CHARGING E-TRUCKS

Location of optimal charging areas for freight transport in Italy

in collaboration with:

Introduction

The electrification of heavy-duty vehicles (HDVs) represents a crucial component in the broader technological diversity enabling the transition to decarbonization of the transport sector. It is therefore essential, in parallel with the registration of electric trucks, to develop public charging hubs specifically designed for trucks along the main trans-European transport networks and at logistics hubs.

127 km

Average internal freight transport distance [1]

200 -> 430km

Average range of electric LCVs and HDVs sold in Europe

50 kW → night stops (7h)
350 kW → intermediate stops (<1h)
MCS (1,000kW) → quick stops <20'

Average times to recharge 300 km

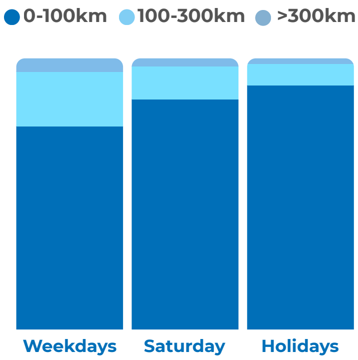
The rapid development of strategic hubs requires significant investment in a robust electricity grid, essential to adequately support dedicated charging points. To address this challenge, the European Union and its Member States must not only strengthen existing electricity networks but also simplify connection procedures, making them more accessible and less bureaucratic. Regulatory authorities and policymakers play a crucial role in the transition to more sustainable transport systems.

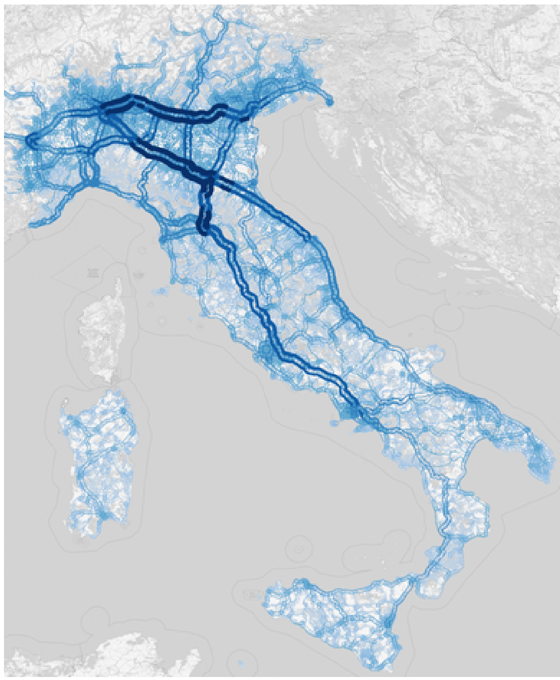
[1] http://dati.istat.it/Index.aspx?DataSetCode=DCSC_TRAFERR)

The objective of this study is to provide strategic planning for electric charging stations dedicated to heavy-duty vehicles (over 3.5 tons), ensuring effective national coverage. The study is based on the analysis of GPS data from over 100,000 vehicles, out of approximately one million in circulation, generating approximately one billion daily records (FCD) and analyzing 12 different scenarios (three typical days for four seasons).

Heavy vehicle traffic is concentrated mainly on motorways, with most transit occurring in central and northern Italy, particularly along the Milan-Venice and Milan-Bologna-Florence routes.

Furthermore, approximately 75% of weekday journeys are in the 0-100 km range, which reaches over 85% on holidays; journeys between 100 and 300 km is approximately 20% on weekdays, but only 8-10% on weekends, finally, tra beyond 300 km are marginal.





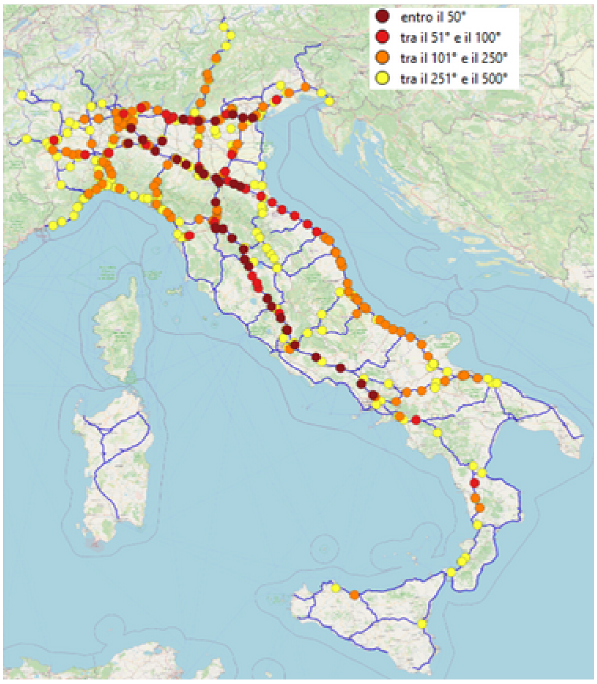
Winter weekday flow chart

Heavy vehicle targets

REGULATION (EU) 2023/1804 - AFIR

	→2025	→2027	→2030
RETE TEN-T (CORE/GLOBAL)	**15%** every 120/100 km of at least 1.4 MW	**50%** every 120/100 km of at least 1.4 MW	**every 60/100km** of at least 3.6 MW
PARKING AREAS		**at least 2 points** 100 kW each	**at least 4 points** 100 kW each
URBAN NODES		**at least 0.9MW with at least 150 kW per point**	**at least 1.8MW**

Assuming a transition scenario towards electric, with 35% of electric trucks in circulation by 2035, analyses were carried out on the annual number of vehicles that could charge at charging areas and on the kilometres necessary for charging, considering both origins and destinations.



Localization of the first 500 AdRs

Thanks to this information, it was possible to classify the top 500 charging areas, divided into service areas, fuel stations and car parks.

However, it is important to keep in mind that, in the initial phase, not all trucks will be electric, which makes it crucial to plan and have a data-driven approach to identifying a strategy for developing a public charging network for heavy-duty vehicles.

For this reason, from an in-depth qualitative analysis, the first 40 Charging Areas ("AdR") were selected, 20 on the TEN-T network and 20 outside it: these areas are characterised by a daily average of 15 vehicles charging on the TEN-T network and 5 on the extra-TEN-T network.

The average charging time is around 50 minutes for each vehicle, and the average charging distance is just under 300 km, which requires the presence of high-power charging (HPC) points.

The optimal areas

TEN-T   extra TEN-T

MOTUS-E

Call to action

To truly stimulate market development, it is essential to actively engage with the entire sector, particularly to identify suitable locations where the industry is already ready to invest in the transition, without their investments.

- Synergistic engagement: actively collaborate with italian organizations (like GSE), distributors (DSOs), and local authorities to optimize integration with the energy grid and ensure balanced territorial distribution.
- Toll exemptions: introduce experimental exemptions from motorway tolls on optimal routes identified for zero-emission vehicles, in accordance with European Directive 2022/362 (Eurovignette). Italy is currently lagging behind in implementing this regulation; the adoption of incentive measures could accelerate the transition to sustainable mobility while reducing the risk of fines for violations.
- Stimulate demand: don't limit incentives for purchasing vehicles, but also stimulate customers. If customers, even in public tenders, don't offer adequate rates, logistics operators won't be able to sustain costs, even with older and more polluting traditional vehicles. Useful tools may include: tax breaks for customers who reduce their CO_2 footprint, long-term tenders for effective planning, and clear reward criteria based on actual CO_2 savings.
- Guidelines for new industrial sites: binding national guidelines for industrial areas, requiring adequate space for trucks and integrated charging infrastructure as a standard requirement.

At the European level, the entire organization of freight transport is being rethought, for example by considering mandatory breaks for drivers as an integral part of working hours.

The implementation of these solutions will not only help achieve the AFIR and decarbonization objectives, but will also have a multiplier effect on surrounding areas, on related industries, and on improving air quality.

Who we are

Motus-E is the Italian association founded by leading industrial players in the automotive and energy sectors and academia to foster the energy transition in the transportation sector, promoting electric mobility and disseminating its economic, social, and environmental benefits.
The association currently brings together over 100 members and partners across the entire e-mobility value chain and represents the industry's most authoritative voice for institutions at all levels.

Infoblu NewGen (evolution of Infoblu Telepass Innova), Line of Business of eXyond, part of the Circle group, specializes in the provision of advanced services for monitoring and managing traffic on the Italian road and motorway network.
It offers infomobility and telematics services, with real-time traffic information, advanced solutions for logistics and intelligent mobility, and Big Traffic Data Analytics.

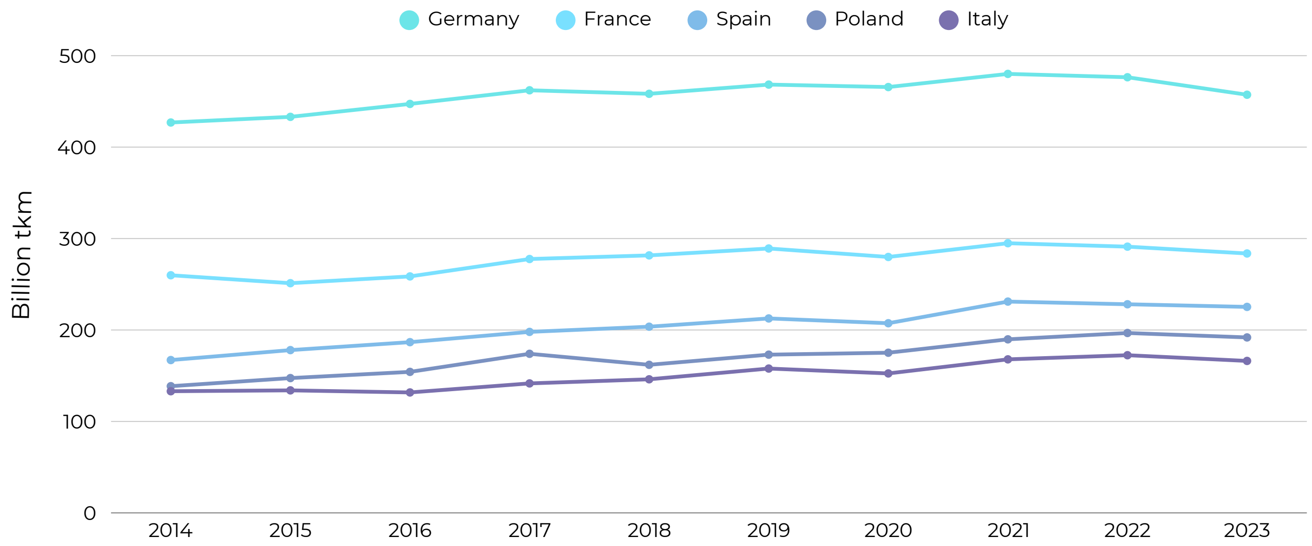
GSE (Energy Services Manager), the company that plays a central role in incentivizing and promoting renewable energy sources, energy efficiency, and sustainable mobility, through the Single National Platform, plays a crucial role in promoting and incentivizing electric mobility, integrating renewable energy sources and facilitating the development of a widespread and sustainable charging network.

Heavy-duty vehicles are responsible for over 28% of greenhouse gas emissions from road transport in the EU and account for over 6% of total EU greenhouse gas emissions.

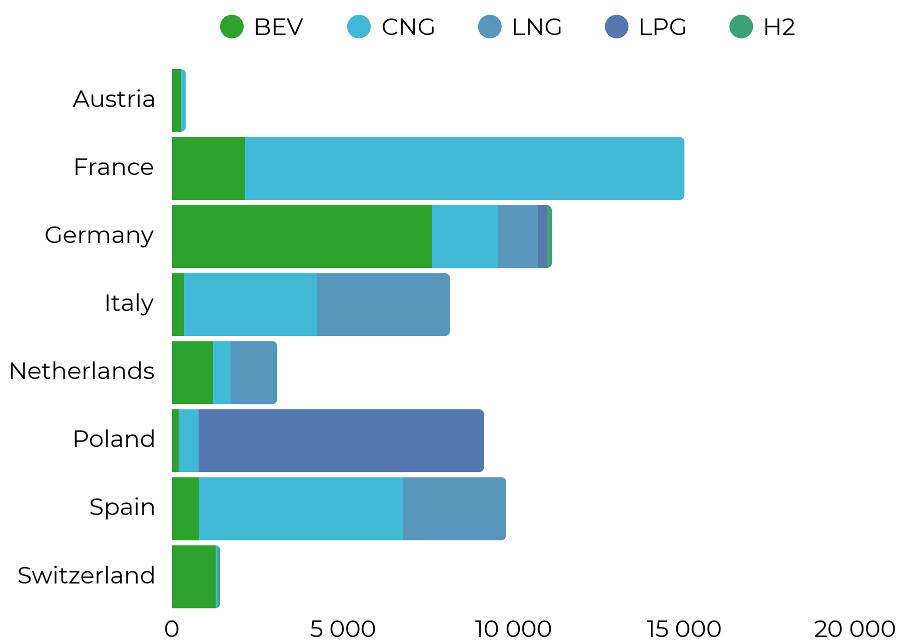
(European Environment Agency)

The European context

Road freight transport volumes in the European Union have increased significantly over the past decade, peaking at 1.92 trillion tonne-kilometers in 2022. The infographics below show how Germany and France dominate the European market, both in terms of higher road freight transport volumes – thanks to their economic weight, central geographic location, seaports, advanced transport infrastructure, and manufacturing capacity – and in terms of the share of electric trucks on the road.



