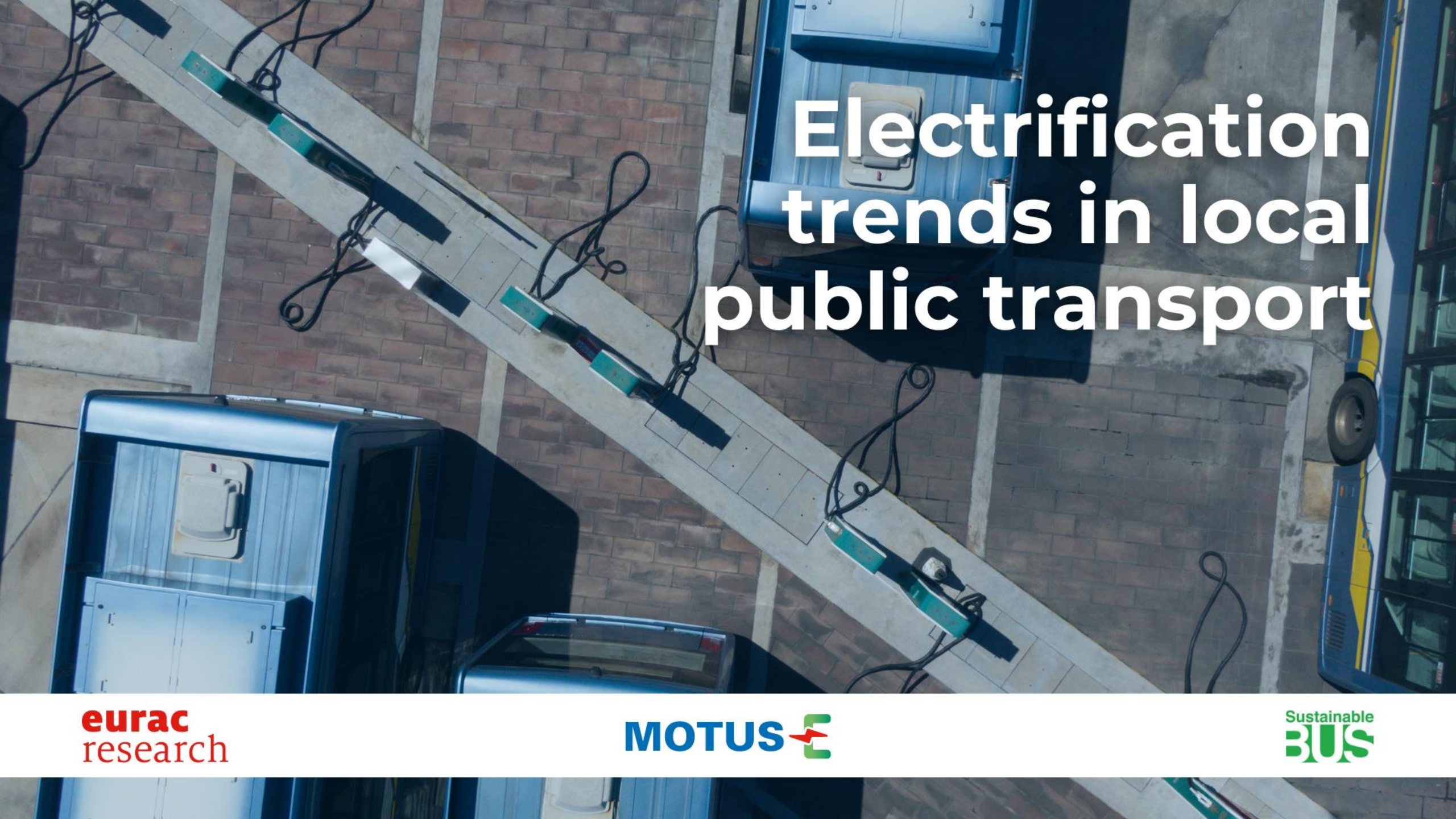


Electrification trends in local public transport

eurac research

MOTUS-E

Sustainable BUS

Executive Summary (1/5)

1

EVOLUTION OF THE BUS MARKET BETWEEN EUROPE AND ITALY

- At European level, the **city bus market** has seen significant growth in **alternative traction in** recent years, **accounting for 73 per cent of the registered vehicles in 2023. In the** same year, **zero-emission** buses accounted **for more than 40 per cent** of the urban registered vehicles.
- Also on a continental level, **CNG drives are stalled**, **mild hybrids** are **growing strongly** and **fuel cell** technology remains **a niche market** (1.3 per cent of zero-emission buses). The **electric** technology of **E-bus is the** only one that has maintained **almost constant growth** for ten years now.
- In 2023 **in Italy, 27.5 per cent of the registered urban vehicles has been zero-emission** (compared to 40 per cent in Europe) and our country **rank ninth in Europe in terms of** the **circulating electric fleet.** In September 2022, electric buses amounted to 1.5 per cent of the circulating fleet, 20 per cent of which is made up of Euro 2 and Euro 3 vehicles, which will be banned from 2025.
- **Almost 80 per cent of the electric buses registered** in Italy **between 2022 and 2023 circulate in the north of the country.** More than half of the zero-emission registered buses of 2023 are distributed between Milan, Turin and Genoa.
  The **Italian bus fleet has** an **average age of 10.3 years**, 33% higher than that of the other four main European markets (France, Germany, UK, Spain).
- **As far as Class II** vehicles are concerned, **CNG** technology is on the **rise** (in contrast to Class I).
  There is also a **strong increase in mild hybrid technology** (1,075 registrations in 2023 compared to 19 in 2022).

Note: The term 'alternative drives' refers to alternative fuels to diesel. This category includes hydrogen (F-bus), hybrid, CNG and fully electric vehicles (E-bus).
The term 'zero-emission' refers to fully electric battery vehicles and hydrogen vehicles

Executive Summary (2/5)

2

REGULATORY FRAMEWORK AND FUNDING: THE PUSH FOR ELECTRIC IN THE TPL

- Starting **in 2019**, an unprecedented series of **legislative measures** and **financing schemes were** adopted with the **aim of reducing the average age of the** Italian **bus fleet** by renewing it with **low- and zero-emission vehicles:** a record sum of **more than EUR 7.5 billion**. **More than 80 per cent of the resources** are for **alternative drive buses and** their **charging infrastructure**.
- At **European level,** important **targets** have been set regarding the **emissions of new buses sold**:
  URBAN BUSES: 90% zero-emission buses in 2030 and only zero-emission vehicles from 2035 onwards.
  EXTRA-URBAN & COACH BUSES: 45% CO2 emission reduction in 2030, 65% in 2035, 90% in 2040.
- The **resources** from the **Next Generation EU** for **vehicles** can be considered **exhausted**, however, **remains** the possibility of using them for the installation of **charging infrastructure**. Instead, it remains in place **until 2033** the **National Strategic Plan for Sustainable Mobility, which** provides for the allocation of **3.7 billion over 15 years.**
- The **Social Climate Fund**, a total investment plan worth **EUR 86 billion** (including co-financing by the member states), of which **Italy** will be the third beneficiary, will **soon be activated** with about **7 billion investments.**
- Considering **all types of power supply**, the years from 2021 onwards saw a real **boom in the volume of tendered Class I city buses:** starting with an **annual average** of **1,600 vehicles in the period 2015-2020**, the figures rose to **2,400 units in 2021, 4,000 units in 2022 and 3,700 units in 2023** (to which over 3,000 Class II were added in 2022 and over 1,000 in the following year).
- **A total of 2,326 E-buses and 165 F-buses were tendered in 2023, with** a **total investment of EUR 1.8 billion: one fifth of these vehicles** came from **CONSIP** agreements.

Executive Summary (3/5)

3

CONCRETE EXAMPLES (AND BEST PRACTICES)

- The top four Italian cities by number of zero-emission buses put out to tender in 2023 (Milan, Turin, Rome and Naples) were analysed in more detail. The **difference between the investments and targets** declared by the cities during the drafting of the **PUMS** and the **plans of the companies were** highlighted. **The latter** (more recent) plans estimate **higher investments** than the forecasts of the municipal administrations.
- Among the tenders analysed in the study, the use of **innovative solutions for managing charging in depots were studied. An effective initiative in this regard is the integration of 'smart charging' systems, both for the individual vehicle and especially for the entire fleet,** in which the power delivered to the vehicles for charging is a function of the quantity of vehicles present and the time they are parked in the depot, so as to limit the power required from the network (and thus reduce costs).
- The **consortia**, as in the case of **'full green' between ATM Milan, ANM Naples and ATAC Rome**, make possible to **share expertise** in the technical-economic field and to **collaborate on the** design of tenders for charging infrastructure.
- In addition to the tenders launched within individual cities, **Consip** (the national purchasing centre, 100% owned by the Ministry of Economy and Finance) has enabled **considerable development for the deployment of city buses**, providing assistance to companies that are unable to tender independently.

