar_go_qmc* was used for this purpose. Ports selected were at a maximum of 5 per country in terms of containerised transport (measured by total loaded and unloaded activity), so long as this activity exceeded 1000kt per year[5]. This criteria resulted in 53 ports across the EU27, UK, and

[5] The Roro sector was not considered in this analysis, despite some ports having significant numbers of accompanied and unaccompanied trailers, which will mostly continue their journeys by road. This is because these ports are not considered likely candidates as hydrogen terminals or hubs, and the roro ships have the potential to be battery electric.

Norway. Ports were matched to corresponding NUTS3 regions through proximity and were cross-checked to ensure that they were correctly assigned. This step was necessary to correct for example some Danish ports which were closer to neighbouring German NUTS3s or for La Havre. The resulting ports are shown in Figure 6 to show their geographical spread, and listed in Table 3 to show the amount of tonnes associated to containerised freight. Las Palmas (in the Canary Islands) was excluded from the analysis to keep the scope to continental Europe. Treatment of transshipments (i.e., freight going from ship to ship in a port) are described further below.

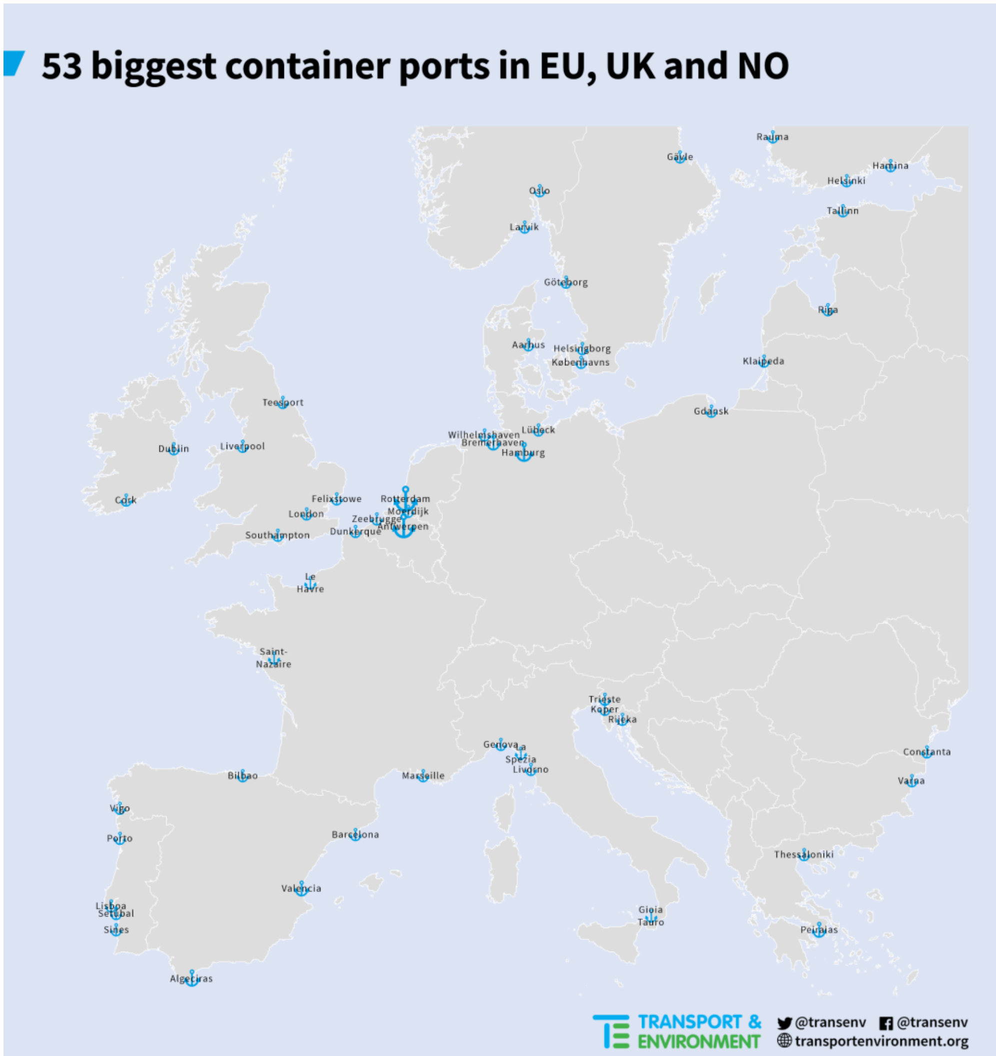

Figure 6: Map showing the 53 container ports that were considered in the Ports report.

Country	Port	Container freight 2018 (kt)	Country	Port	Container freight 2018 (kt)	Country	Port	Container freight 2018 (kt)
BE	Antwerpen*	107667	FR	Le Havre	23058	NO	Oslo	1580
BE	Zeebrugge	2091	FR	Marseille*	10496	NO	Larvik	1032
BG	Varna	1765	FR	Dunkerque	2587	PL	Gdansk	21623
DE	Hamburg*	72012	FR	Nantes Saint-Nazaire	1452	PT	Sines	18498
DE	Bremerhaven*	45766	GR	Peiraias	44719	PT	Leixões (Porto)*	5382