Total road freight transport volumes by country
(data updated for the year 2022)



Total number of alternative fuel trucks (N2&N3)
(data updated for the year 2024)

From the graph alongside, we can deduce that our neighboring countries, with a significant rate of medium-distance transport, such as Austria and Switzerland, in addition to the aforementioned France and Germany, also have a notable percentage of e-trucks among alternative fuels, which makes them potential users of charging stations in Italy.

[1] Eurostat (https://ec.europa.eu/eurostat/databrowser/view/road_go_ta_tott/default/table?lang=en)
[2] EAFO (https://alternative-fuels-observatory.ec.europa.eu/)

The European Commission study

The analysis, published on May 27, 2025, highlights a rapid transition to zero-emission heavy-duty vehicles, although significant challenges remain. Currently, these vehicles represent only 2.09% of new registrations in the EU (data updated to the end of 2024, almost all fully electric). However, targets stipulate that by 2030, one in three trucks sold will be zero-emission.

Dominance of full electric technology

The predominant technology will be battery-powered electric vehicles (BEVs), which are expected to account for approximately 90% of the estimated fleet (between 410,000 and 600,000 vehicles). Meanwhile, hydrogen (both fuel cells and combustion engines) will play a marginal role due to the high costs of producing green hydrogen and the scarcity of available models.

Need for adequate infrastructure

To support this transition, it is essential to rapidly expand dedicated charging infrastructure, which is currently insufficient, with only 16,000 public points above 350 kW. It is also necessary to modernize the electricity grid, whose bottleneck is the main obstacle. EU Regulation 2023/1804 will ensure basic coverage along the TEN-T networks, but further investment will also be needed to meet real demand.

Hydrogen challenges and other solutions

Despite the 270 filling stations already operating in the EU, hydrogen is struggling to take off due to high costs and a lack of available models. Other solutions, such as electrified roads or battery swapping, are not considered viable on a large scale by 2030.

Conclusion

The transition is therefore technically possible, but it will require coordinated support to overcome infrastructural, economic, and technological barriers. It is essential to pay particular attention to the needs of SMEs, which dominate the sector but have limited investment resources.

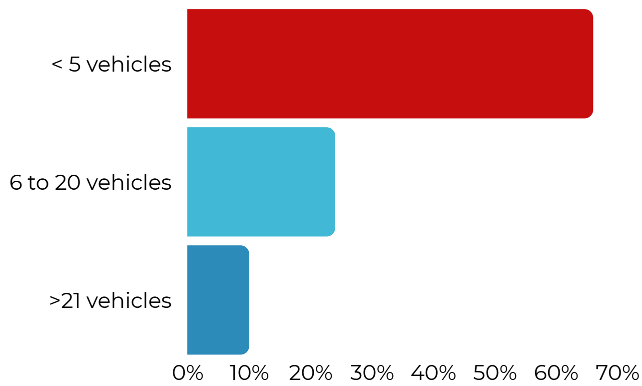
[1] EUR-Lex https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025DC0260

The national context

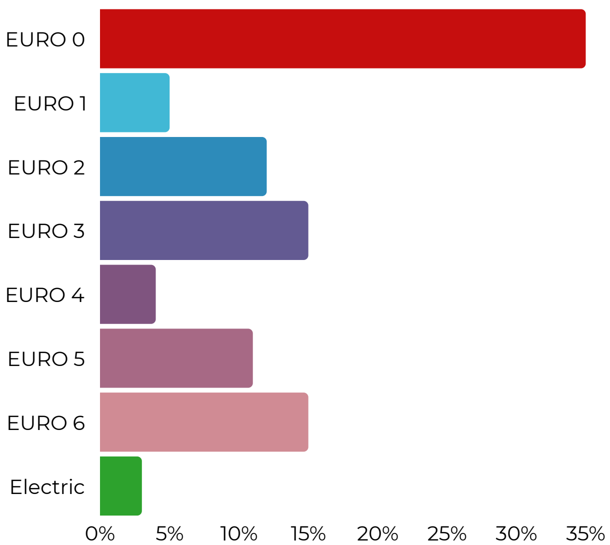
In Italy, of the 988,165 heavy-duty vehicles (>3.5t) in circulation at the end of 2024 with an average age of 19 years, over 70% are equipped with pre-Euro 4 engines, with less than 3% having zero emissions and a residual (<0.1%) using other fuels (petrol, other). Worrying numbers for the logistics sector and for the entire Italian economy, considering that of the more than one billion tons of goods transported approximately 84% occurs on roads and especially on highways.

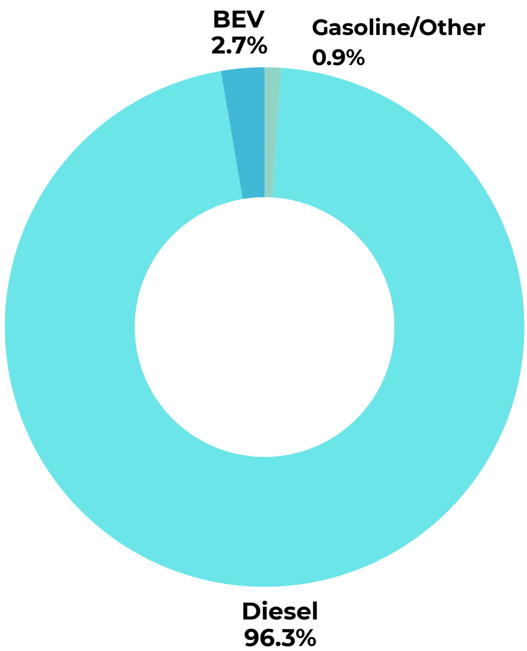
It is useful to remember that this sector is strongly influenced by economic factors, such as trade, production and consumption, as well as geopolitical elements, such as oil price shocks and global uncertainty.

The data therefore highlights the presence on our roads of a high number of heavy vehicles that do not yet comply with the zero or low environmental impact emissions parameters established by the European Union.



Fleet composition of road haulage companies
(data end of 2020)



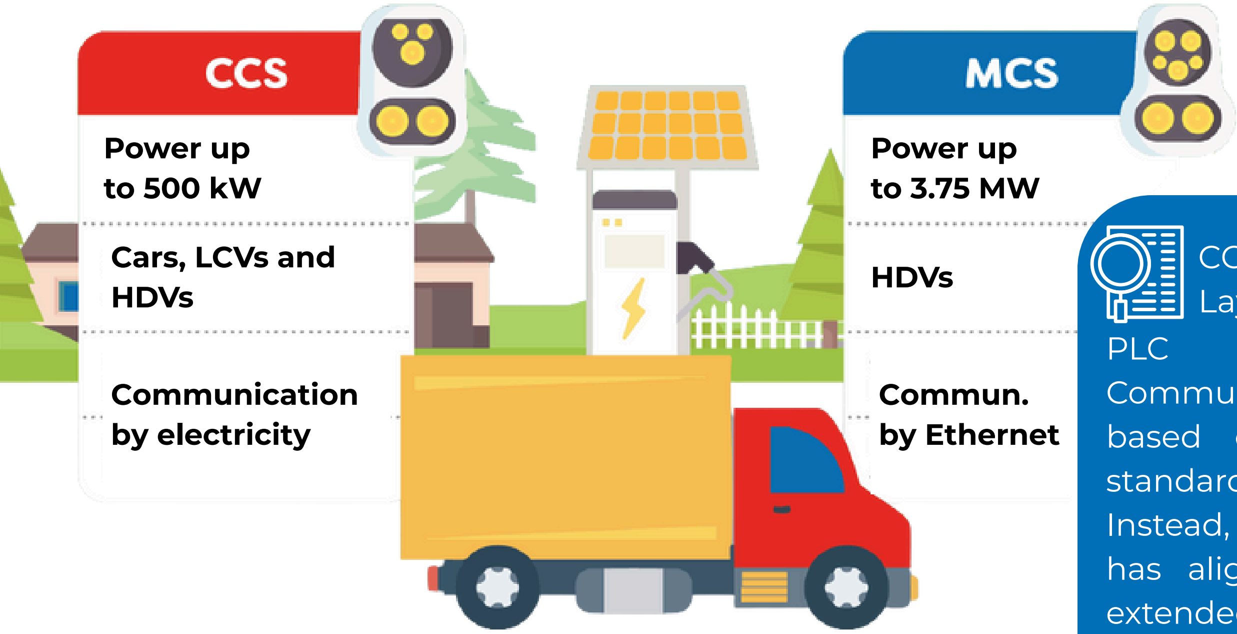


Vehicle fleet distribution by Euro standard and fuel type.
(data end of 2024)

[1] ACI https://aci.gov.it/attivita-e-progetti/studi-e-ricerche/autoritratto/
[2] Italian road transport register (https://www.alboautotrasporto.it/web/portale-albo/)

Charging systems

To address these challenges, investing in adequate charging infrastructure for electric trucks is essential. Identifying optimal charging areas is crucial to fostering a transition to more sustainable freight transport: these areas must be strategically located along major trade routes, ensuring easy access and efficient charging times. In this context, selecting the most suitable charging method will also be crucial, as it will influence charging power and, consequently, the time required to "top off" the battery.
Currently, the most common European standard is the Combined Charging System (CCS), used for high-power DC charging for cars and light commercial vehicles, with charging powers up to 500 kW. However, with the expansion of the heavy-duty electric vehicle sector, such as buses and trucks, which require significantly more energy quickly, a new technology capable of supporting charging powers of up to 3.75 MW has been developed. This technology, known as the Megawatt Charging System (MCS), represents a significant step forward for the heavy-duty transport sector: MCS is designed to dramatically reduce charging times, allowing trucks to fully charge during mandatory driver breaks.



CCS charging uses a Layer 1 protocol PLC (Powerline Communication) based, based on the ISO 15118 standard.
Instead, the MCS ecosystem has aligned itself on the extended ISO 15118 protocols, which are based on digital communication via Ethernet, according to the IEEE 802.3 standard.

Charging strategies

OVERNIGHT CHARGING

Depots
1-22 kW AC -> LCVs
50-150 kW DC -> HDVs
System power relative to the number of vehicles in the depot
Low-to-medium OPEX
Low charging costs

DAILY CHARGING

Logistics centers and delivery hubs
50-150 kW DC during loading/unloading
System power relative to BEV/h flow
Average OPEX
Low-to-medium charging costs

DAILY CHARGING

Public hubs
150-350 kW DC - ad hoc parking
System power compared to BEV/h flow and MV network
Average OPEX
Average charging costs

DAILY CHARGING

Long haul
0.3-1 MW DC - highway rest stop
Upgrading of highway rest stop/parking area
High OPEX
Variable charging costs

The charging strategy for commercial vehicles is based on the daily operating cycle, divided into:

- under 300 km: vehicles returning to storage
- above 300 km: need to recharge along the route and at the destination.

There are then two types of recharging:

1. Night charging: advantageous, at low power, with lower energy costs
2. Daily charging: more expensive, it occurs during stops at service areas, logistics hubs and during loading/unloading operations.

Public hubs typically feature:
at least 4-6 direct current charging points (>150kW)

- a location analyzed in coordination with various logistics players, energy distributors, municipal bodies and various institutional interlocutors.
- Charging points installed at logistics hubs and so-called destination chargers can be managed with existing PODs, offering advantages on charging costs.

The regulatory targets

TEN-T core network

It includes the most strategic connections (urban hubs, ports, airports, borders) with high standards of interoperability and multimodal integration.

By the end of 2025

At least **15%** of the length of the TEN-T network must be provided with charging hubs with a power of

≥ 1,400 kW each

including at least
1 charging point with a power of

≥ 350 kW

Charging hubs
in every direction of travel

By the end of 2027

At least **50%** of the length of the TEN-T network must be provided with charging hubs with a power of

≥ 2,800 kW each

including at least
2 charging points with a power of

≥ 350 kW

By the end of 2030

Charging hubs must be provided at intervals of **up to 60 km** with a power output

≥ 3,600 kW each

including at least
2 charging points with a power of

≥ 350 kW

TEN-T comprehensive network

It extends the network to all regions, with the aim of ensuring connectivity everywhere, even in less central areas, integrating existing and developing infrastructure.