Executive Summary (4/5)

4

BUS EVOLUTION, INFRASTRUCTURE & ELECTRICAL SYSTEM

- **71% of electric vehicles** currently on the market use a **mid-engine, which** guarantees greater energy recovery and easier maintenance. As far as batteries are concerned, the lower cost of **LFP** (Lithium-Iron-Phosphate) **batteries** has enabled a **strong development** and **increasing popularity of E-buses**, with a strong increase in energy density.
- **Since 2020, there has been** a **34% increase in the maximum capacity of** 12-metre buses. As a result, the supply of E-buses with a **capacity of more than 400 kWh has increased from 3 to 27 (+800%).** Furthermore, considering the battery sector as a whole (i.e. not only for city buses applications), **the price of battery packs and cells reached $130/kWh and $95/kWh respectively in 2023**, continuing the cost reduction trend of the last decade.
- **The 'end-of-life' management of** batteries represents a **potential market opportunity for city bus companies** (total capacity of 77 GWh in 2050). Currently, **companies can already agree on** 'second-life' management **with bus manufacturers** during tenders. **Further development is expected in the** coming years from a **regulatory** point of view due to the **new European Regulation 2023/154**, which provides **more clarity in terms of battery management** (e.g. introduction of the digital battery passport) and defines **targets for battery waste collection** (e.g. 61% by the end of 2031 for light transport vehicles). From a **technical point of view,** a strong step forward is the **construction of battery recovery and treatment plants** in Italy (e.g. Cobat in Abruzzo)
- **In depots, the** technology most frequently used is **CCS2 charging** (lower investment and easier handling), with the **first trials of Megawatt Charging.** Considering all tenders analysed in the study, the construction of bus charging points with a **total capacity of 72 MW was** awarded (the start date of construction is not explicitly known), with an **average of 68 kW per bus** tendered.
- With the growing trend of electrification of all end consumption (domestic, transportation, etc.), **interventions on the national infrastructure of 3.5 billion euros are planned, increasing grid capacity by 1 GW in 2024 and an additional 4 GW by mid-2026.**

Executive Summary (5/5)

5

FLEET EVOLUTION SCENARIOS & ENERGY IMPACT

- **Fleet turnover is a slower and more gradual process than new registrations, which are constrained by European targets**. Assuming that the number of vehicles remains constant in the future (equal to 42,600 buses as indicated by MIMS) and considering an average service life of 21 years, the city bus fleet **in 2050 will be 97% zero-emission vehicles (88% e-bus and 9% f-bus)**

- In **order to achieve these values** in terms of renewing the vehicle fleet and maintaining the average age of vehicles, it will be necessary to have around **2,000 registrations per year**. This value is slightly higher but still in line with the average number of bus registrations (urban and suburban) provided by ANFIA over the last 10 years, which is 1,820 buses.

- **From an environmental** point of view, the conversion of the bus fleet will allow **a reduction of 2,393 kt of CO2 and 957 million litres of fossil fuels to be saved in 2050 compared to 2023.**

- From the point of view of the **impact on the public grid, an increase of 2.55 GW** of installed capacity for **recharging vehicles is** foreseen in **2050;** this value is however lower than the **capacity of renewable** energy sources installed in Italy in **2023, equal to 5.23 GW of photovoltaics and 488 MW of wind power**). In terms of **electricity demand, 3,412 GWh** of electricity **will be required in 2050**, which is below the **6,094 GWh of photovoltaics** (added to the **861 GWh of wind power**) **that can be generated** by the renewable energy plants installed in 2023.

- **The electrification of the city bus fleet is therefore not a problem from the point of view of overall electricity consumption**. It is also true that **an adaptation of** the network at **local** level will be **required, as far** as recharging within the **individual depot is concerned.**

Glossary of abbreviations

ABBREVIATION	EXTENDED TERM	TRANSLATION EXTENDED TERM
CNG	Compressed Natural Gas	Compressed natural gas
CRM	Critical Raw Material	Critical raw materials
DM	Ministerial Decree	Ministerial Decree
E-bus	Battery electric bus	Battery Electric Bus
F-bus	Fuel cell electric bus	Electric fuel cell bus
FC	Fuel Cell	Fuel cell
LNG	Liquefied Natural Gas	Liquefied natural gas
LFP	Lithium Iron Phosphate	Iron phosphate and lithium
OEM	Original Equipment Manufacturer	Original equipment manufacturer
LPT	Local Public Transport	Local Public Transport
YoY	Year-over-Year	On an annual basis
ZE	Zero Emission	Zero emissions
ZTL	Restricted Traffic Zone	Restricted Traffic Zone

MOTUS-E

Contents

Bus market development - Europe

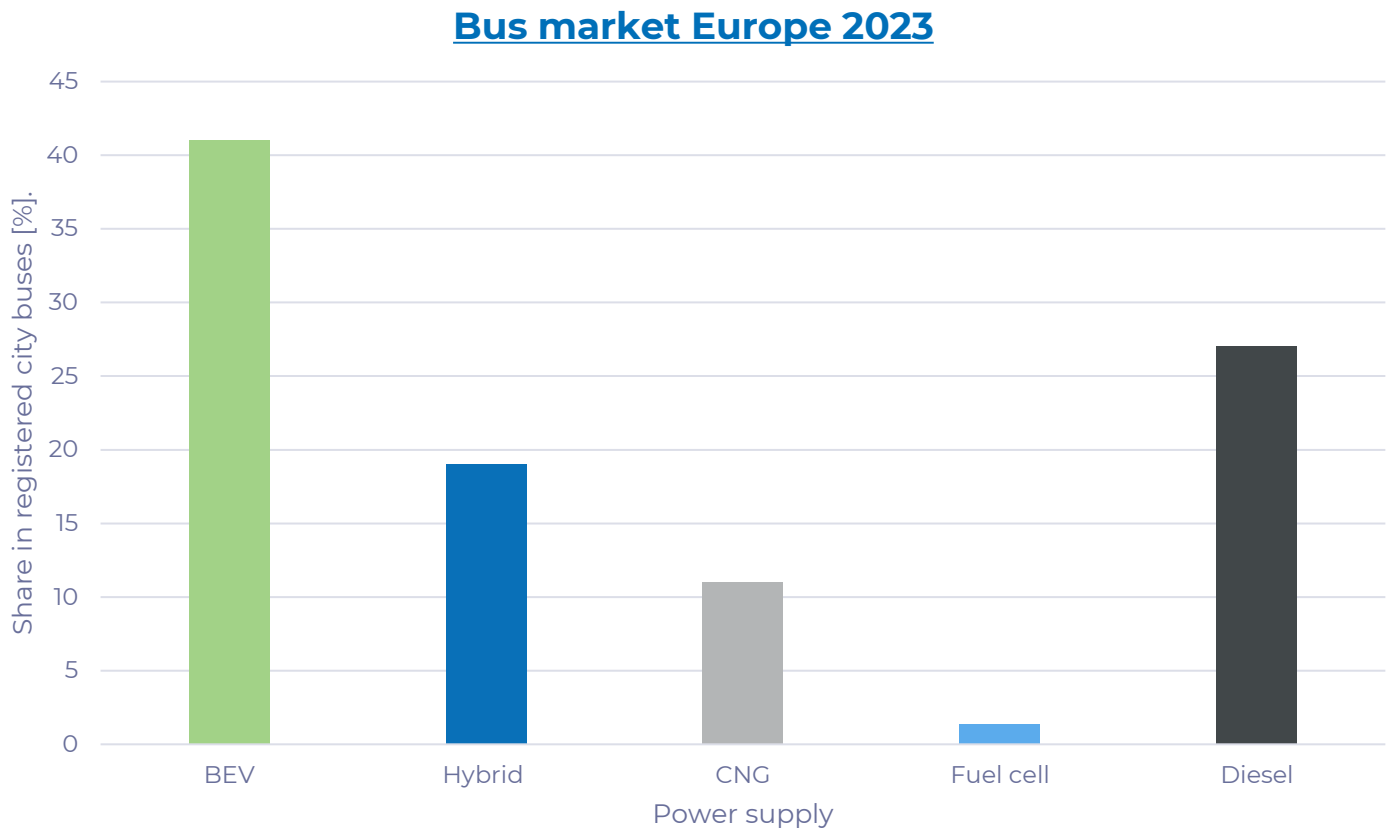
Credits: iStock

Bus market Europe

The European city bus market has recently seen **conspicuous growth in alternative drive** and a concomitant gradual **decrease** in **diesel bus registrations.**

Alternative drives will account for 73 per cent of the European[1] city bus **market in** 2023 (in 2020 this figure was 53 per cent).

The share of E-buses is higher than that of diesel vehicles, but not if you add up diesel and hybrids (mostly mild hybrids).