DE	Wilhelmshaven	7173	GR	Thessaloniki*	3615	PT	Lisboa*	3462
DE	Lübeck	1908	HR	Omisalj	2034	PT	Setúbal	1022
DK	Århus	3390	IE	Dublin*	5532	RO	Constanta	5225
DK	Københavns Havn*	1298	IE	Cork*	1802	SE	Göteborg	6932
EE	Tallinn*	1880	IT	Gioia Tauro	26424	SE	Helsingborg	2419
ES	Algeciras	50844	IT	Genova*	21853	SE	Gävle	1583
ES	Valencia*	47104	IT	La Spezia	13691	SI	Koper	9160
ES	Barcelona*	27862	IT	Livorno	10463	UK	Felixstowe	24521
ES	Bilbao*	5530	IT	Trieste	8629	UK	London*	13638
ES	Vigo	3289	LT	Klaipeda	6951	UK	Southampton	9347
FI	HaminaKotka	4426	LV	Riga*	3894	UK	Liverpool	5776
FI	Helsinki*	3640	NL	Rotterdam*	125145	UK	Tees & Hartlepool*	2810
FI	Rauma	2012	NL	Moerdijk	2422			

Table 3. List of ports selected for the Ports report and the containerised tonnes in 2018, from Eurostat mar_go_qmc. (*) show ports that are also Urban nodes from Table 1.

Dry and liquid bulk were excluded from the extraction for several reasons. The first being that a large share of dry bulk is imported coal, which based on EU policy and climate objectives should decrease significantly over time. This is also the case for imports of bulk biomass, such as palm, that cause climate and ecological degradation. The second is that data from the Port of Rotterdam[xi] shows that most of the truck activities around the port of Rotterdam are containerised transport (figure 7), an assumption that we extend to all ports that are analysed herein. Additionally, many of the ports have specialised rail freight operations that take the dry bulk to the power plant, which can often be in close proximity (for example, Algeciras in southern Spain). Excluding dry and liquid bulk from the analysis also means that fuel terminals and refineries are excluded, where liquid fuels may be refined on site and may also be loaded onto trains or pipelines from locations within the terminal.