By the end of 2025

At least **15%** of the length of the TEN-T network must be provided with charging hubs with a power of

≥ 1,400 kW each

including at least
1 charging point with a power of

≥ 350 kW

Charging hubs
in every direction of travel

By the end of 2027

Na co najmniej **50%** sieci TEN-T obowiązek funkcjonowania stref ładowania o mocy

≥ 1,400 kW each

including at least
1 charging point with a power of

≥ 350 kW

By the end of 2030

Maksymalnie **co 60 km** obowiązek funkcjonowania stref ładowania o mocy

≥ 1,500 kW each

including at least
1 charging point with a power of

≥ 350 kW

***Trans-European Transport Network**

The regulatory targets

Safe and secure parking

Areas dedicated to heavy vehicles with EU safety and service standards (lighting, surveillance, availability information).

By the end of 2027

In every safe and secure parking area, at least **2 public charging stations** for eHDVs with a power of **≥ 100 kW** each

By the end of 2030

In every safe and secure parking area, at least **4 public charging stations** for eHDVs with a power of **≥ 100 kW** each

Urban nodes

Key cities of the TEN-T network, critical points of interconnection between European transport networks and local mobility systems where different modes of transport are integrated (railways, roads, airports, ports, public transport),

By the end of 2025

In each urban node, public charging points for eHDVs with a total power output **≥ 900 kW** each charging station with a power of **≥ 150 kW**

By the end of 2030

In each urban node, public charging points for eHDVs with a total power output **≥ 1,800 kW** each charging station with a power of **≥ 150 kW**

The current dedicated charging infrastructure

Today, in Italy, the charging infrastructure dedicated to heavy trucks is still under development with four active sites with dedicated stalls installed in Vado Ligure (SV), Bagnolo San Vito (MN), Bolzano and Piacenza, San Vitaliano (NA) soon active, all are equipped with CCS2 (Combined Charging System) connectors capable of delivering up to 600 kW of power. Thanks to this power, electric trucks can recharge their batteries in just 30-40 minutes, an optimal time for driver refreshment stops and short-term logistics operations. The most advanced site is in Bolzano, where the first MCS (Megawatt Charging System) connector in Italy was installed, capable of delivering up to 1,000 kW: this system represents the future of ultra-fast charging for heavy vehicles, further reducing stop times and approaching the performance of diesel refueling. The MCS, developed to support the next generations of battery-powered trucks, with capabilities above 600-800 kWh, are expected to reach full operation as early as 2026 in the main European markets.

Sites operational Planned sites

Finally, to bridge the infrastructure gap between North and South, over 10 new sites have been planned, financed under the European CEF-AFIF (Alternative Fuels Infrastructure Facility) program, which in the next 2-3 years will guarantee the creation of a motorway and near-highway network, a bridge between the North and the South of Europe, in a "Digital Green Corridor".

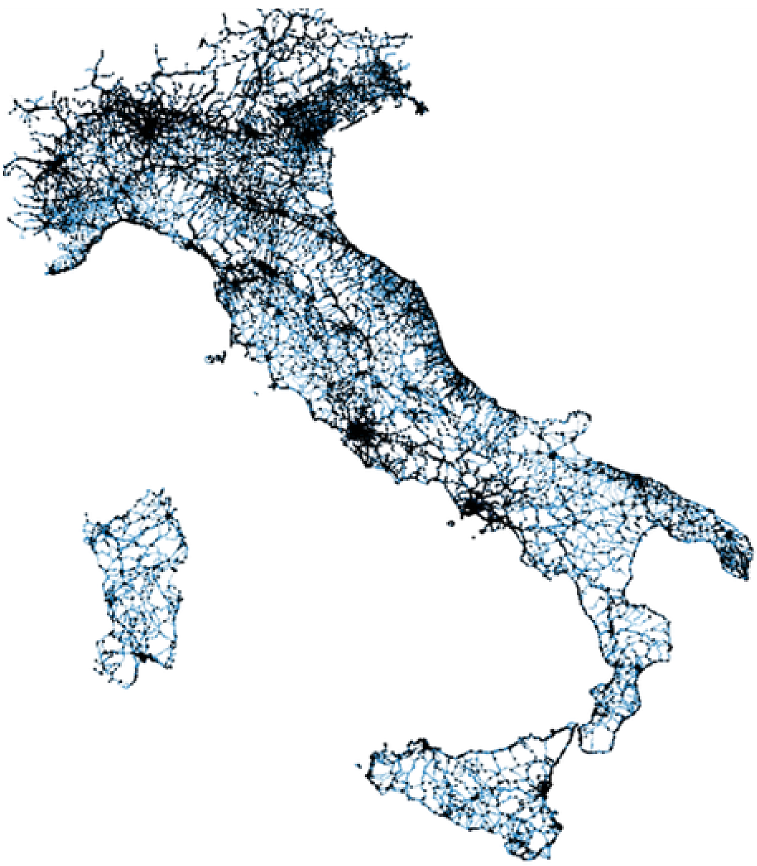
Transport analysis

The study outlines the need to plan, based on empirical traffic data, the future Italian charging network for electric heavy vehicles, in accordance with the AFIR EU Regulation 2023/1804. The methodological approach combines OpenStreetMap cartography with the official representation of the TEN-T network: the first provides a complete and updated graph, while the second identifies the strategic European routes on which to concentrate interventions.

Traffic data comes from three sources:

- Floating Car Data: Over 20 Million Routes Collected in 2023-24
- ANAS surveys on approximately 1,400 sections
- counts at the toll booths of 525 motorway stations.

Thanks to an expansion algorithm calibrated on the control sections, the FCD sample is projected onto the universe of heavy vehicles: this has allowed us to estimate the average daily traffic on each road arch and to evaluate the average and peak energy demand, based on the expected range of electric vehicles and the probability of stopping along the route at potential future charging areas.



Point of interest location

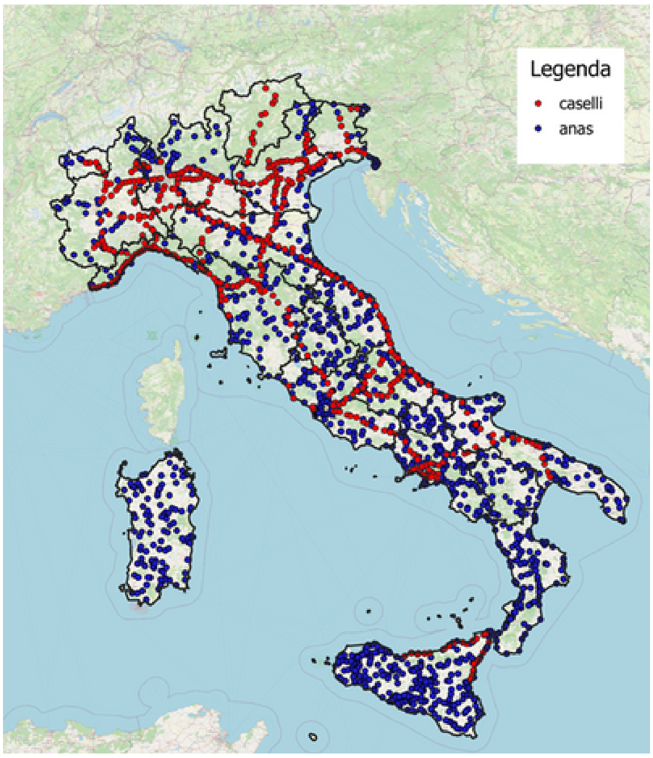
Vehicle mobility behavior was then analyzed, such as travel time, stops, and timetables, and over 300,000 potential charging areas (AdR) were identified. After a thorough selection of the most suitable ones, 26,325 AdRs were identified.

The analysis revealed a close correlation between the location of the selected POIs and the demographic distribution and production activities within Italy: this correlation ensures that the selected POIs will interface with the largest flows of heavy commercial vehicles, which are mainly concentrated in production areas.

The available databases

The "Primary Graph" was built by extracting road-class 1-3 arcs (motorways, main and secondary roads) from the OpenStreetMap database, overlaid with the TEN-T network map, which, after a validation process, was found to be just over 20,000 km long: in particular, the final extracted TEN-T network represents approximately 80% of the roadclass 1 road arcs (motorways), 12% of the roadclass 2 ones (main roads) and less than 1% of the roadclass 3 ones (secondary roads).

Primary graph of the analysis

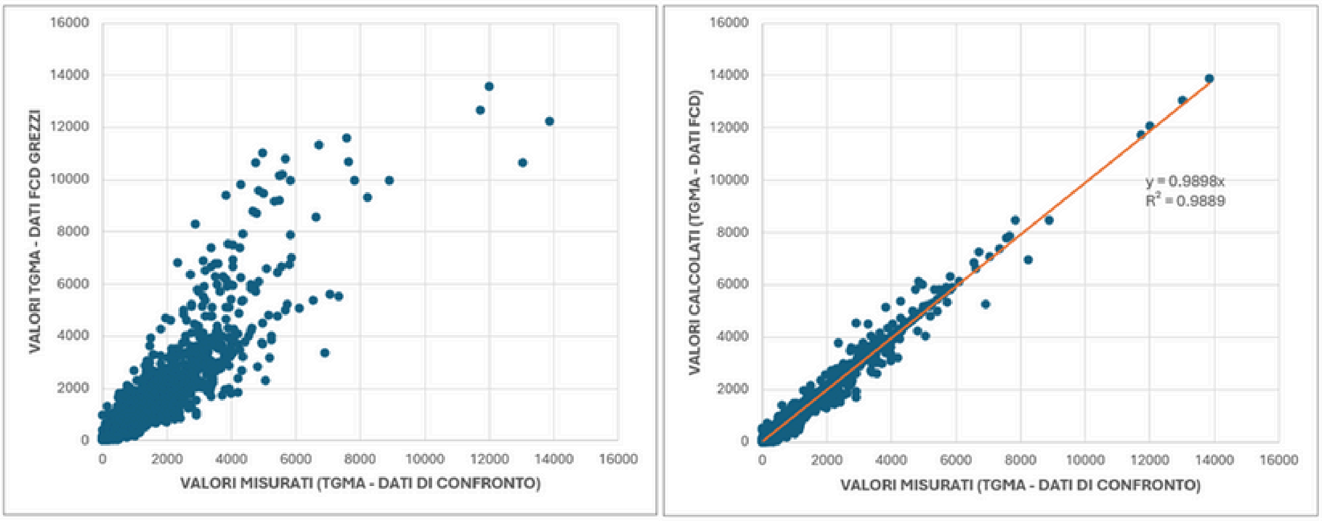


ANAS sections and motorway toll booths

In order to estimate actual traffic, an expansion process was necessary, using two sets of comparative data: ANAS surveys on ordinary roads and transits at motorway toll booths. The ANAS sections, distributed mainly in Central and Southern Italy, provide average annual traffic values (AAT) for heavy vehicles on approximately 1,376 sections, with a prevalence of data updated to the 2021–2023 period. Motorway toll booths, more widespread in the North, provide detailed data for over 500 sections, broken down by direction, day of the week, and time of day, consistent with the survey period (2023–2024).

Reconstruction of traffic flows

The FCD (Floating Car Data) used in the analysis is derived from GPS-equipped vehicle tracking of over 100,000 vehicles, out of approximately one million in circulation, which continuously record their position over time. A route-matching algorithm reconstructed the vehicles' routes as sequences of road segments crossed, indicating for each the entry time, average speed, and vehicle class. In the analysis, the FCD data covers a period of approximately 140 days between 2023 and 2024, spanning all seasons and different types of days (weekdays, Saturdays, holidays), thus enabling a comprehensive and detailed analysis of heavy vehicle mobility.