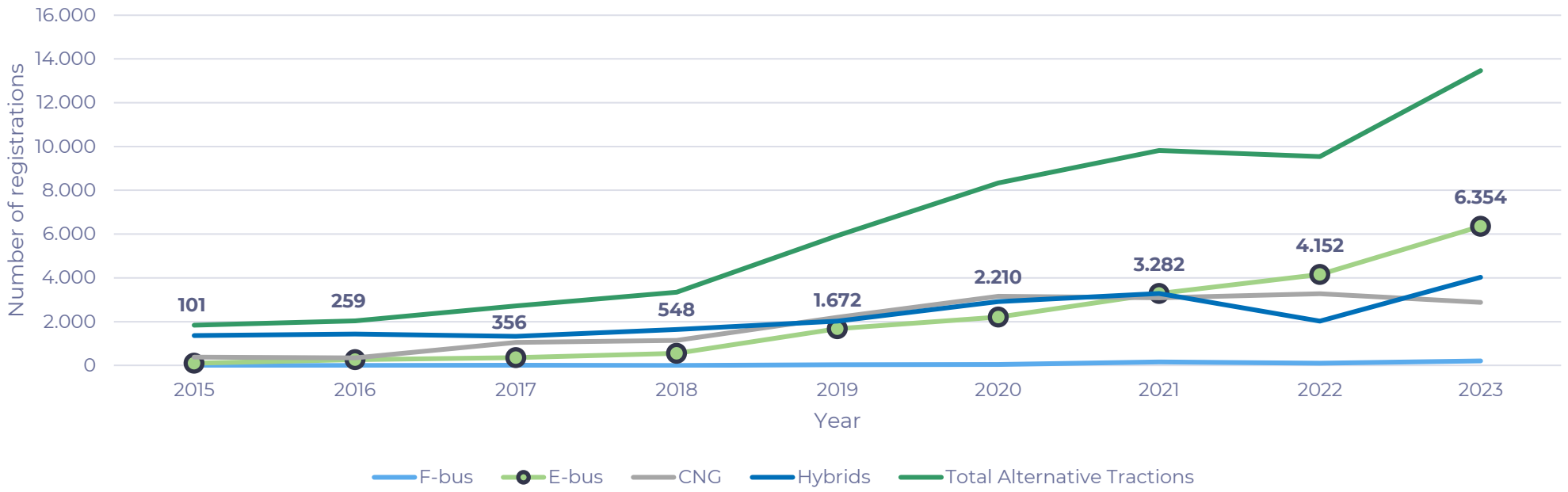
[1] EU27+UK+ICE+NO+CH
Source: Sustainable Bus elaboration on Chatrou CME Solutions data

European bus market - Alternative drives

A look at the **alternative drive** types as a whole and the evolution of registered volumes shows that **E-buses have been growing steadily for ten years now**. The trend of the other fuel types is very fragmented, while the numbers of the fuel cell market still remain particularly limited.

E-bus registrations above 8 tonnes.

Years 2012-2019: Western Europe + Poland / Years 2020-2023: EU27+UK+ICE+NO+CH



Source: Sustainable Bus elaborations on Chatrou CME Solutions data for battery-electric buses > 8 tonnes

Bus market Europe - E-bus

The **technology used by E-buses** can provide **greater efficiency compared to fuel cell** vehicles, making all-electric battery vehicles the **most promising solution** among **'zero-emission'** vehicles to achieve a reduction in emissions from the transport sector.

The **advantages of** this technology **over fuel cell** vehicles are also the **lower cost of the vehicles** and the **easier installation of charging infrastructure.**

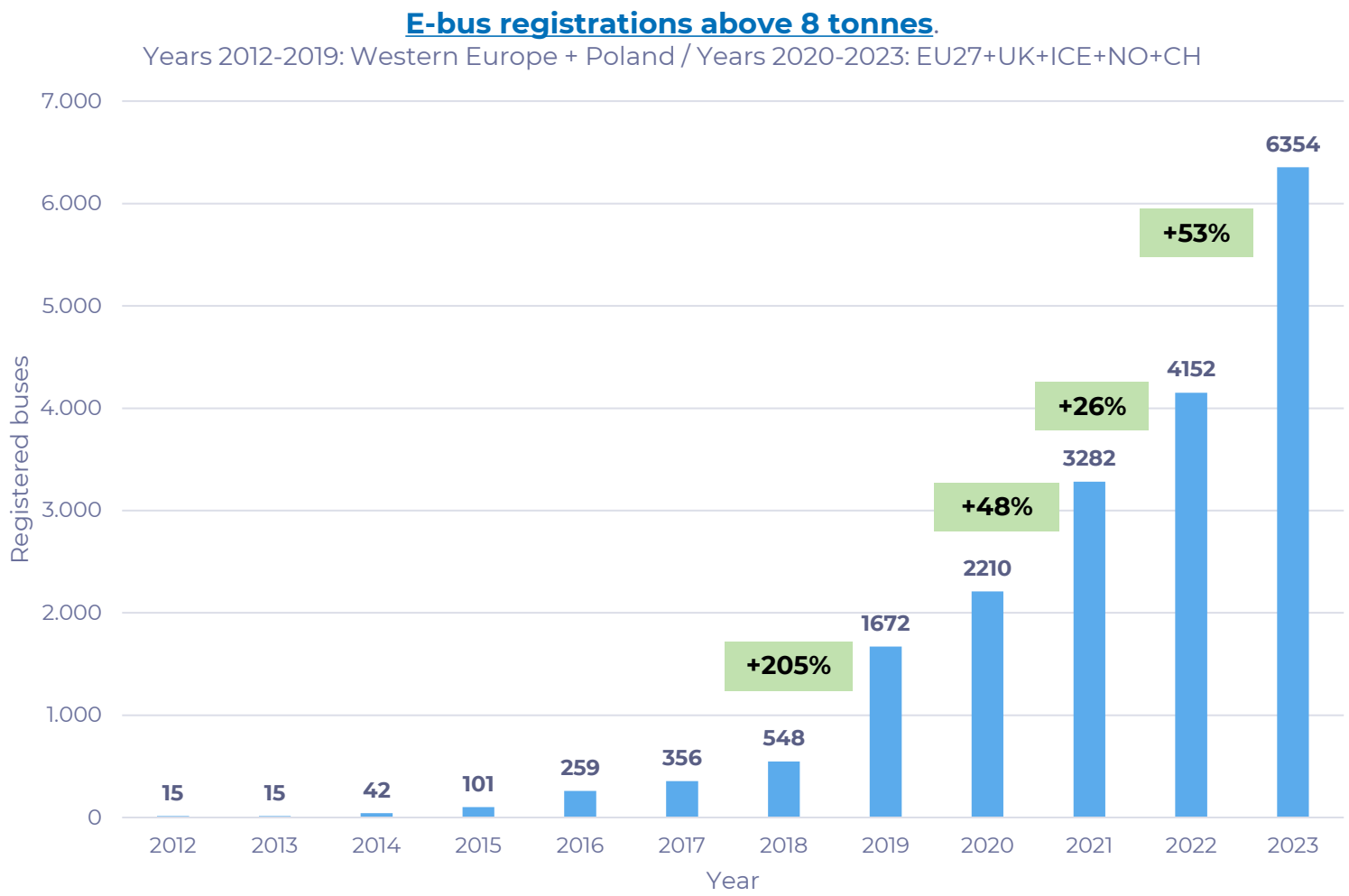
Details on the European development of the E-bus market follow in the next slides

Bus market Europe - The spread of E-buses

The share of **electric bus within the urban bus registration** has multiplied by 3.5 over five years: **from 12% in 2019 to 40% in 2023** (higher than the 22.5% share set by the Clean Vehicles Directive).

From 2012 to 2023, **more than 19,000 E-buses have been** registered in Europe, more than half of them in the period 2022-2023.

From 2016 onwards, with the exception of 2022 alone, the **market** has been **growing** at over **40% year-on-year**.



Source: Sustainable Bus elaboration on Chatrou CME Solutions data for battery-electric buses > 8 tonnes
Note: The YoY trend between the years 2019 and 2020 is not reported due to differences in the areas considered

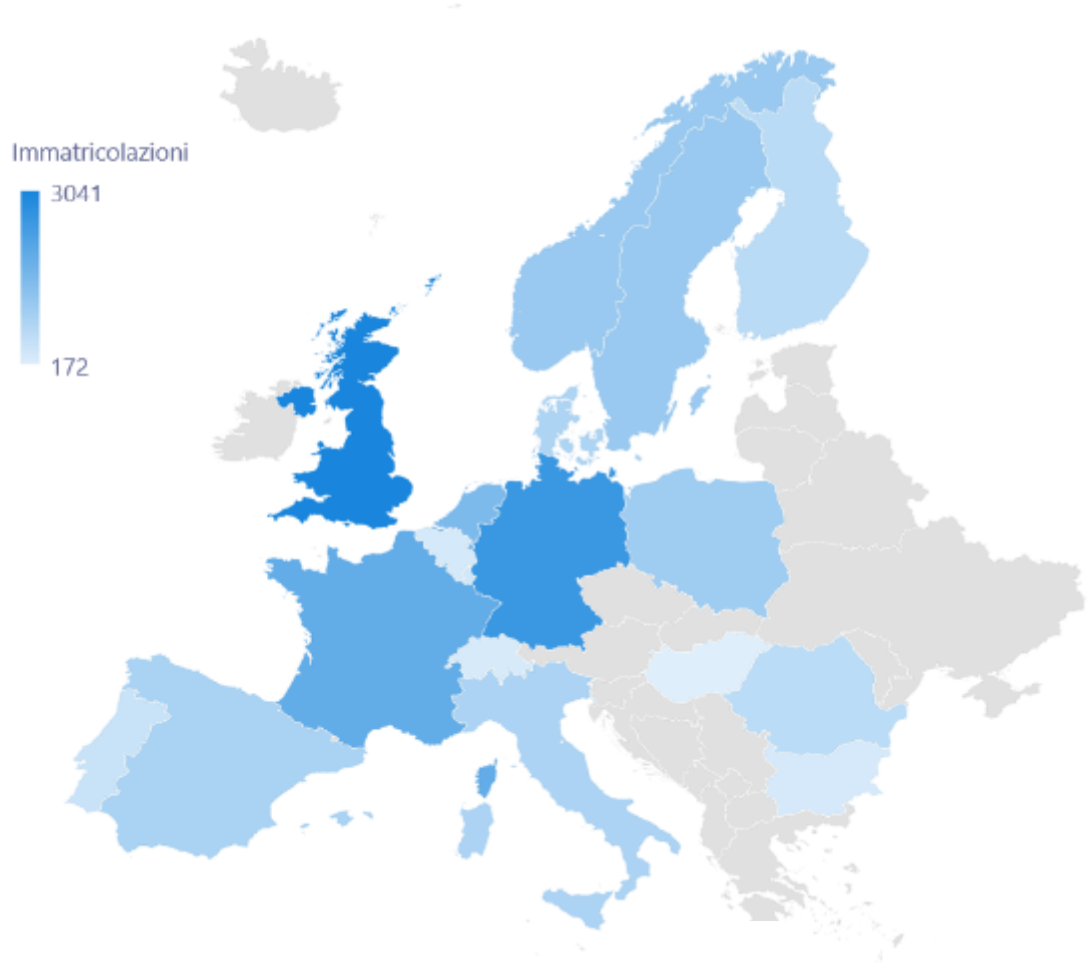
Bus market Europe - National E-bus distribution