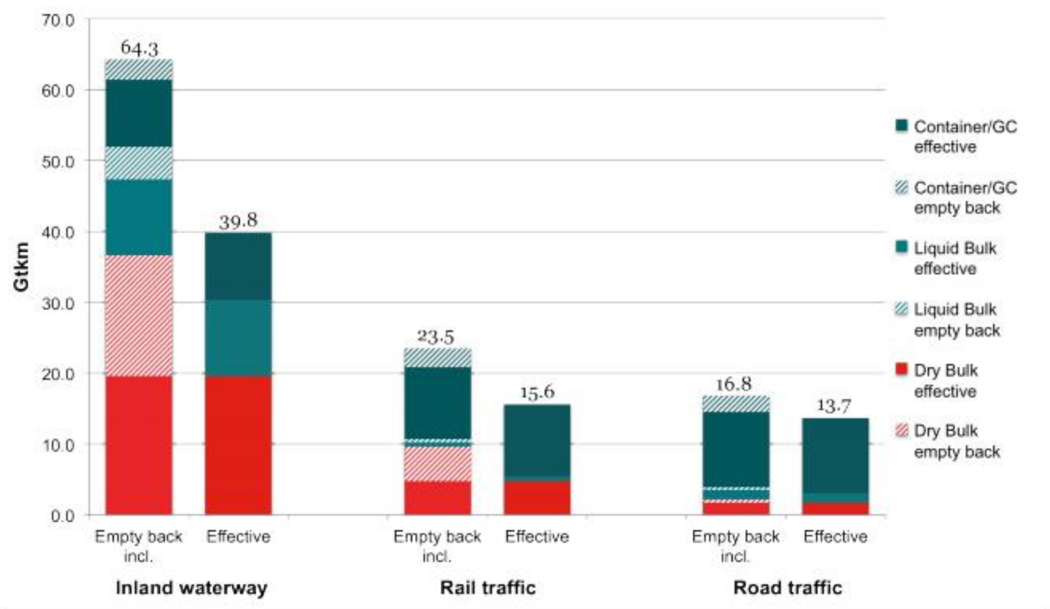

Figure 2-3 Status quo Transport Volumes Hinterland 2015 (Gtkm)

Figure 7: Transport by mode and type in the Rotterdam hinterland[xii]

With the ports identified and the total tonnes coming in from ships by containers and bulk, the next step was to subtract the total freight going onto rail and inland shipping (data contained in the ETIS project as O/D matrices), to leave the total amount to be assigned from the ports to road freight. For each NUTS3 region containing a port, the top 100 destinations were identified, and the share and absolute amount of tonnage by distance determined. The port related tonnes were then subtracted from these freight movements and stored in a new O/D matrix. Once applied to all ports, a port O/D matrix was constructed, and this was used for the analysis of truck movements around ports and the hinterland[6]. Checks were in place to ensure that the tonnes loaded onto trucks in the region corresponded with the containerised maritime freight volume. These checks ensured that a maximum of 80% of maritime containers were assigned to road transport and a minimum of 15%. There were cases for example where the unloaded and loaded maritime transport far exceeded the truck activity departing that region, implying significant transhipment operations. Although the amount of transshipments is not known, these assumptions allowed for a reasonable amount of maritime traffic to be assigned to road transport into the hinterland.

4.2. Nodes and Pathways

Once the O/D matrix from the Ports project was subtracted, the remaining O/D matrix covered the freight movements to be covered by both the Nodes and Pathways projects. As some of the port related activity was associated with 21 NUTS3 regions identified as urban nodes of the TEN-T network, this reduced the activity here. Aside from the 88 urban nodes, a scenario looking at electrifying the next busiest NUTS3 regions (so called secondary nodes) in each member state was completed. The same number of secondary nodes were assigned to a member state based on the number of urban nodes they had. For more, see Volume 1 of the Trilogy[xiii].

5. Scenario development

The scenarios of the uptake or potential coverage of zero-emission trucks were based on industry announcements and also T&E's long term 2050 vision for the uptake of electric trucks. Once the activity data that was covered by a specific scenario was computed, the number of electric trucks implied by the scenario was approximated by dividing the total freight activity by the average freight activity of a new truck in 2018[7]. Each report has its own uptake scenarios depending on the expected technological development of zero emission trucks.