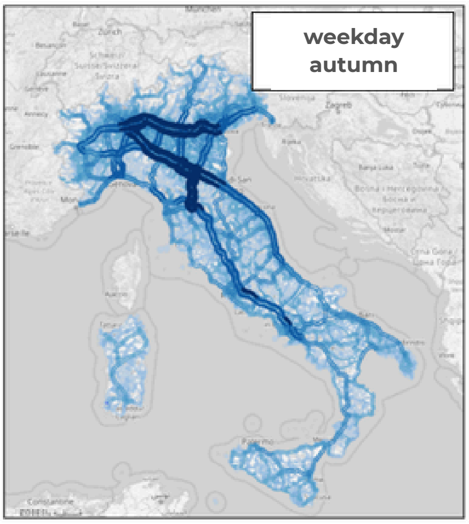


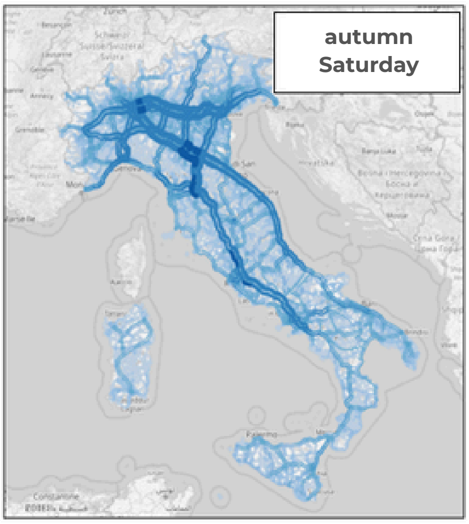
Comparison between the unexpanded FCD data and the detected data (left) and Comparison between the expanded FCD data and the detected data (right) on a typical weekday

The expansion of the FCD sample occurs by grouping over two million "similar routes" associated with a scaling coefficient obtained from approximately two thousand comparison sections: the R^2 index between expanded traffic and reliefs exceeds 0.98 on weekdays, 0.92 on Saturdays and 0.83 on Sundays; the average deviation on the TGMA is contained within 3% even on holidays.
National flow charts show how the TEN-T network, representing just 3% of the network's length, accounts for approximately 60% of heavy vehicle kilometers: peaks occur on the A4 between Milan and Venice, on the A1 between Piacenza, Bologna, and Florence, and on the access routes to the Ligurian ports. Urban zooms reveal areas of intense traffic even within Milan, Bologna, and Rome, confirming the need for charging not only along transit corridors but also in urban logistics hubs.

Transportation analysis

On average, each vehicle is in motion for only 18% of the day; on weekdays, the percentage rises to 19%, on Saturdays it drops, and on Sundays it increases slightly. Over 75% of trips are shorter than 100 km, 20% fall between 100-300 km, and less than 5% exceed 300 km without stopping.
The regional maps highlight Lombardy, Veneto, and Emilia-Romagna as leaders, with Sardinia and Basilicata at the bottom of the list; the hourly charts confirm two waves of weekday departures (7-10 a.m. and 2-4 p.m.) and higher average speeds during low-congestion times. The origin and destination matrices also show that the same provinces are both generators and attractors: Milan, Rome, Turin, and Naples stand out in every season. In summer, volumes drop without altering the geography of flows, while the transition from weekdays to holidays leads to a collapse in long-distance travel and a relative increase in urban distribution routes. In large cities, last-mile logistics remain high even on weekends, suggesting a constant need for charging in metropolitan hubs.





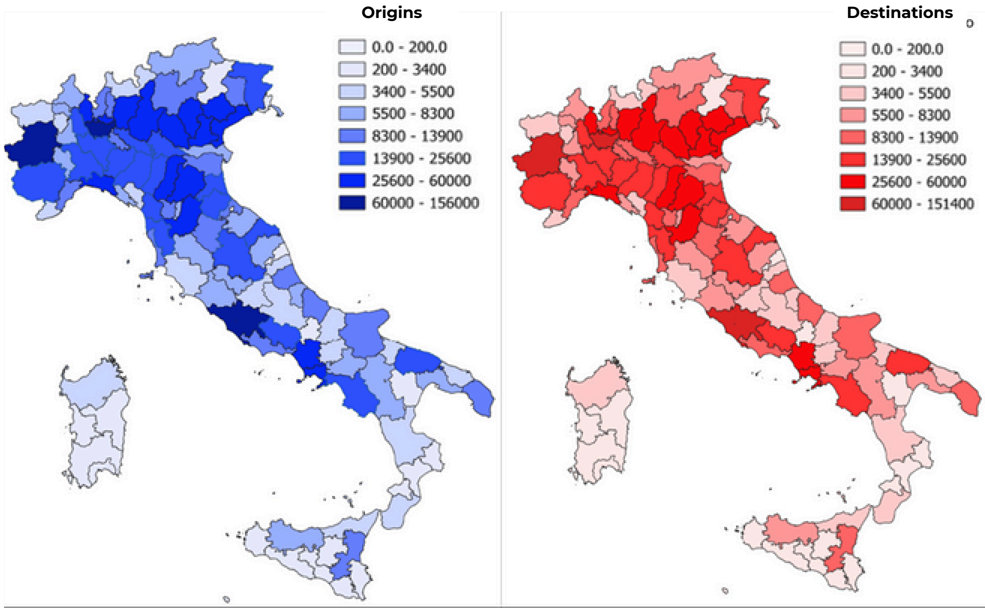
National scale flowgram comparisons

PERIODO	0 – 100 km	100 – 300 km	300 – 500 km	oltre 500 km
weekday winter	76,67%	20,27%	2,77%	0,30%
Saturday winter	86,82%	11,18%	1,74%	0,26%
holiday winter	89,60%	8,22%	1,88%	0,30%
weekday spring	74.86%	21.55%	3.13%	0.46%
Saturday spring	85.94%	12.09%	1.70%	0.28%
holiday spring	87.63%	9.68%	2.31%	0.37%
weekday summer	74,86%	21,55%	3,13%	0,46%
Saturday summer	85,94%	12,09%	1,70%	0,28%
holiday summer	87,63%	9,68%	2,31%	0,37%
weekday autumn	74,88%	21,38%	3,23%	0,52%
Saturday autumn	86,10%	11,77%	1,86%	0,26%
holiday autumn	87,76%	9,77%	2,14%	0,34%

Movements in length classes and by period

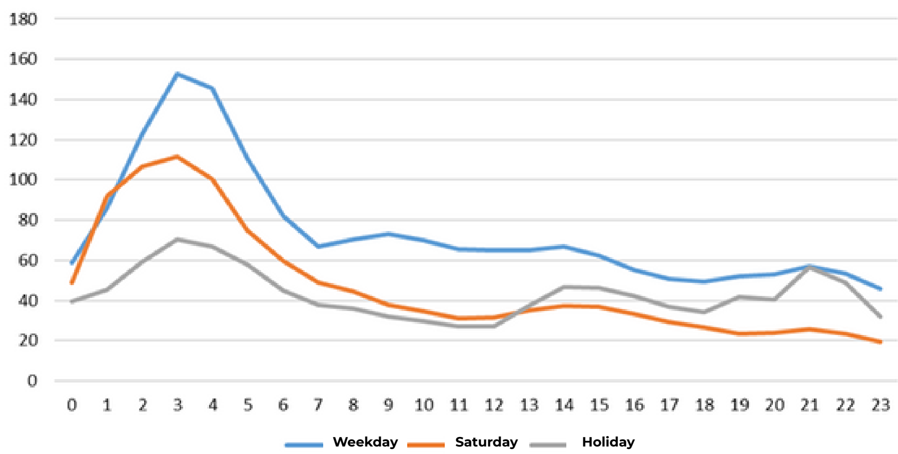
Analysis of origins and destinations

The distribution of travel can be analyzed based on the provinces of departure and destination, showing departures and arrivals on three typical days for the four seasons. A comparison of arrivals and departures on a winter weekday highlights that the most attractive areas, such as Rome, Milan, and Turin, generate the majority of flows, followed by the Naples area with Caserta and Salerno, the transversal part of the province from Bergamo to Venice (along the A4 motorway) and the A1 section between Emilia and the metropolitan city of Florence.



Comparison between arrivals and departures, winter weekdays

Average length per time slot of trip start



Overall, the analysis found that differences between day types are more significant than seasonal differences.

Classifying the length of journeys according to the departure time and the type of day, we observe that on weekdays departures take place in the early hours of the morning for longer journeys, while later the average length decreases, indicating local movements with frequent stops for loading and unloading.

Evaluation of current stops

Each vehicle makes an average of 1.6 stops per day at the mapped POIs.

- Stops lasting less than two hours, distributed throughout the day (6-14 hours), correspond to regulatory breaks or operational loading-unloading waits: in these areas it will therefore be necessary to enable higher connection power in order to allow for rapid charging "top-ups".
- Stops between five and ten hours are concentrated after 9pm and represent night stops along multi-day routes: lower power charging stations may be provided for these stops.

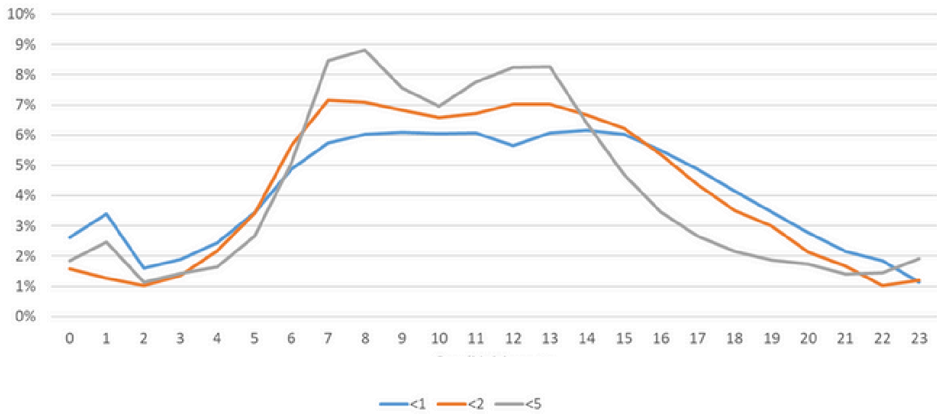
<1	short stop	16%
<2		15%
<5	loading/unloading	18%
<10	overnight stop	15%
<15		18%
<24	day of inactivity	12%
<48		5%
<72	weekend	1%
>= 72	prolonged inactivity	1%

Stops, distribution based on classes of duration in hours

- Finally, the ten to fifteen hour stops, peaking at 5-6 pm, represent the evening inactivity of the vehicles that return to the depot daily: even in these areas, lower power connections will be sufficient for electric charging.

On weekdays, during the early hours of the day, the average length of stops is generally less than 5 hours, which corresponds to stops for necessary breaks regulated by current regulations or waiting outside the company to access loading and/or unloading.

Starting from 2pm, the average duration of parking increases as long-term parking begins for the period of night-time inactivity of vehicles which, in addition to the private yards of companies, also occurs in external car parks and above all in the various motorway service areas As the evening progresses, the average length of the stop decreases, always with a view to a subsequent restart of activities around 7 or 8 the following morning.



Hourly distribution of stops, short durations

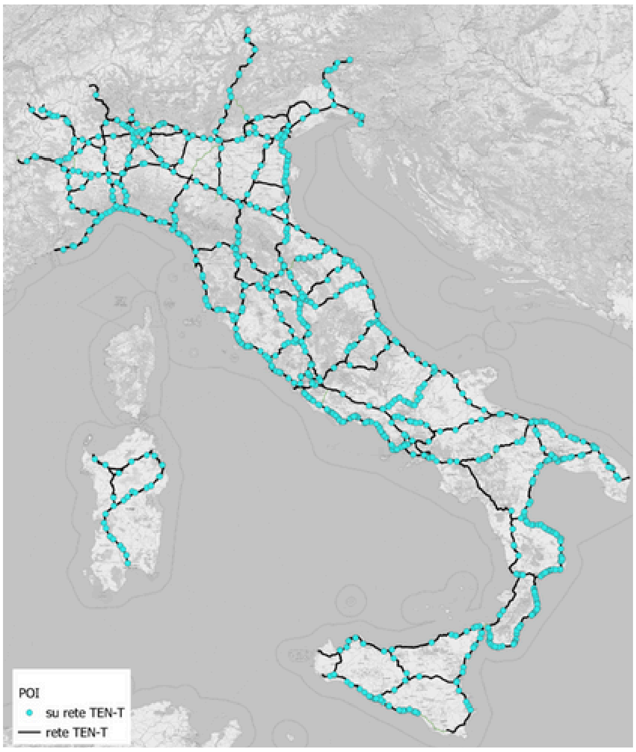
AdR Identification

The process of identifying the locations of future charging stations begins with a list of possible Charging Areas (AdR).
This audience refers to the entire national territory and includes:

- the currently existing fuel distributors;
- service areas, both the more organised ones located on motorways or main roads and those of a more local nature located on lower-level roads;

REGIONE	EXTRA TEN-T	TEN-T	TOTALE
Abruzzo	875	36	913
Basilicata	136	14	150
Calabria	477	126	603
Campania	1.269	71	1.340
Emilia Romagna	2.153	80	2.233
Fiuli Venezia Giulia	896	25	921
Lazio	2.022	129	2.151
Liguria	664	54	718
Lombardia	3.499	71	3.570
Marche	843	55	898
Molise	142	29	171
Piemonte	2.351	69	2.420
Puglia	1.099	103	1.202
Sardegna	671	47	718
Sicilia	1.639	130	2.025
Toscana	1.895	130	2.025
Trentino Alto Adige	892	14	906
Umbria	602	65	667
Valle d'Aosta	157	15	172
Veneto	2.666	74	2.740

AdR by region and network type



AdR on TEN-T

- on-street or surface parking areas, organized in various ways, excluding those underground or in structures.