Considering the **distribution of E-bus registrations across** EU nations from 2012 to the end of 2023, the **United Kingdom** represents the **largest market, followed by Germany.**

Within this ranking, **Italy ranks ninth with 908 e-buses** registered from 2012 to 2023 (trolley buses are not counted).

E-bus registrations above 8 tonnes divided by country

Years 2012-2019: Western Europe + Poland / Years 2020-2023: EU27+UK+ICE+NO+CH



Source: Sustainable Bus elaborations on Chatrou CME Solutions data for battery-electric buses > 8 tonnes

Bus market Europe - Annual E-bus trend by country

Focusing on the **trend in recent years, the UK and Germany** show a **steady increase in the number number of registrations**, placing themselves always at the top ranking of European nations.

As far as **Italy and Spain**, following the 'contained' values until 2022, a **strong increase** in **registrations can be** noted during **2023.**

France bucked the trend, where, on the other hand, **2023 was** marked by a **reduction in** E-bus **registrations.**

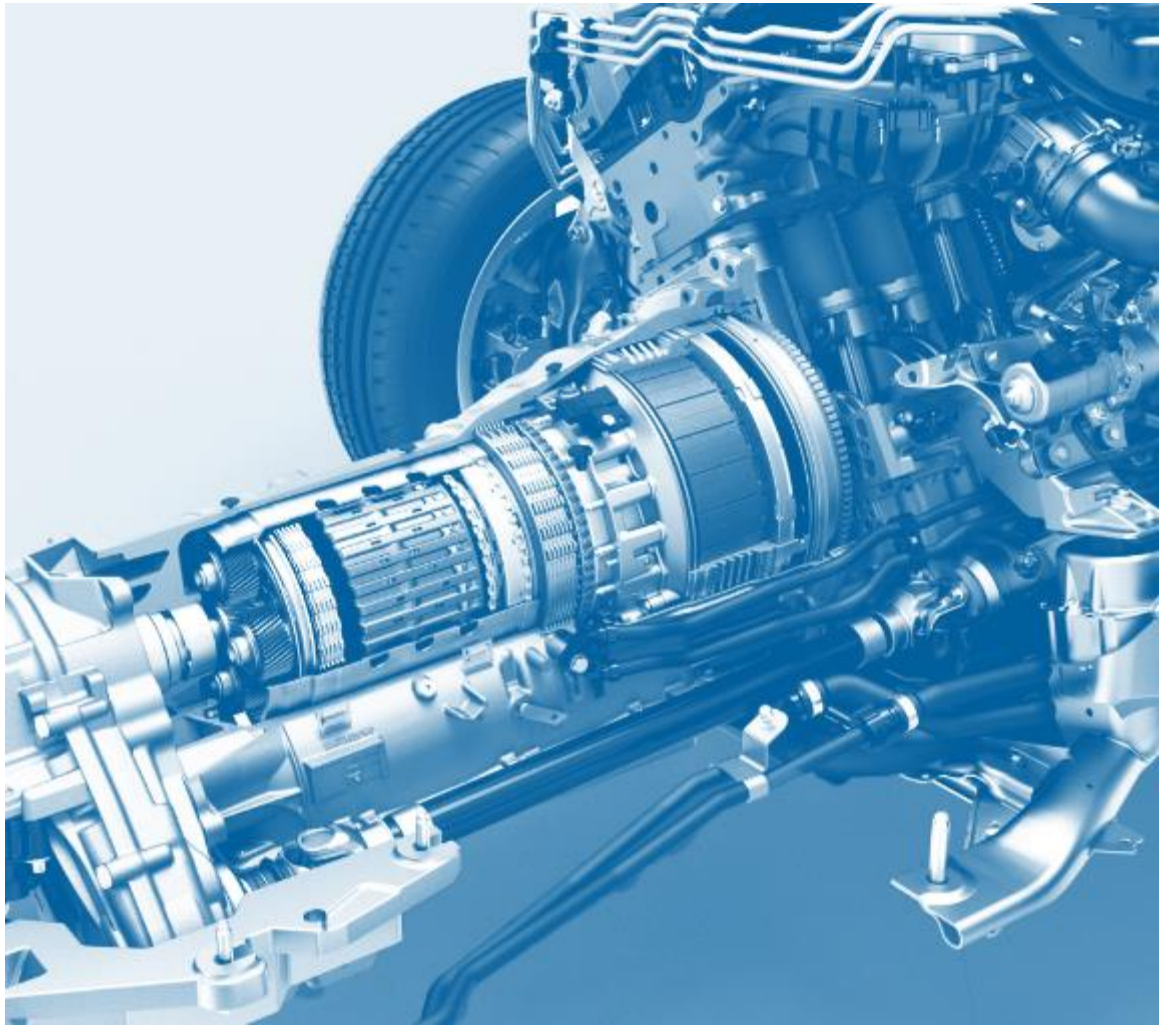
Source: Sustainable Bus elaborations on Chatrou CME Solutions data for battery-electric buses > 8 tonnes

Bus market Europe - Hybrid

Within 'hybrid' technology, there is the distinction between:
Mild hybrid: electric motor to support the heat engine (e.g. in restarts).
Full hybrid: The vehicle can run (for short distances) on the electric motor alone.

Significant increase in registered 2023 (+100% over 2022) contrasts with the phase-out of plug-in and full hybrid models in the list of leading manufacturers.

The growth is driven **by the massive adoption of mild hybrid buses**, used as an alternative **'bridge' technology** to diesel by many operators at an early stage in the infrastructure and planning of the decarbonisation of the fleet.



Credits: Deakerlink.co.uk

European bus market - CNG/LNG

The market for buses using **liquid gas (LNG)** or **compressed (CNG)** has some **substantial differences.** Where **LNG**, a technology widespread in **trucks**, has seen extremely **low and limited penetration**, **CNG** experienced years of **growth from 2016 to 2020, only** to **then** find itself in a **stalemate of the market**.

The **low uptake of LNG** can be traced back to to the need to install **dedicated recharging infrastructure**, with **uncertainty of return on investment in** a phase of rapid transition to zero-emission technologies.

The **Italian market** positioned in 2023 **counter-trend**: registrations of CNG buses **grew by 113%** (706 vehicles over 8 tonnes against 331 in 2022).