6. Key Eurostat data definitions and considerations

The definition of a trip is an important element of our analysis - indeed, our recommendations and analyses are based on being able to electrify truck *trips*. The ETIS modelling, and as a consequence our reports, relies on freight transported by O/D pairs, and thus a trip is defined as beginning at one origin and finishing at one destination. In reality however, freight movements can be more complex than this

[6] A hinterland has no strict geographical definition, but in relation to ports, it is an area or cluster of industrial areas relating to a port, including logistic centres and hubs and heavy industry. This is discussed in greater detail in the EU Ports report.

[7] The average operations of a new electric truck are assumed to be 80000 km annual mileage, 300 running days per year, with an average load of 10 tonnes.

simple trip. For example, the empty kilometres of a truck, from depot to point of loading, is not captured in our trip definition.

Eurostat provides a detailed methodology on how truck operators are surveyed on their activities, the *Road freight transport methodology 2016 edition*[xiv], which provides insights to the data collected and its reliability. We note that although there may be limitations to the data which may not be as complete as certain national datasets or indeed by those of the truck operators and owners themselves, the data is the most reliable source available. Eurostat claims that total and the national transport should be within 5% standard percentage error (SPE) based on their survey data.

6.1. Loading and unloading relation to origin destination

The metadata provided with the data tables used to calibrate the freight activity (*Road freight transport measurement (road_go) Reference Metadata in Euro SDMX Metadata Structure, ESMS*[xv]) gives the following definition for unloading and loading in Section 3.4. Statistical concepts and definitions:

Place of loading *(of the goods road transport vehicle on another mode of transport): The place of loading is the first place where the goods road motor vehicle was loaded on to another mode of transport (usually a ship or a rail wagon).*
Place of unloading *(of the goods road transport vehicle from another mode of transport): The place of unloading is the last place where the goods road motor vehicle was unloaded from another mode of transport (usually a ship or a rail wagon).*

This seems to imply that places of unloading are origins, and places of loading destinations. However further reading through the metadata note and the Methodology show more clearly the relationship showing loading being equivalent to origin and unloading to the destination. From Section 18.5:

The compilation of European aggregates on the level of origins (places of loading) or destinations (places of unloading) are also produced and published in the tables.

From Section 19:

GEO is always the reporting country (where the vehicles are registered)
LOAD is the place of loading goods onto the vehicle
UNLOAD is the place of unloading goods from the vehicle.

This is also formalised in the Methodology in Section 9.4.1 Coding of place of loading/unloading (Page 121):

In goods road transport statistics, the place of loading/unloading of the goods plays an important role. The place of loading for a laden journey is the first place where the goods are loaded on the goods road vehicle that was previously completely empty (or where a road tractor is coupled up to a loaded semi-trailer). The place of unloading for a laden journey is the last place where the goods are unloaded off the goods road vehicle that then is subsequently completely empty (or where the road tractor is uncoupled from a semitrailer). Where a lorry and trailer(s) combination is in use, a loaded journey will end when both lorry and trailer(s) are completely empty.

6.2. Definition of a trip/journey

Freight movements entail complex and varied operations that are not necessarily trivial to report in a consistent way. As previously stated, the data we have used omits trucks that run empty, for example from its depot to the location where it needs to load, or from its final point of unloading back to the depot. Thus the simplest type of trip involves a truck picking up cargo at a location (its origin) and dropping it off at a final destination. However in reality there can be several stages, for example picking some cargo at location A, driving to location B to pick up more cargo, driving to location C to drop some of the cargo off, and finally to location D to unload all remaining cargo. Section 6.4 page A-66 of the Methodology describes some more key examples, and section 6.5 8 archetypal types of journeys. The key take away however is that Eurostat states that most trips are indeed the simple type with one origin and destination: 1 stop journeys 88%, 2–4 stop journeys 2%, 5 or more stop journeys 10%. For multistage journeys, the trip is defined as the first origin (in the previous example, location A) to the final destination where the truck would unload all remaining cargo (location D).