The regions with the highest number of AdRs are Lombardy, Piedmont, Veneto, Emilia-Romagna, Tuscany and Lazio, mainly in urban or suburban areas.
Considering only the TEN-T network, the regions with the most AdRs are Tuscany, Lazio and Calabria, where the high number is influenced by the classification of some state roads as part of the network, even if they pass through urban centres along the Italian coast.

Charging demand estimate

To simulate charging needs, a standard average range of 300 km was adopted for each electric vehicle. The required charging time depends on the power of the infrastructure, which ranges from a minimum of 50 kW to the new Megawatt Charging Systems (1,000 kW minimum).

To recharge 300 km the following were estimated:

- less than 7 hours (night stops) with a power of 50 kW;
- approximately fifty minutes (intermediate stops) with HPC stations (350 kW);
- less than 20 minutes (quick stops) with the new 1,000 kW MCS.

The stations were then classified by required power range and related charging times, so as to adapt to the duration of stops observed in the mobility data.

The heart of the analysis is a probabilistic and algorithmic model that, using Floating Car Data, simulated charging behavior along routes.

Each vehicle starts with a 100% battery charge and, along the way, the model evaluates whether and where it could make a stop or a recharging stop, depending on:

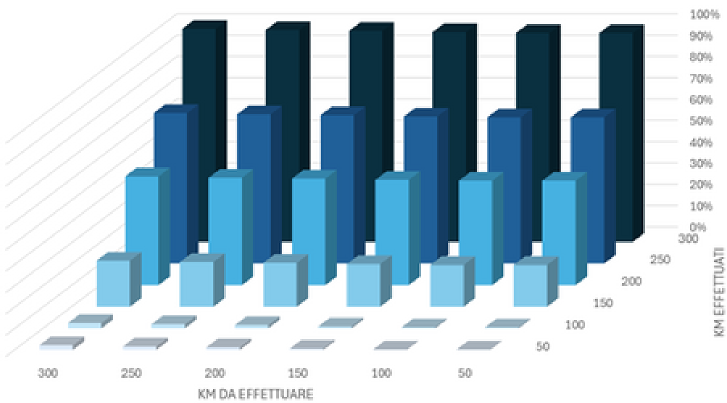
- of the distance already traveled,
- of the remaining distance,
- of the average duration of stops in the various AdRs

At each AdR along the route, the probability of a stop was assessed, based on the distance already traveled and the distance still to be traveled, thus generating a precise estimate of the kilometers to be recharged.

The model therefore distinguished between:

- intermediate stops, with an average of 120 km to recharge;
- final stops, in which the entire route travelled is recharged.
- according to the algorithm, each vehicle makes an average of 0.35 stops per trip, but this frequency increases beyond 300 km. Stops, however, only occur at the end of the journey and on average here they recharge all the kilometers traveled.

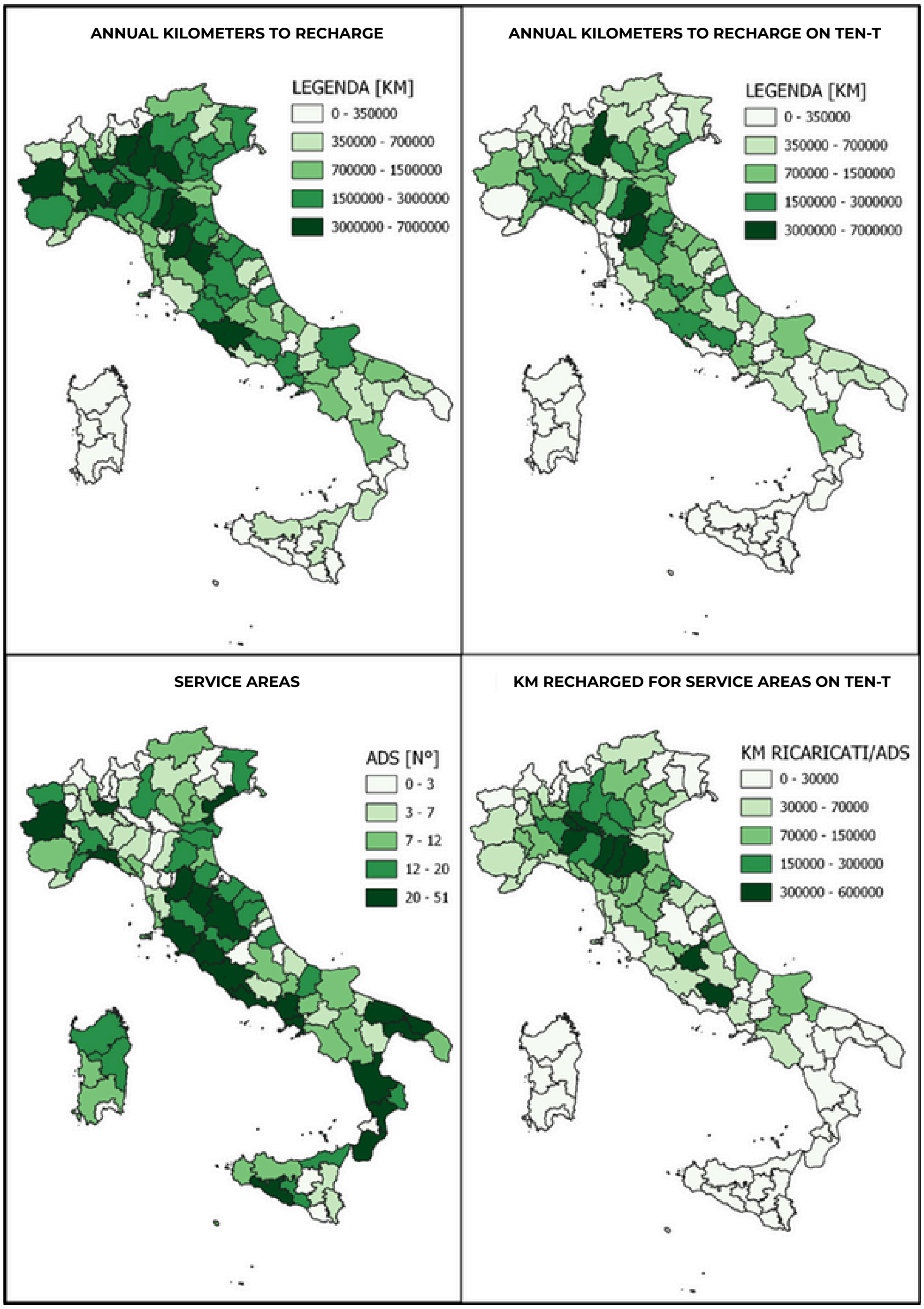
Temporal analyses show high activity on weekdays, especially at strategic times (7–8, 11–12, 16–17), and a seasonal distribution that favors spring and autumn.



Reload probability

Territorial distribution

Below is information on the kilometers to be charged, both considering all potential rest areas and only those on the TEN-T network, which is the most relevant.



Infographic showing potential charging on a provincial basis

With reference to the total kilometers to be recharged, you can see in the map (top left) that some of the main metropolitan cities such as Milan, Turin, Bologna, Florence and Rome are highlighted, as well as other provinces in Central and Northern Italy.

If we shift our attention to analyzing only the TEN-T network, we can see how the focus shifts to just three areas: the metropolitan cities of Bologna and Florence and the province of Brescia.

Finally, comparing the km to be recharged on the TEN-T network with the relative number of service areas highlights the areas where charging points can be installed to satisfy the greatest demand: among the most significant areas (i.e. with the highest ratio km/areas and greater km) include Bologna, Modena and Brescia.

Analysis of AdRs by charging requirement

Assuming a transition scenario to electric with 35% of electric trucks in circulation by 2035, and therefore calculating

- the annual number of vehicles potentially charging at AdRs,
- the kilometers to be recharged based on the origin and destination,
- It was possible to order the first 500 charging areas, including service areas, fuel stations and parking, throughout the country, leaving only Sardinia uncovered (the first area is 513th).

Localization of the first 500 AdRs

The optimal areas

TEN-T extra TEN-T

However, it is important to consider that initially, not all trucks will be electric, making it crucial to plan and adopt a data-driven approach to identify a strategy for developing a public charging network for heavy vehicles. For this reason, a more qualitative analysis identified the first 40 AdRs, both within the TEN-T and non-TEN-T networks, characterized by:

- a daily average of vehicles charging (15 on the TEN-T network and 5 on the extra),
- an average charging time of about 50' each,
- just under 300 km to recharge on average, for which HPC points are required.

Analysis of AdRs by Charging Requirement

Below is a breakdown of the areas identified with respect to charging needs, with a 35% BEV penetration scenario.

NAME		TYPE	MUNICIPALITY	PROVINCE	AVERAGE STOP TIME -	TGMA	VEHICLES YEAR -	RECHARGE TIME -	KM CHARGE -	KW (POWER)
Secchia Ovest	A1	parking	Modena	Modena	0,28	5.695.810	325.219	0,48	311	HPC+ (350-1000)
Cortile San Martino	A1	service	Parma	Parma	0,28	4.173.040	233.292	0,47	295	HPC+ (350-1000)
AdS Prenestina Est	A1	service	Gallicano nel Lazio	Roma	0,20	2.327.064	177.205	0,47	353	HPC+ (350-1000)
AdS Arda Est	A1	service	Fiorenzuola d'Arda	Piacenza	0,43	3.692.622	214.920	0,49	278	HPC+ (350-1000)
Sillaro ovest	A14	parking	Castel San Pietro Terme	Bologna	0,35	3.337.221	215.091	0,46	289	HPC+ (350-1000)
La Macchia Est	A1	service	Anagni	Frosinone	0,28	2.569.892	179.935	0,48	301	HPC+ (350-1000)
Badia al Pino ovest	A1	parking	Civitella in Val di Chiana	Arezzo	0,32	2.308.731	178.794	0,45	309	HPC+ (350-1000)
Area di Scaligera Est	A4	service	Soave	Verona	0,42	4.081.730	172.172	0,49	272	HPC+ (350-1000)
Area di parcheggio	A1	parking	Scandicci	Firenze	0,24	3.641.616	136.412	0,49	313	HPC+ (350-1000)
Teano Ovest	A1	parking	Teano	Caserta	0,39	1.740.588	127.678	0,49	333	HPC+ (350-1000)
AdS San Zenone est	A1	service	San Zenone al Lambro	Milano	0,31	3.014.244	143.022	0,47	298	HPC+ (350-1000)
Flaminia Est	A1	service	Magliano Sabina	Rieti	0,23	2.599.216	142.008	0,46	298	HPC+ (350-1000)
Montepulciano Est	A1	parking	Montepulciano	Siena	0,22	2.053.837	164.191	0,40	292	HPC+ (350-1000)
Arino Est	A4	service	Dolo	Venezia	0,42	3.784.382	132.324	0,49	263	HPC+ (350-1000)
Tevere ovest	A1	fuel	Civitella d'Agliano	Viterbo	0,38	2.024.841	129.410	0,47	273	HPC+ (350-1000)
Area di Limenella Est	A4	parking	Padova	Padova	0,45	3.284.880	121.351	0,49	271	HPC+ (350-1000)
Area di Tortona Nord	A21	service	Tortona	Alessandria	0,49	2.094.477	94.505	0,50	276	HPC+ (350-1000)
Esino Est	A14	service	Chiaravalle	Ancona	0,24	1.793.402	102.132	0,43	289	HPC+ (350-1000)
Area di servizio Tarsia ovest	A2	parking	Tarsia	Cosenza	0,21	453.183	55.381	0,48	459	HPC+ (350-1000)