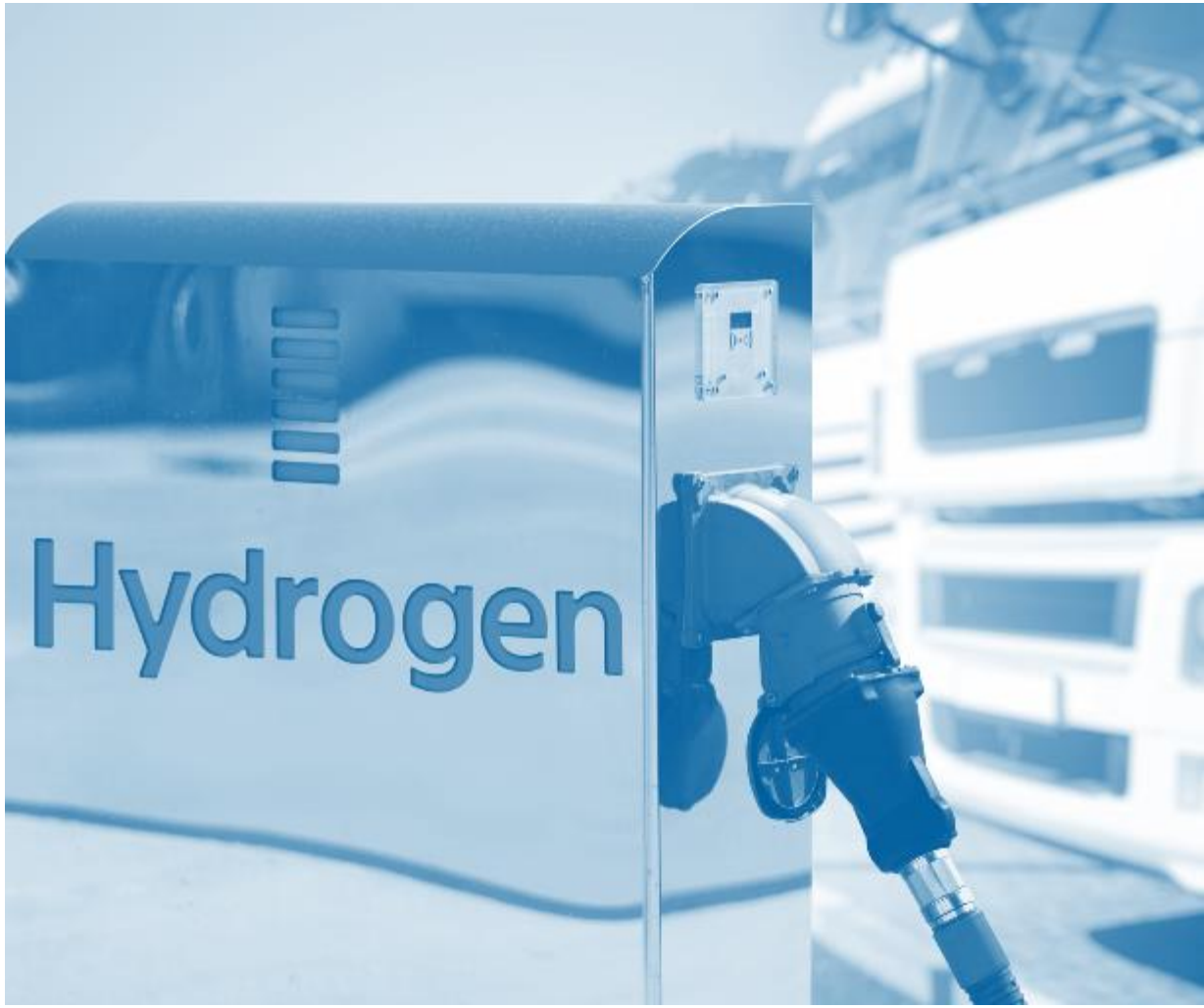
Credits: iStock

Bus market Europe - Hydrogen

An alternative among 'zero-emission' technologies is the F-bus, in which hydrogen is used by fuel cells that power an electric motor. Due to **issues** such as hydrogen **storage** and **the high cost of** refuelling of green hydrogen, the penetration of **fuel cell technology remains extremely limited** and subject to fluctuating trends.

2023 saw a significant exploit in terms of **growth** (207 registrations, +109% YoY), **mainly attributable to the German market**.

In Italy, 0 hydrogen-powered buses were registered in 2023. With regard to the 2023 tenders for zero-emission buses, hydrogen buses account for 6% (details in the following slides).

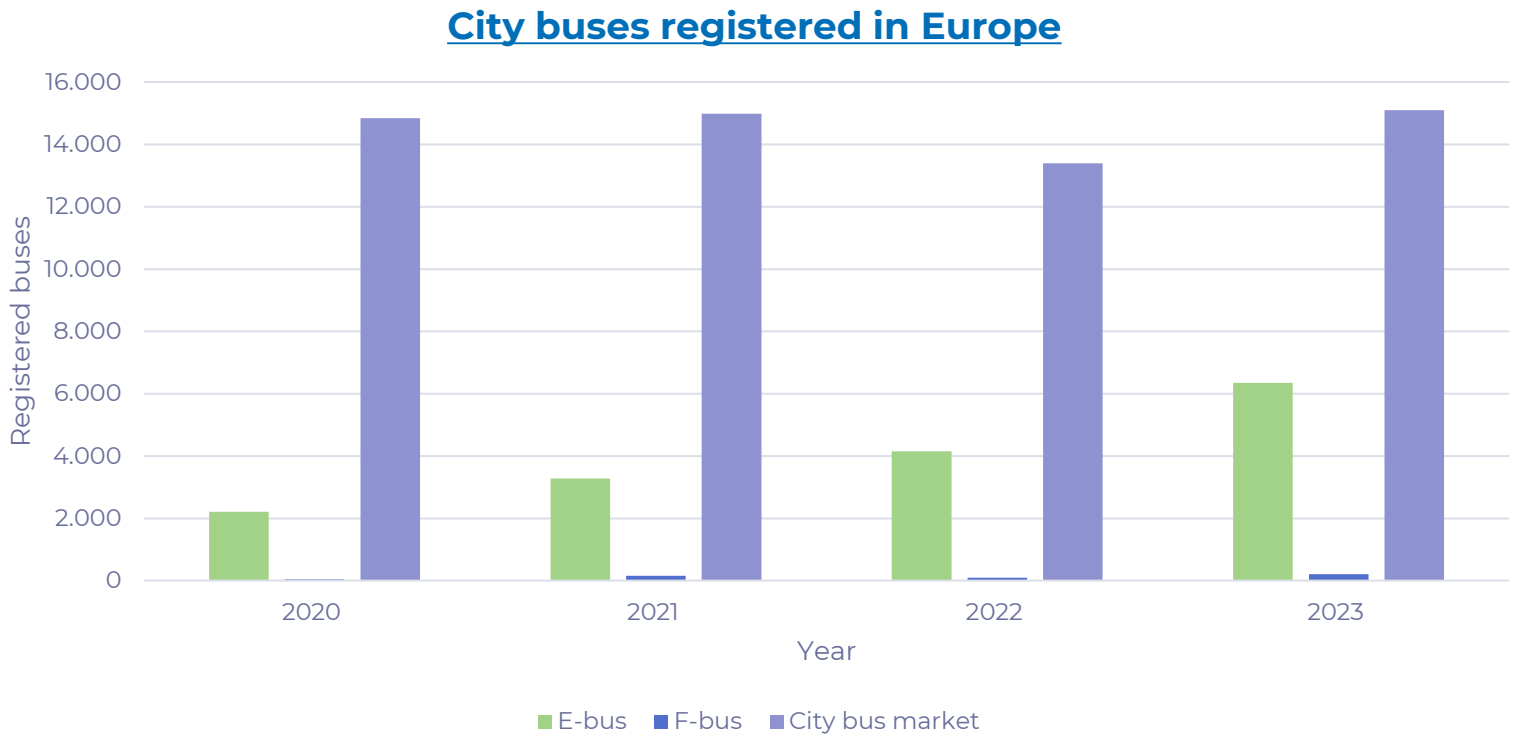


Credits: iStock

Bus market Europe - Hydrogen

Over the past five years, the fuel cell bus segment has had a **'weight' equivalent to** 3% of the zero-emission bus segment.

With a specific focus on 2023, **E-buses** covered more than **40%** of the market, while the share of **F-buses** was **1.3%.**

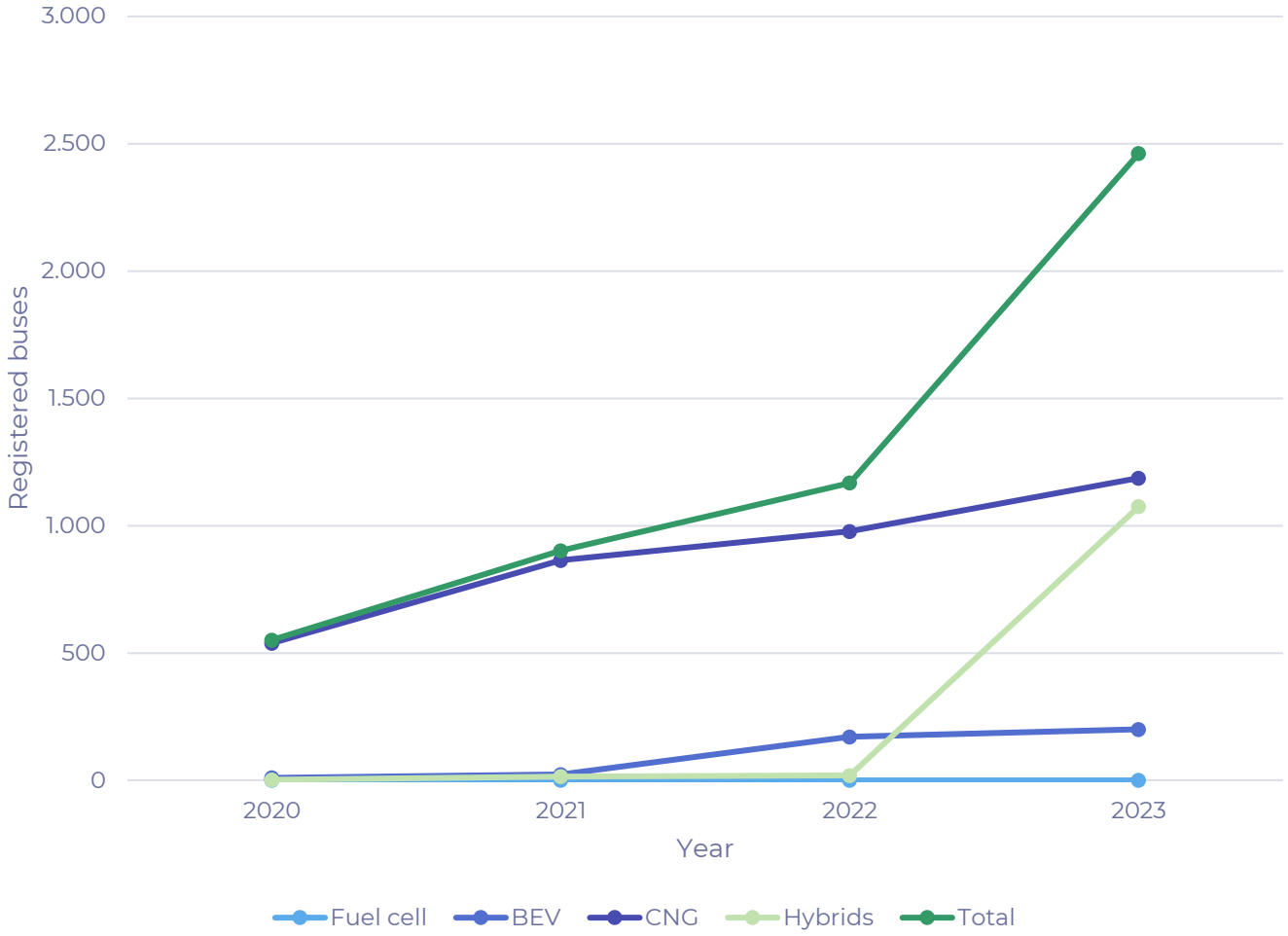


Source: Sustainable Bus elaborations on Chatrou CME Solutions data for battery-electric buses > 8 tonnes