The implication of this definition on our analysis is that for the trips that may be multistage and represented in the data as one trip (so a trip that recorded as 400km in Eurostat maybe in reality be several shorter trips), we would miss the potential to have opportunity charging at intermediate loading events. From discussions with large truck fleet owners in Europe, loading trucks typically takes longer than unloading events. We therefore may be underestimating the short term potential of urban deliveries to be electrified.

6.3. National and international data

Eurostat offers the following data on national and international data:

- **National transport** is road transport between two places (a place of loading and a place of unloading) located in the same country by a vehicle registered in that country.
- **Cabotage** is road transport by a motor vehicle registered in a country performed on the national territory of another country.
- **International transport** is road transport between two places (a place of loading and a place of unloading) in two different countries and cabotage by road. It may involve transit through one or more additional country or countries.
- **Cross-trade** is international road transport between two different countries performed by a road motor vehicle registered in a third country.
- **Transit** is any loaded or empty road motor vehicle, which enters and leaves a country at different points by whatever means of transport, provided the total journey within the country is by road and that there is no loading or unloading in the country.

As described in Section 3.3, we have combined cabotage freight activity with national activity. Cross-trade is assumed to have the same flows as international transport, so to account for cross trade international transport was scaled until the total freight activity across the Unions is reached, as described in Section 3.3.

References

[i] Transport & Environment (2020). Roadmap for electric truck charging. Available: https://www.transportenvironment.org/publications/roadmap-electric-truck-charging

[ii] Rupprecht Consult, E-course integration of urban nodes in the Ten-T corridors, consulted in May 2020. Available: https://www.rupprecht-consult.eu/news/news-detail/news/e-course-integration-of-urban-nodes-in-the-ten-t-corridors.html

[iii] ETISplus Project. See https://www.tmleuven.be/en/project/etisplus

[iv] ETISplus Project. See https://www.tmleuven.be/en/project/etisplus (Final Report Part 3) or available: https://trimis.ec.europa.eu/sites/default/files/project/documents/20100120_125530_51920_ETIS%20BASE%20-%20Final%20Technical%20Report.pdf

[v] Panteia, CERTH/HIT, DEKRA, CBRA, ESPORG and IRU (2019) Study on Safe and Secure Parking Places for Trucks MOVE/C1/2017-500. Available: https://www.iru.org/system/files/Final-Report-SSTPA-27022019.pdf

[vi] https://ec.europa.eu/eurostat/web/nuts/nuts-maps

[vii] https://www.python.org/

[viii] ec.europa.eu/eurostat/web/nuts/nuts-maps. Note: The maps show the boundaries of the NUTS3 regions version 2013. Between the 2010 and 2013, UKD31 has been split into UKD33, UKD34 and UKD35 and UKD32 has been split into UKD36 and UKD37.

[ix] Eurostat, RFT by type of transport, 2017-2018 (million tonne-kilometres). Available: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:RFT_by_type_of_transport,_2017-2018_(million_tonne-kilometres).png

[x] See Table 2.2.4d of Transport in Figures 2019 Statistical Pocketbook. Available: https://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2019_en

[xi] https://epub.wupperinst.org/frontdoor/deliver/index/docId/7140/file/7140_Rotterdam.pdf

[xii] https://epub.wupperinst.org/frontdoor/deliver/index/docId/7140/file/7140_Rotterdam.pdf

[xiii] T&E (2020) Unlocking Electric Trucking in the EU: Recharging in Cities: Available: https://www.transportenvironment.org/publications/unlocking-electric-trucking-eu-recharging-cities

[xiv] *https://ec.europa.eu/eurostat/documents/3859598/8134263/KS-GQ-16-105-EN-N.pdf/fcd315ef-0439-4f9c-ae51-90735c2c1dc1*

[xv] https://ec.europa.eu/eurostat/cache/metadata/en/road_go_esms.htm