The first 20 areas identified along the TEN-T network

NAME		TYPE	MUNICIPALITY	PROVINCE	AVERAGE STOP TIME -	TGMA	VEHICLES YEAR -	RECHARGE TIME -	KM CHARGE -	KW (POWER)
AdS Valdera	Fi-Pi-Li	fuel	Pontedera	Pisa	0,32	1.244.704	60.359	0,49	348	HPC+ (350-1000)
Area di parcheggio		parking	Parma	Parma	0,27	1.248.521	46.383	0,50	292	HPC+ (350-1000)
Distributore carburante	SS253bi:	fuel	Bentivoglio	Bologna	0,25	2.074.581	41.001	0,49	264	HPC+ (350-1000)
Area di parcheggio	SS53	parking	Bolzano Vicentino	Vicenza	0,63	1.606.676	33.864	0,50	285	HPC+ (350-1000)
Area di parcheggio		parking	Verona	Verona	0,43	1.203.080	32.091	0,50	277	HPC+ (350-1000)
Piazzale Ugo Bubani		parking	Cesena	Forli'-cesena	0,16	1.083.083	57.827	0,33	201	HPC (150-350)
Distributore carburante	SP40	fuel	Carpiano	Milano	0,37	2.162.329	30.977	0,49	239	HPC+ (350-1000)
Quiesa Nord	A11	service	Lucca	Lucca	0,34	901.975	29.373	0,45	253	HPC+ (350-1000)
Distributore carburante	SS156	fuel	Frosinone	Frosinone	0,35	841.435	24.991	0,48	265	HPC+ (350-1000)
Area di parcheggio		parking	Capriate San Gervasio	Bergamo	0,30	1.312.167	22.255	0,50	266	HPC+ (350-1000)
Distributore carburante	RA16	fuel	Fiume Veneto	Pordenone	0,49	565.207	19.092	0,50	302	HPC+ (350-1000)
Grecciano	Fi-Pi-Li	parking	Collesalvetti	Livorno	0,42	913.299	26.936	0,47	222	HPC+ (350-1000)
Distributore carburante	SS655	fuel	Melfi	Potenza	0,27	663.993	22.996	0,46	260	HPC+ (350-1000)
Area di parcheggio		parking	Tortona	Alessandria	0,37	854.607	21.545	0,49	256	HPC+ (350-1000)
AdS Sala Consilina est		parking	Sala Consilina	Salerno	0,42	83.227	20.149	0,46	289	HPC+ (350-1000)
Distributore carburante	SS16	fuel	Foggia	Foggia	0,20	555.008	18.040	0,49	287	HPC+ (350-1000)
AdS Frascineto ovest		parking	Castrovillari	Cosenza	0,24	54.596	14.944	0,40	422	HPC+ (350-1000)
Area di parcheggio		parking	Noventa di Piave	Venezia	0,65	478.926	16.259	0,50	302	HPC+ (350-1000)
Area di Trebbia Sud		service	Piacenza	Piacenza	0,30	187.771	25.340	0,37	261	HPC+ (350-1000)
Distributore carburante	SS16	fuel	Giovinazzo	Bari	0,59	510.439	17.050	0,51	269	HPC+ (350-1000)

The first 20 areas identified outside the TEN-T network

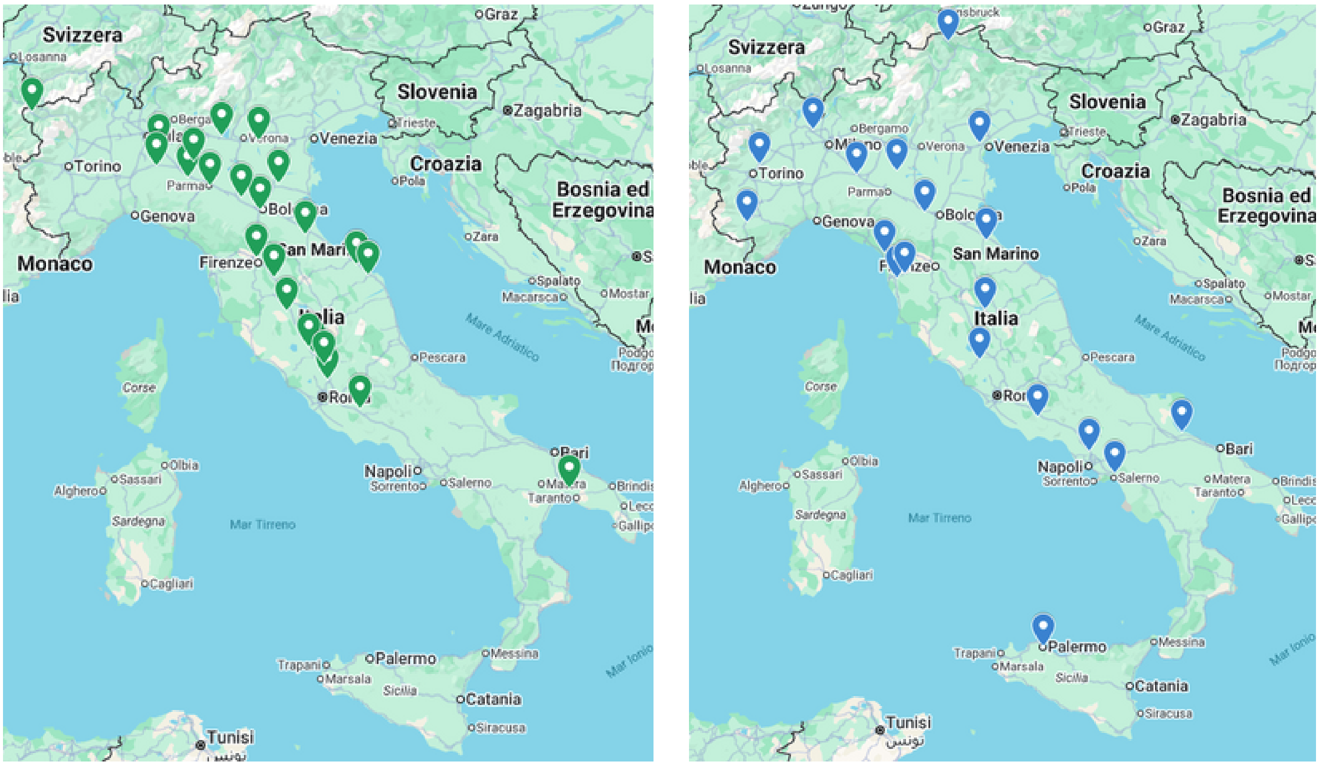
* TGMA: average annual daily traffic at service area

Analysis of current transit and parking AdRs

A further analysis was then carried out considering:

- current traffic flows, based on the average annual daily traffic over the reference period,
- the time in which logistics operators stop today,

For this analysis, a 1% penetration of electric trucks in circulation was considered.



The optimal areas

TEN-T

extra TEN-T

The analysis reveals significant differences between charging stations along the TEN-T network and those outside the TEN-T: in the main motorway network, the demand for high-power points (350-1,000 kW) predominates, with average waiting times of 19 minutes; these stations mainly serve transit users, with an average chargeable distance of 276 km and high annual traffic (2.8 million vehicles on average).

Conversely, non-TEN-T stations feature greater technological variety, with lower power (150-350 kW) in over 60% of cases; they display slightly longer parking times (22 minutes) and serve an average lower traffic volume (450,000 vehicles/year), indicating a more local use: the average charging distance is 166 km.

Analysis of current transit and parking AdRs

Below is a breakdown of the identified areas based on average annual traffic and the current dwell time of logistics operators.

NAME	TYPE		MUNICIPALITY	PROVINCE	AVERAGE STOP TIME - TGMA		VEHICLES YEAR -	RECHARGE TIME - KM CHARGE - KW (POWER)		
Cantagallo Ovest	A1	service	Casalecchio di Reno	Bologna	0,26	3.509.460	4.746	0,40	276	HPC+ (350-1000)
Montepulciano Est	A1	parking	Montepulciano	Siena	0,22	2.053.837	4.691	0,40	292	HPC+ (350-1000)
Arno Est	A1	parking	San Giovanni Valdarno	Arezzo	0,25	2.697.015	4.697	0,41	288	HPC+ (350-1000)
Secchia Ovest	A1	parking	Modena	Modena	0,28	5.695.810	9.292	0,48	311	HPC+ (350-1000)
AdS Arda Est	A1	service	Fiorenzuola d'Arda	Piacenza	0,43	3.692.622	6.141	0,49	278	HPC+ (350-1000)
Giove ovest	A1	service	Giove	Terni	0,42	1.994.149	3.839	0,47	252	HPC+ (350-1000)
Cortile San Martino	A1	service	Parma	Parma	0,28	4.173.040	6.665	0,47	295	HPC+ (350-1000)
Bevano ovest	A14	parking	Bertinoro	Forli'-cesena	0,39	2.477.355	3.475	0,46	249	HPC+ (350-1000)
AdS Mascherone Ovest	A1	service	Capena	Roma	0,43	1.961.425	3.181	0,48	255	HPC+ (350-1000)
Area di Scaligera Est	A4	service	Soave	Verona	0,42	4.081.730	4.919	0,49	272	HPC+ (350-1000)
La Macchia ovest	A1	service	Anagni	Frosinone	0,47	2.102.967	3.251	0,49	279	HPC+ (350-1000)
Esino Est	A14	service	Chiaravalle	Ancona	0,24	1.793.402	2.918	0,43	289	HPC+ (350-1000)
Flaminia Est	A1	service	Magliano Sabina	Rieti	0,23	2.599.216	4.057	0,46	298	HPC+ (350-1000)
Bisenzio Ovest		service	Sesto Fiorentino	Firenze	0,31	1.085.191	2.259	0,43	290	HPC+ (350-1000)
AdS San Zenone est	A1	service	San Zenone al Lambro	Milano	0,31	3.014.244	4.086	0,47	298	HPC+ (350-1000)
Area di Stradella Sud	A21	service	Stradella	Pavia	0,32	2.048.416	3.556	0,47	282	HPC+ (350-1000)
Area di Cremona Sud	A21	service	Cremona	Cremona	0,31	2.087.304	3.392	0,47	301	HPC+ (350-1000)
Distributore carburante	SS7	fuel	Massafra	Taranto	0,40	449.077	915	0,41	118	HPC (150-350)
Area di servizio Monte Alto Est	A4	service	Desenzano del Garda	Brescia	0,37	4.437.918	3.487	0,48	238	HPC+ (350-1000)
Area di servizio Po Est	A13	parking	Ferrara	Ferrara	0,32	2.006.535	2.637	0,46	277	HPC+ (350-1000)
Area di parcheggio	T1	parking	Courmayeur	Aosta	0,49	79.566	788	0,49	134	HPC (150-350)

The areas identified along the TEN-T network

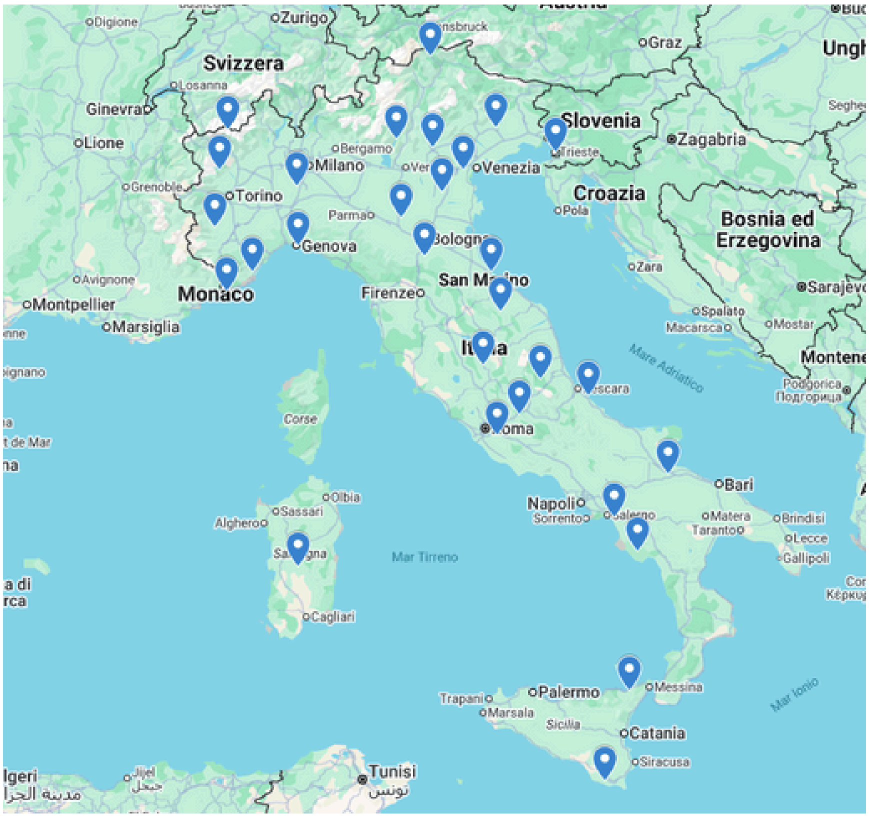
NAME	TYPE		MUNICIPALITY	PROVINCE	AVERAGE STOP TIME - TGMA		VEHICLES YEAR -	RECHARGE TIME - KM CHARGE - KW (POWER)		
Piazzale Ugo Bubani		parking	Cesena	Forli'-cesena	0,16	1.083.083	1.652	0,33	201	HPC (150-350)
Area di Trebbia Nord		parking	Piacenza	Piacenza	0,49	282.468	806	0,49	164	HPC (150-350)
Distributore carburante	SS7bis	fuel	Santa Maria Capua Vetere	Caserta	0,24	576.733	634	0,33	133	HPC (150-350)
Distributore carburante	SP32	fuel	Mirano	Venezia	0,22	336.204	590	0,33	119	HPC (150-350)
Cancellieri carburanti	SP1	fuel	Viterbo	Viterbo	0,40	166.711	500	0,40	63	DC (150 KW)
Area di servizio Baronissi est		parking	Baronissi	Salerno	0,31	89.327	482	0,33	226	HPC+ (350-1000)
Distributore carburante	SP48	fuel	Crispiano	Taranto	0,65	155.677	461	0,65	30	DC (150 KW)
Area di parcheggio	SP25	parking	Cuneo	Cuneo	0,65	237.928	432	0,63	73	DC (150 KW)
Autohof Trens - Autoporto Sadobre		parking	Campo di Trens	Bolzano	1,46	72.471	413	1,38	51	DC (150 KW)
Distributore carburante	SP6	fuel	Trinitapoli	Foggia	0,17	109.887	395	0,33	195	HPC (150-350)
Versilia Ovest	SS1	parking	Pietrasanta	Lucca	0,29	320.640	373	0,33	213	HPC+ (350-1000)
Distributore carburante	SP11	fuel	Patrica	Frosinone	0,48	362.672	434	0,49	139	HPC (150-350)
Grecciano	Fi-Pi-Li	parking	Collesalvetti	Livorno	0,42	913.299	770	0,47	222	HPC+ (350-1000)
Distributore carburante	SS623	fuel	Spilamberto	Modena	0,31	600.756	485	0,39	202	HPC (150-350)
Distributore carburante	SR75bis	fuel	Magione	Perugia	0,30	418.420	393	0,35	175	HPC (150-350)
Distributore carburante	SPexSS234	fuel	Genzone	Pavia	0,31	453.462	361	0,35	104	HPC (150-350)
Area di Servizio Valdera	Fi-Pi-Li	fuel	Pontedera	Pisa	0,32	1.244.704	1.725	0,49	348	HPC+ (350-1000)
Area di parcheggio	SP3	parking	Volpiano	Torino	0,22	461.538	315	0,33	141	HPC (150-350)
Area di parcheggio	SP20	parking	Cassano Magnago	Varese	0,31	419.149	351	0,36	187	HPC (150-350)
Area di parcheggio	SS10	parking	Marcaria	Mantova	0,27	624.602	381	0,35	174	HPC (150-350)
Distributore carburante		fuel	Palermo	Palermo	0,50	175.562	266	0,50	86	DC (150 KW)