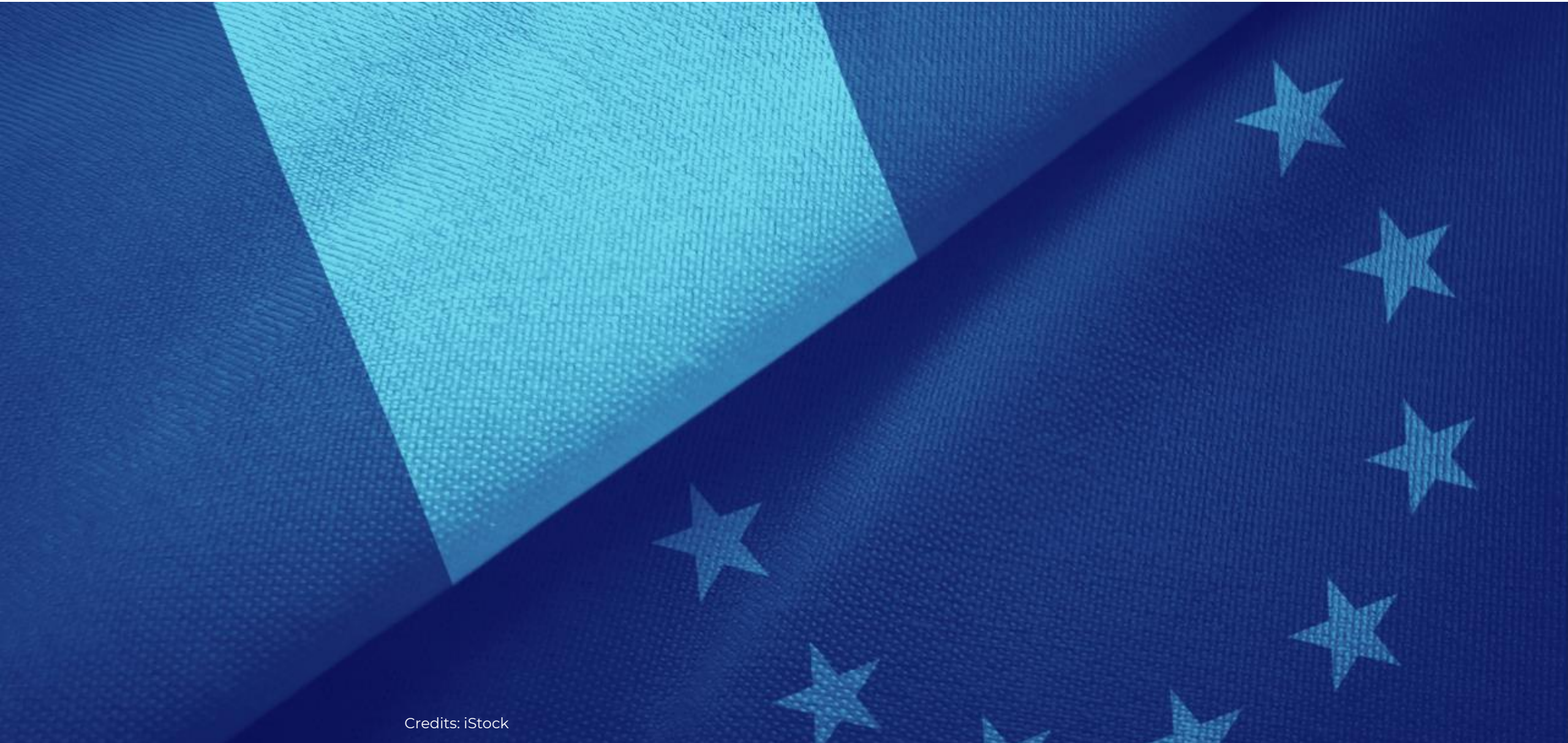
European bus market - Alternative drives in Class II?

To date, the development of the **electric bus** market in Europe **only concerns the city bus segment**. **Intercity** vehicles fall into the **'heavy-duty' category** subject to the emission reduction roadmap currently being negotiated in Brussels (and not to the quotas of the Clean Vehicle Directive).

Alternative tractions gain in each case volumes from year to year. **As far as CNG is concerned, growth in the extra-urban area is in** contrast to the stall in Class I. The spread of **mild hybrid** engines also on the Class II has decreed **a significant increase in** registrations in 2023.



Bus market development - Italy

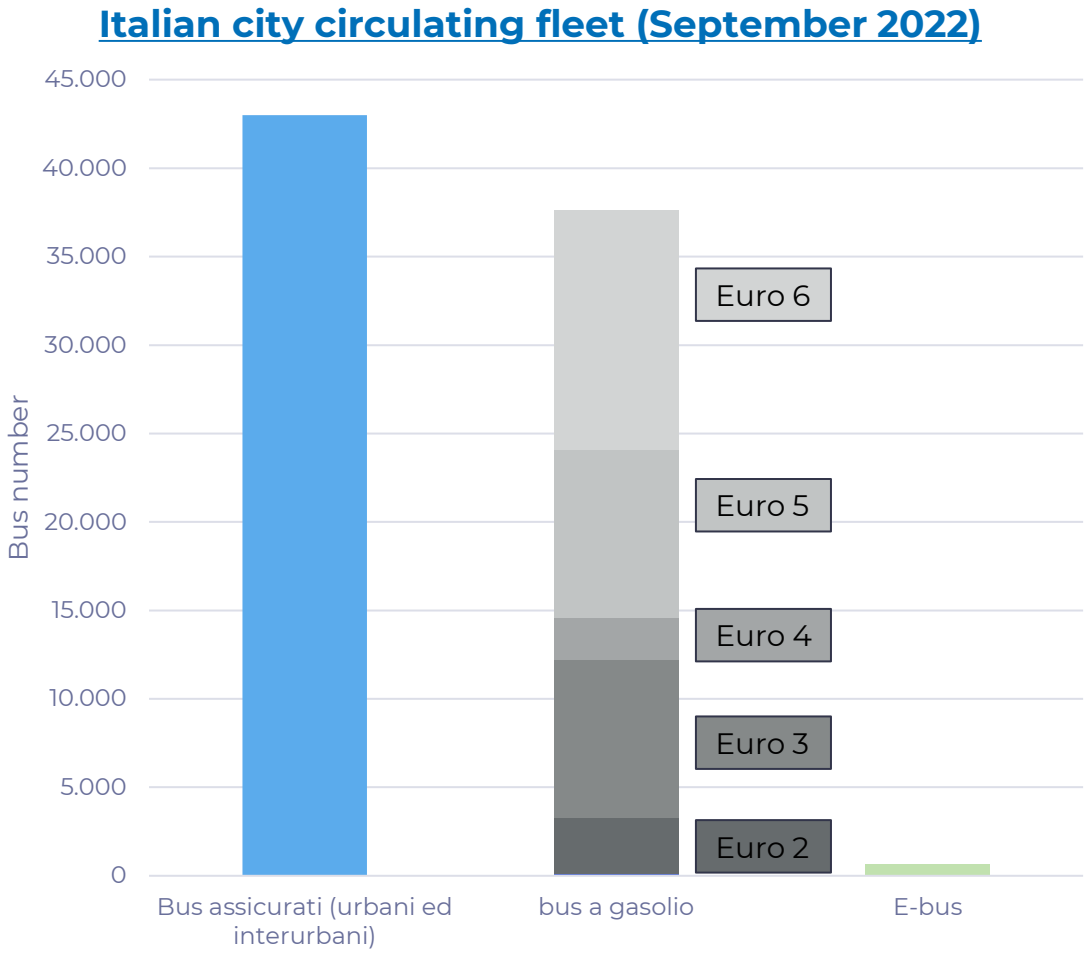


Credits: iStock

Bus market Italy - Fleet supply

The most up-to-date 'snapshot' of the Italian bus fleet in circulation is the one taken by the then «Motorizzazione Civile» with data as of **30 September 2022**. On that date, of the **43,001 buses (urban and suburban)** circulating in Italy, **90 per cent were powered by diesel**. **Zero-emission buses**, mostly E-buses**, amounted to 621 units**, or **1.5% of the fleet**.

The sum of the **Euro 2 and Euro 3 categories**, both of which will be banned from 2025 following an extension, **is 8,700 vehicles**, according to MIT data processed by ANAV (7,100 Euro 3 and 1,600 Euro 2) and updated to October 2023. This is **more than 20% of the entire bus fleet**.

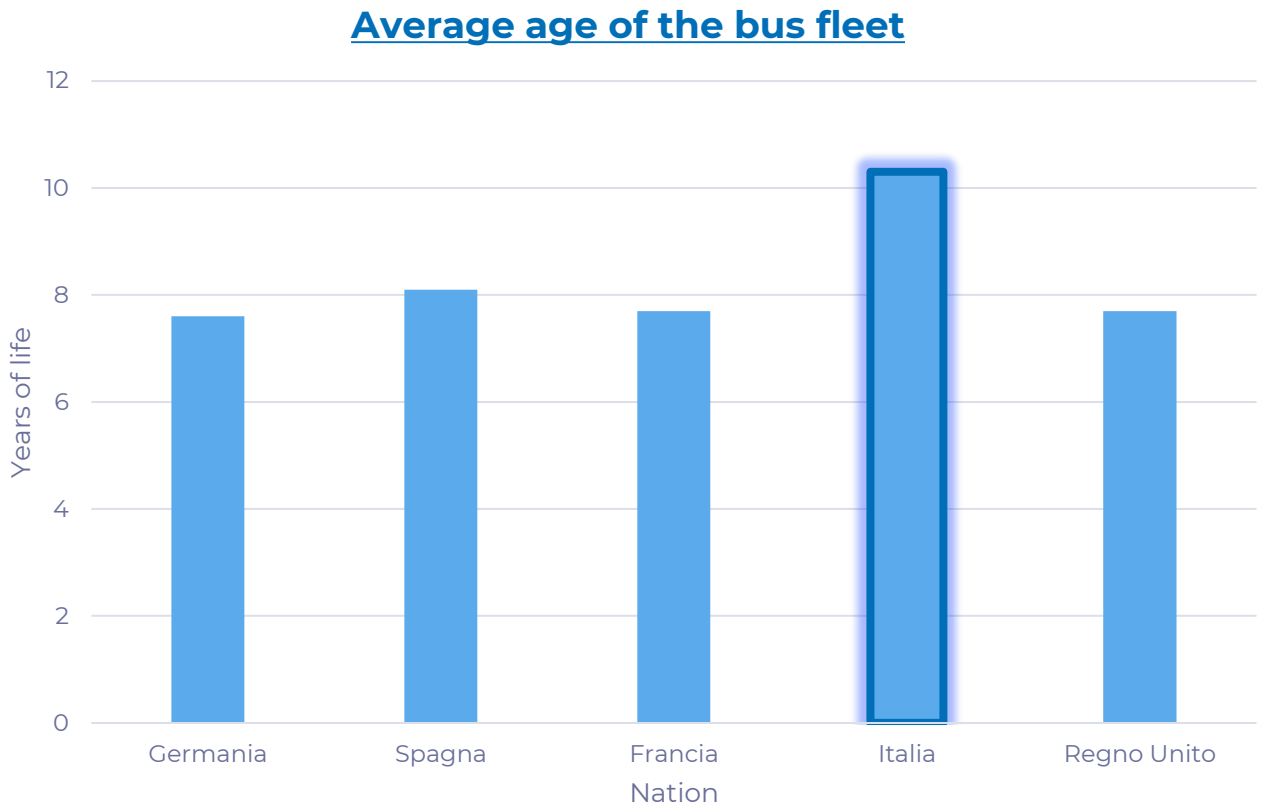


Source: Number of insuring buses & power supply: MIMS - Motorizzazione Civile data updated as of September 2022
Number of Euro 2-3 buses: ANAV processing of MIT data updated to October 2023

Italian bus market - Average fleet age

The average age of the insured fleet is 10.3 years, with Friuli-Venezia-Giulia, the autonomous province of Bolzano, Valle d'Aosta, Lazio, Campania and Lombardia leading the 'ranking' of the 'youngest' fleet.

Referring to the most recent data of June 2023, the **Italian** fleet is **33 % older** than the **average of the other four main European markets**.



Bus market Italy - The spread of E-buses

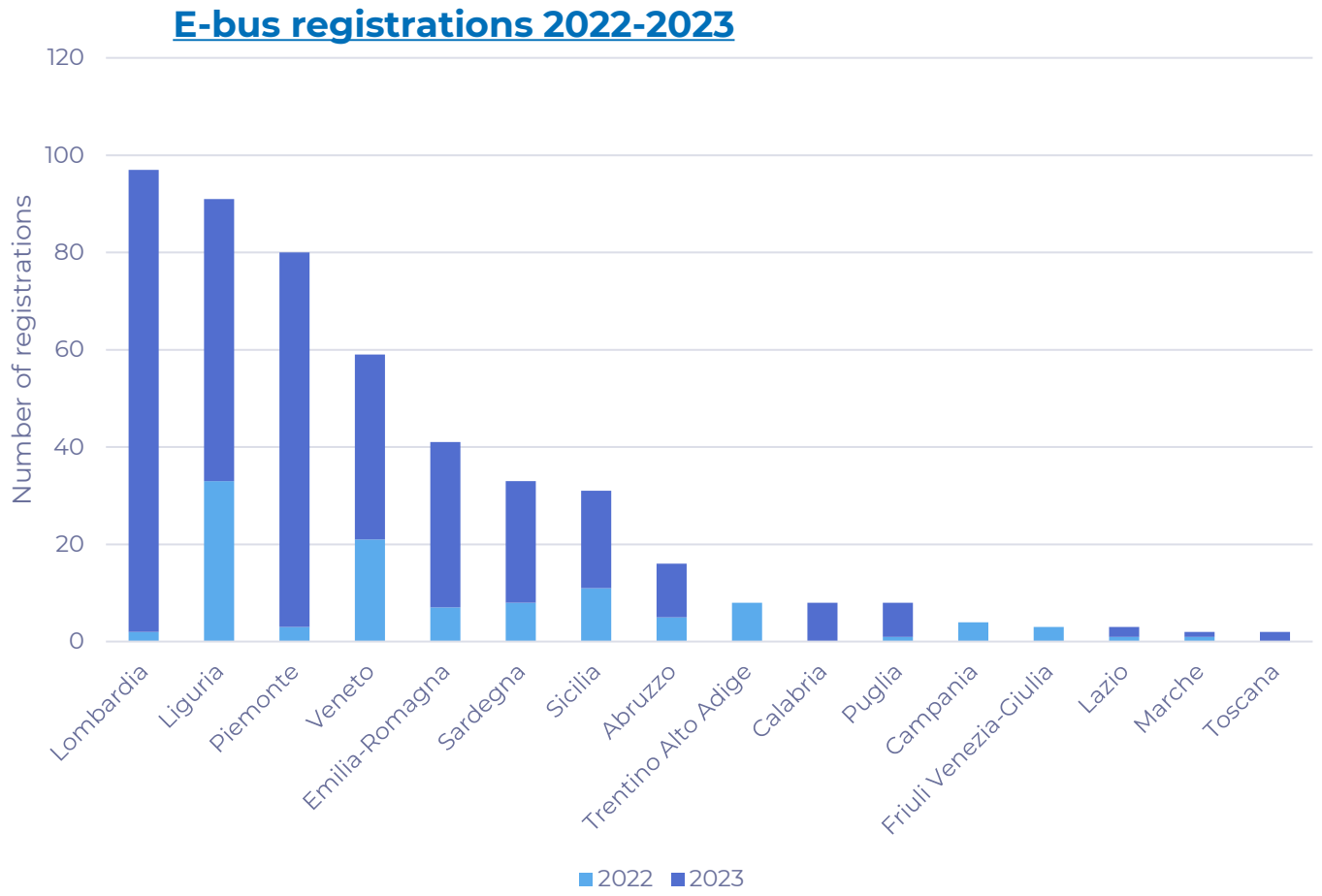
The **Italian E-bus market experienced a 250% increase in registrations in 2023**. Where the **share of electrics in** the overall **market** in Class I was only 15% in 2022 (below the share required by the Clean Vehicle Directive, which in any case focuses on vehicles put out to tender and not on registered vehicles), in **2023 increased by more than ten percentage points to 27.5 per cent.**

Year	Registered E-buses	Trend registered YoY	Class I registrations	Share e-bus on urban registration
2023	378	250%	1.374	27,5%
2022	108	-39%	710	15%
2021	178	+83%	853	20,8
2020	97		947	10,2%

Bus market Italy - Regional E-bus distribution

Looking at the **Italian E-bus registration of the two-year period 2022 - 2023**, **79%** of vehicles were **registered in the northern regions.**

Despite the case of some 'virtuous' southern regions in the year 2022 (such as Sicilia and Campania), the number of registrations in 2023 marked the strong growth of regions such as Lombardy, Piemonte, Liguria and Veneto