The areas identified outside the TEN-T network

* TGMA: average annual daily traffic at service area

Analysis of AdRs with respect to longer stops

The latest analysis identifies areas that currently have parking times exceeding 4 hours: the distribution of charging points is deliberately strategic throughout the country, with diversified technological solutions: at major hubs, such as Tarvisio and Trieste, higher-power points will be required, given the greater number of vehicles to be charged, while most other stations will be able to adopt lower-power DC systems, considering the longer time available for charging and less traffic.



The areas identified in the rest areas >4h

The locations are prioritized in existing parking areas and gas stations, with a focus on secondary roads and peripheral areas. This approach aims to create a widespread network, although traffic forecasts are quite limited in some areas. However, the financial investment for installing lower-powered points will also be limited, ensuring greater distribution across the country to meet the diverse charging needs.

Analysis of AdRs with respect to longer stops

Below is a breakdown of the identified areas based on average annual traffic and the current parking time of logistics operators exceeding 4 hours.

NAME	TYPE	MUNICIPALITY	PROVINCE	AVERAGE STOP TIME - TGMA	VEHICLES YEAR -	RECHARGE TIME - KM CHARGE - KW (POWER)	
Area di parcheggio	A23	parking	Tarvisio	Udine	7,97	101.179	HPC+ (350-1000)
Distributore carburante	SP13dir	fuel	Campodoro	Padova	4,75	77.474	DC (150 KW)
Area di parcheggio	SPexSS596	parking	Garlasco	Pavia	5,45	282.392	DC (150 KW)
Distributore carburante	SR11	fuel	Fiesso d'Artico	Venezia	4,62	187.832	DC (150 KW)
Planet via Emilia		fuel	Genova	Genova	4,35	28.500	50 KW - DC
Area di parcheggio		parking	Pordenone	Pordenone	7,66	41.578	DC (150 KW)
Capone	SS18	fuel	Pontecagnano	Salerno	4,16	123.641	DC (150 KW)
Area di parcheggio	SS16	parking	Ortona	Chieti	4,53	128.061	DC (150 KW)
Area di parcheggio	SP349	parking	Thiene	Vicenza	8,45	128.301	DC (150 KW)
Distributore carburante	SS80	fuel	Crognaleto	Teramo	4,28	3.239	DC (150 KW)
Area di parcheggio	SS12	parking	Vipiteno	Bolzano	5,15	18.813	DC (150 KW)
Fidone	SP89	fuel	Scicli	Ragusa	4,09	8.986	DC (150 KW)
Area di parcheggio	SR46	parking	Valtournenche	Aosta	8,30	24.852	DC (150 KW)
Distributore carburante	SP26	fuel	Revello	Cuneo	4,54	137.924	DC (150 KW)
Distributore carburante		fuel	Carpi	Modena	5,67	27.777	DC (150 KW)
Antonino Munaf	SS113	fuel	Terme Vigliatore	Messina	4,55	26.198	DC (150 KW)
Area di parcheggio	SP41	parking	Sant'Urbano	Terni	7,53	33.487	DC (150 KW)
Distributore carburante	SP121	fuel	Frontone	Pesaro e urbino	5,15	7.792	DC (150 KW)
Distributore carburante		fuel	Latina	Latina	4,84	35.318	DC (150 KW)
AdS Olmedo		service	Olmedo	Sassari	4,60	635	50 KW - DC
Distributore carburante	SP33	fuel	Samugheo	Oristano	6,42	2.776	HPC (150-350)
Area di parcheggio	SP77b	parking	Frascati	Roma	5,17	37.943	HPC (150-350)
Area di parcheggio	SP22	parking	Loiano	Bologna	4,05	8.073	DC (150 KW)
Area di parcheggio	SR79bis	parking	Todi	Perugia	5,72	1.860	50 KW - DC
Villa Revoltella		parking	Trieste	Trieste	6,34	9.438	HPC+ (350-1000)
Area di parcheggio		parking	Diamante	Cosenza	4,45	1.119	50 KW - DC

The identified long-term parking areas

* TGMA: average annual daily traffic at service area

Immediate energy availability

To ensure completeness and feasibility of the areas identified in the previous pages, the availability of the necessary grid power for each specific area was examined. Specifically, the areas on the left represent locations where the nearest available transformer station is just a few meters away (within 50 m), and therefore the construction of the dedicated truck station could be quicker.

>100 kW >150 kW >350 kW

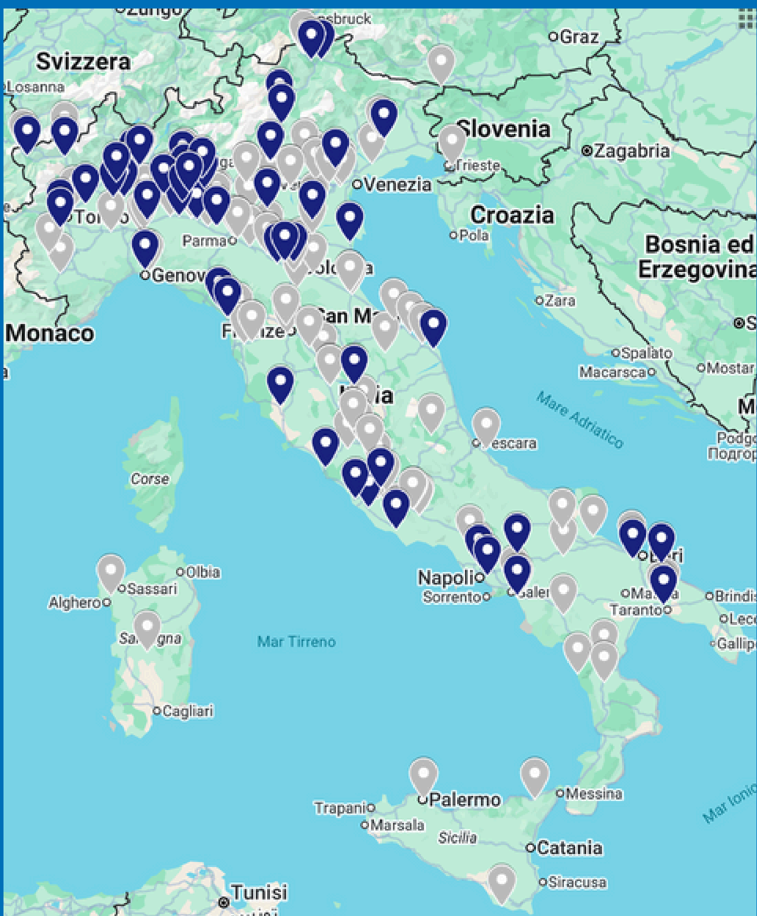
Availability within 50m of the nearest cabin

Availability within 200m of the nearest cabin

However, this digression is intended as a short-term feasibility analysis, at a time when the number of electric trucks circulating in Italy is still limited and only a few charging points are needed per area, as the turnover of vehicles being charged is low and there is no need for charging in just a few minutes to ensure space availability. Over a target time horizon of approximately ten years, with a significant increase in the number of electric heavy-duty vehicles on the road, it will be necessary to plan and establish high-power charging areas, with grid availability in the order of tens of megawatts. Upgrading these will require several years, in order to ensure ultra-fast charging via MCS (Megawatt Charging Systems).

Charging areas at strategic private centers

To conclude the analysis, which focused primarily on public charging for electric trucks, it's worth briefly exploring the importance of installing high-power charging stations in private areas such as logistics centers and freight terminals. These facilities will complement the solutions available to electric truck drivers: in addition to charging in depots and along major roads to accommodate longer hauls, it will be essential to provide complementary solutions, such as rapid charging during loading and unloading operations. In these situations, the truck is "forced" to stop for several hours, providing the opportunity to recharge at high power.



Potential public ADRs

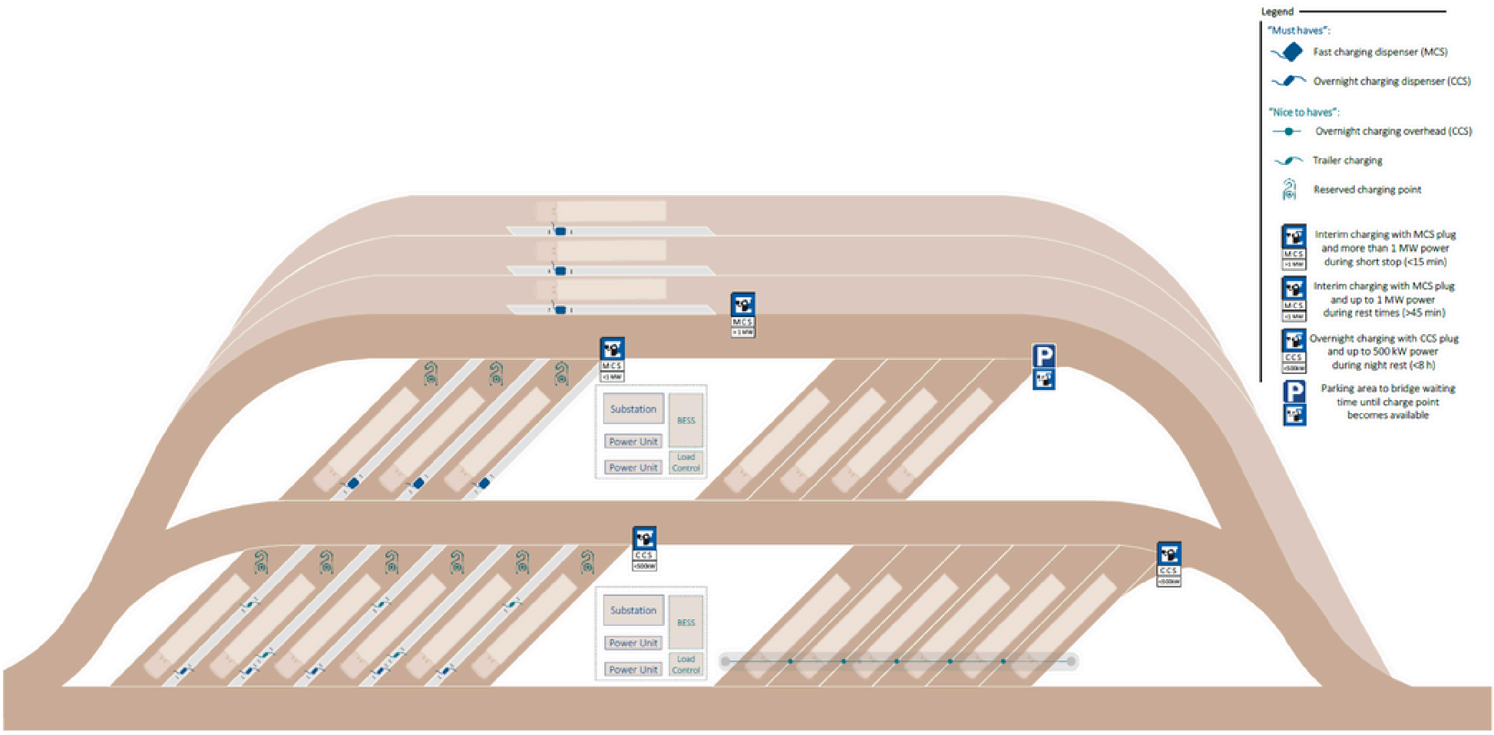
Potential private ADRs

The map alongside highlights how the charging areas dedicated to electric trucks installed at these strategic private locations will meet future logistics needs where refueling is not currently necessary. With the exception of northern Italy, where future energy needs will be both public and private, the rest of the peninsula will require significant initial public investment to kick-start the supply chain and enable the energy transition even where logistics flows do not justify it economically.

In these areas, it will also be crucial to establish agreements between logistics operators, clients, and all stakeholders involved in the process, with the aim of reducing charging costs and bringing them as close as possible to the costs of charging in depots.

Proposal for a standard layout for charging

Given that there are currently no specific regulatory constraints for charging stations, the provisions of the Highway Code and any municipal regulations must be complied with. At fuel stations, safety distances are determined by the owner based on the risks involved. Below is a proposal from the HoLa (High Performance Charging for Long-Haul Trucking) consortium, a German initiative focused on the development and implementation of high-power charging infrastructure for long-haul electric trucks.

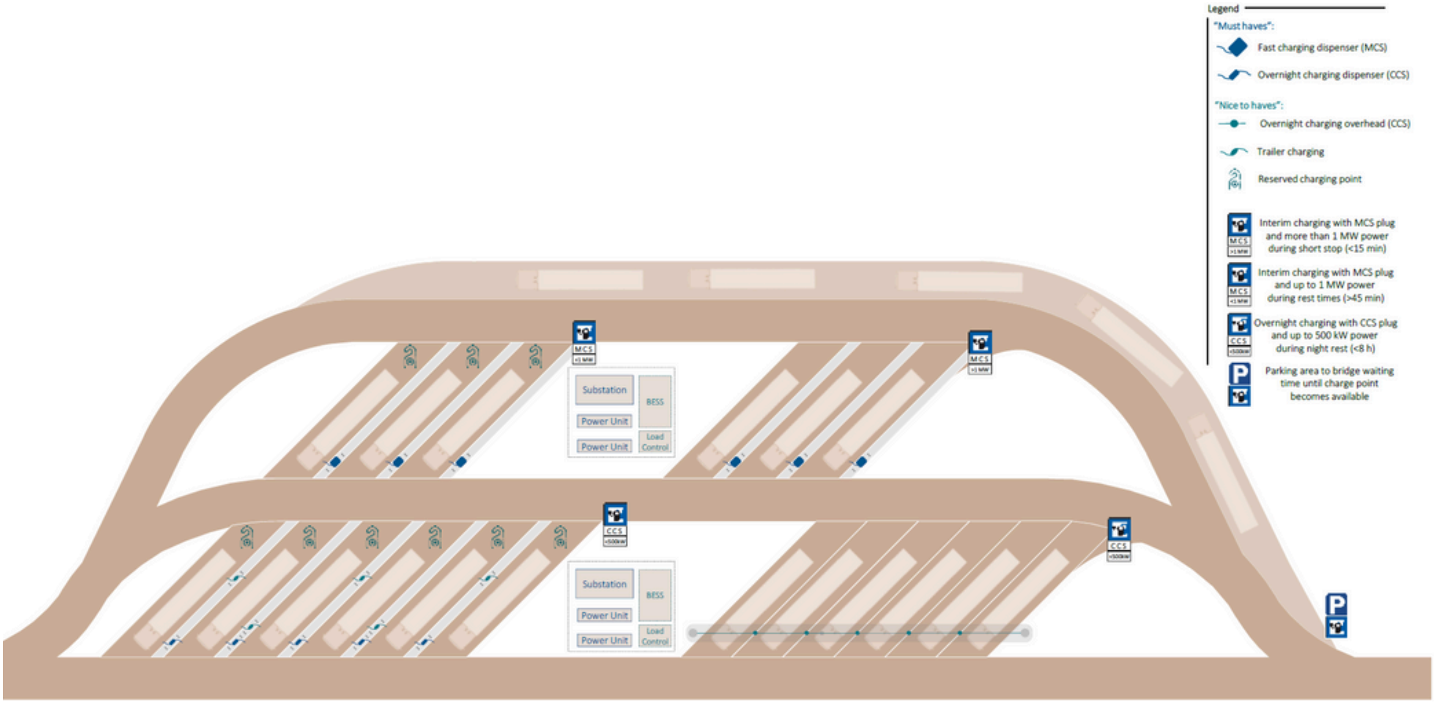


Example with drive-through charging stations

Main Features:

- include drive-through options and dedicated waiting areas,
- have clear signage at the entrance indicating the location of the CCS and MCS columns,
- the MCS socket is always on the left side of the vehicle (industry standard), while the CCS can be on the right or left,
- possibility of slow charging (e.g. at night) with suspended cables to save space,
- need to include transformers, load management systems and any BESS in the area.

Proposal for a Standard Layout for Charging



Example with charging stations with separate waiting areas

Vehicle type	Stall width	Stall length (max)	Recommended maneuvering lane
Truck without trailer	3m	10m	6-7m
Standard truck combination	3.5-4m	18,75 m	6-7m
Modular road train (EU-combi)	3.5-4m	25,25 m	6-7m
Double trailers (Duo2)	3.5-4m	34 m	6-7m

Summary table: recommended dimensions

Recommendations for a standard layout:

- Integrate slow and fast charging in the same station.
- Optimize space to minimize unused parking areas.
- Ensure effective signage, large maneuvering areas, and waiting areas for logistics operators.

Designing charging stations for e-trucks

Below are some of the main best practices suggested by Ewiva, CPO associated with Motus-E and specialized in the creation of high-power charging stations for electric cars and trucks.

Strategic Positioning

- Place stations in strategic locations (motorway axes, interports, industrial areas).
- Importance of services (refreshments, restrooms, vending) for e-truck drivers.

Functional Layout

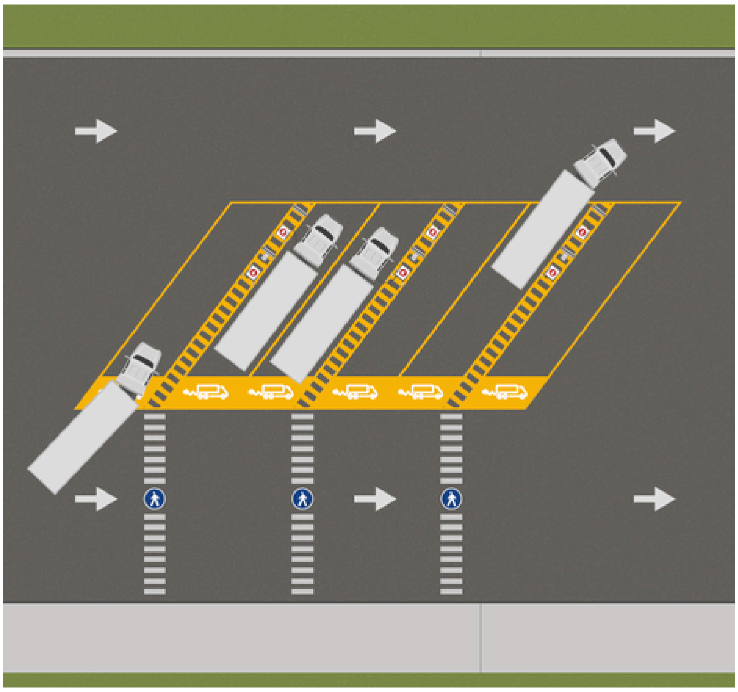
- Large areas for maneuvering vehicles and trailers:
  - Curvature radius: internal 8.75 and external 12.50
  - Minimum stalls: 20 m x 4 m
- Favorite layouts: drive-through and herringbone.
- Charging cables at least 7 meters long, accessible from both sides of the vehicle, with management systems (CMS).

Safety and Accessibility

- Lighting without shadow zones, clear and visible signage.
- Ground level platforms and accessibility for people with reduced mobility.
- Deterrent devices and physical protections for infrastructure and pedestrian safety.

Parking Reservation and Management

- Reservation systems to optimize vehicle flow management and improve station efficiency.



Example layout for electric truck charging stations
Source: Ewiva

[1] In compliance with national and European regulations for the construction of charging infrastructures for electric vehicles

Operators' needs

From the analysis and definition of the strategies, the following specific needs of the operators directly involved emerged:

- encouragement for DSOs to reduce the distance between the transformer cabin, required for higher power, and the charging stations, so as to reduce electrical installation costs (e.g. in France, DSOs generally have the cabin and transformer installed where requested by the CPO with greater ease of network access);
- provide, by virtue of their strategic role and public utility, simplified urban planning procedures and dedicated designated uses. Standardize municipal building regulations through SUAP (User Planning Applications) to standardize permits and timeframes, effectively mandating municipalities to develop charging station development plans with clear objectives, monitoring, and responsibilities;
- establish a national electronic platform to act as a permanent service conference for rapid and traceable authorizations;
- define national conditions for the use of agricultural land for recharge, with mitigation criteria and environmental compensation, adapting regional regulations on land use with exceptions for low-impact plants and introducing national guidelines on landscape mitigation to facilitate authorizations and territorial inclusion;
- Simplify restrictions on road safety zones with clear exemptions based on safety and visibility, aligning national legislation with AFIR to allow the location of charging stations at toll booths and main hubs.

Furthermore, e-trucks, due to the weight of their battery packs, suffer a reduction in load capacity: to address this problem, the European Union should adopt amendments to Directive 96/53/EC, increasing the mass tolerance for zero-emission vehicles from 2 to 4 tonnes and the maximum axle load from 11.5 to 13 tonnes.

The implementation of these solutions will not only help achieve the AFIR and decarbonization objectives, but will also have a multiplier effect on surrounding areas, on related industries, and on improving air quality.

Conclusions and call to action

To stimulate market development, it's essential to actively collaborate with the entire industry and identify sites ripe for investment in the transition. Some key points include:

- Synergistic involvement: Collaboration with italian organization (GSE), DSO, and local authorities is essential to optimize integration into the energy grid. This collaboration not only improves efficiency but also ensures a balanced distribution of energy resources throughout the country.
- Toll exemptions: Introduce experimental exemptions from motorway tolls on optimal routes identified for zero-emission vehicles, in accordance with European Directive 2022/362 (Eurovignette). Italy is currently lagging behind in implementing this regulation; the adoption of incentive measures could accelerate the transition to sustainable mobility while reducing the risk of fines for violations.
- Stimulate demand: Offering incentives, such as tax breaks for contracting companies, is essential to stimulate demand. It's important that public tenders offer appropriate rates so that logistics operators can cover operating costs, including by adopting more sustainable vehicles.
- Industrial development guidelines: Establishing requirements for adequate truck space and charging infrastructure in industrial areas is essential. These guidelines should ensure that new industrial areas are ready for the transition to greener operations.

At the European level, the organization of freight transport is being rethought, considering mandatory stops as part of working hours.
Additionally, high-power charging areas will need to be planned, given the increased number of electric trucks on the road: these areas should be designed to support significant grid load, ensuring rapid charging via MCS systems.

The implementation of these solutions will not only help achieve decarbonization goals, but will also have positive impacts on surrounding areas, improving air quality and stimulating local economic development.

Thanks

A heartfelt thank you goes to all Motus-E members, especially the "Freight" and "Local Public Transport" groups, who collaborated on this study, sharing their skills, data, and know-how.
Furthermore, we would like to thank FIAP and UNIONTRASPORTI for their invaluable support and commitment in analyzing and finalizing the proposals. Their contribution was crucial in ensuring a realistic and concrete vision of the sector's needs, with the shared goal of promoting increasingly innovative and sustainable mobility.

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