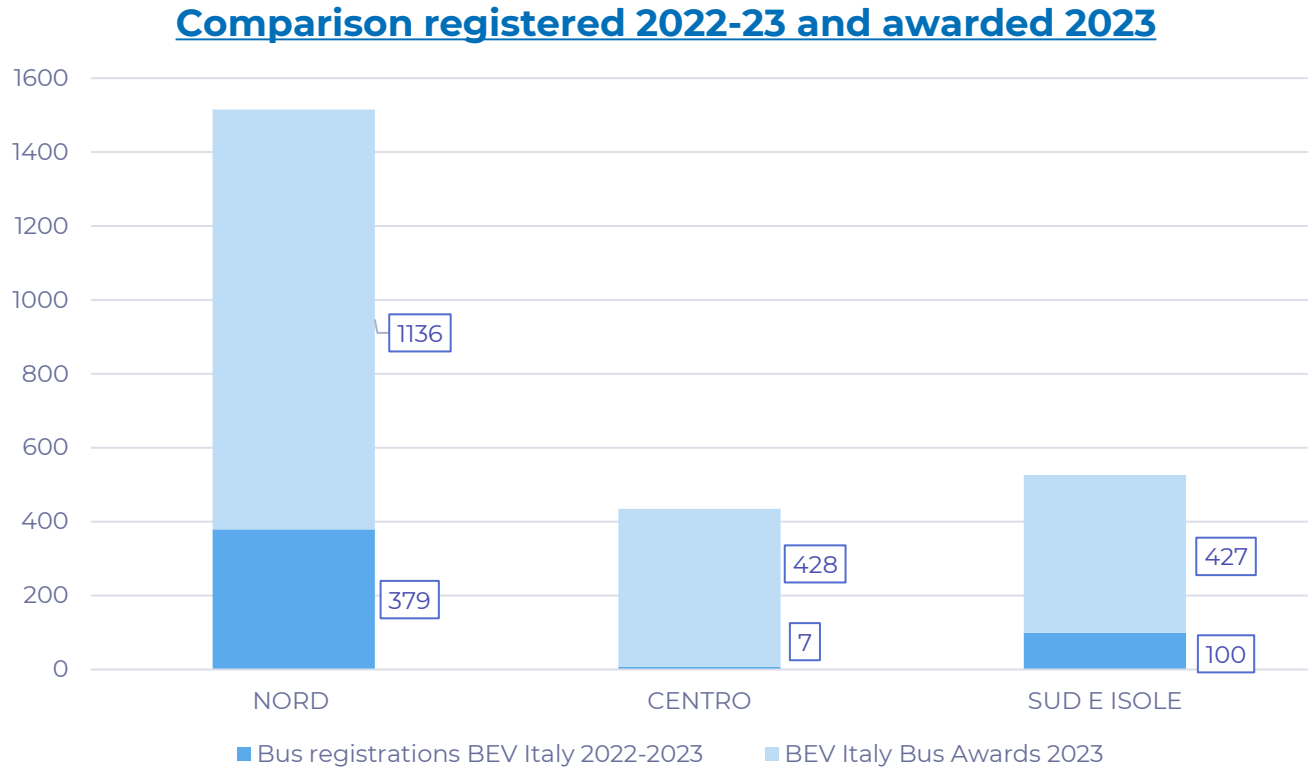


Source: Anfia data (2023) Italian registrations - Statistical data - ANFIA - Associazione Nazionale Filiera Industria Automobilistica

Bus market Italy - E-buses registered & awarded

On the other hand, if we also consider **tenders awarded in 2023** (more on this in the following chapters), a **more balanced distribution of vehicles** can be seen.

Although again the **leading sector is that of** companies in **northern** Italy, the tenders awarded by **ATAC Roma in central Italy** and **ANM Naples in the south** ensure a **greater redistribution over the** Italian **territory.** (Focus in detail in Chapter 3)



Source: Anfia data (2023) Italian registrations - Statistical data - ANFIA - Associazione Nazionale Filiera Industria Automobilistica

Italian bus market - Regional disparity registered

The geographical breakdown of the registered vehicles shows that **Lombaria and Piemonte together cover 42% of the registered vehicles in 2023**, highlighting how the transition to electric mobility remains, to date, a fragmented landscape where the trend lines are determined **by the fleet evolution strategies of some specific metropolitan areas** (and their specific weight in terms of volumes).

Milan's 85 units are followed by 74 Turin and Genoa's 44: **more than half of the 2023 registration is the prerogative of the cities in the 'industrial triangle'**.

MOTUS-E

Contents

The regulatory framework and funding

Credits: Unsplash

The regulatory framework

Starting **in 2019**, **an unprecedented series** of legislative **measures** and funding schemes was adopted with the **aim of reducing the average age of the** Italian **bus fleet** by renewing it with **low- and zero-emission vehicles**.

2019

- **DPCM 30/4/2019:** Stop co-financing for diesel buses
- **DL 34/20 Relaunch:** Start of the National Strategic Plan for Sustainable Mobility

2020

- **DL 34/20 Relaunch:** Obligation to purchase alternative buses postponed to mid-2021. Suspension of co-financing obligation until 31 December 2024 (subsequently postponed sine die by Art. 7-sexies of DL 68/2022 (Infrastructure-ter)

2021

- **DM 530/21:** EUR 1.915 billion from PNRR for renewal of city bus fleets with ZE vehicles
- **DM 315/21:** Complementary PNRR: EUR 600 million for intercity buses BEV, FCEV, CNG (or LNG)
- **DM 478/21:** 300 million from PNRR for national bus chain R&D projects through development contracts
- **Clean Vehicle Directive** implemented: 22.5 per cent EZ buses in public tenders (32.5 from 2026)

2023

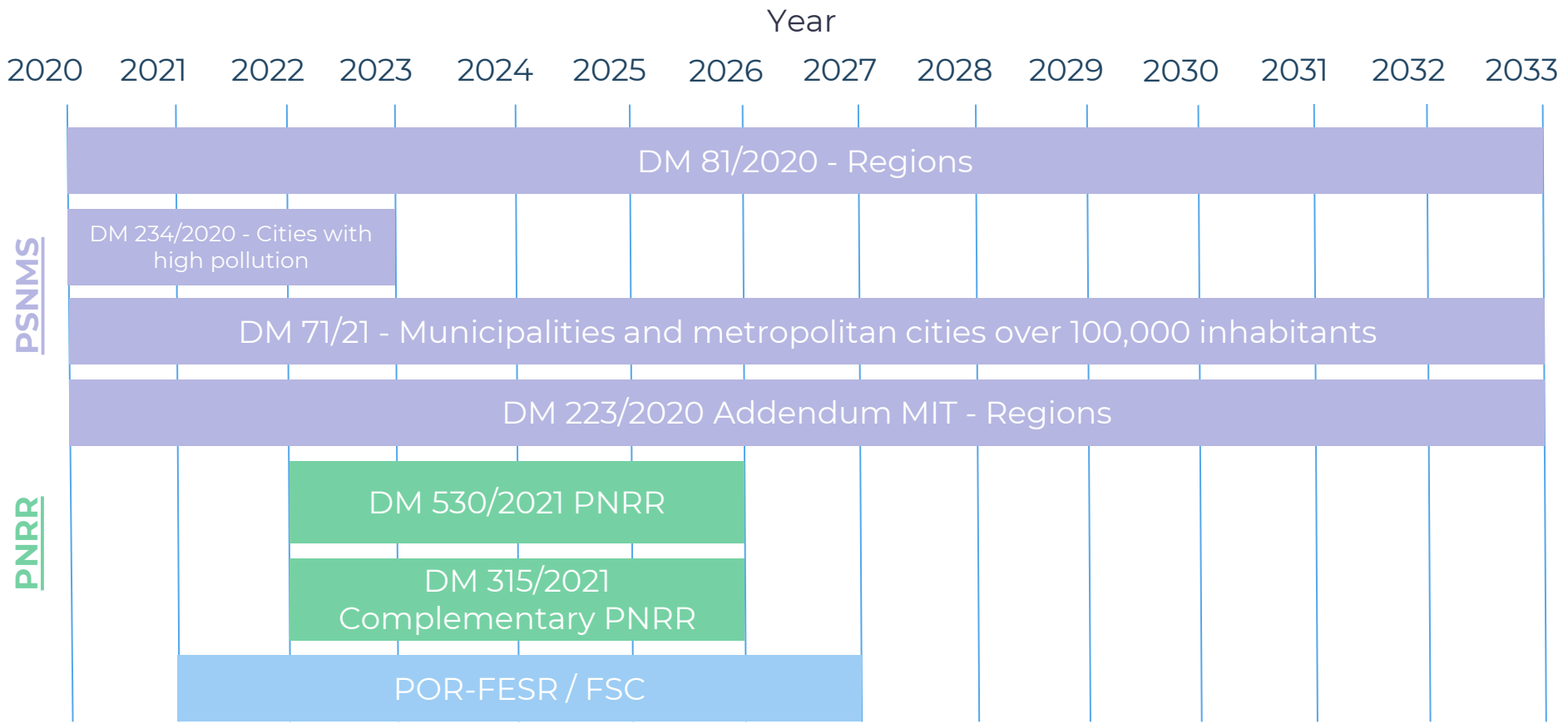
- **MIT Executive Decree No. 241 of 29/12/2023**: The resources allocated to the regions must be used as a priority to replace Euro 2 and Euro 3 buses
- **DPCM 11/12/2023:** PNSMS resources can also be used for alternative suburban buses

2024 - expected

- EU ratification of new emission reduction targets for heavy-duty vehicles

Funding

A record amount of more than EUR 7.5 billion is up for grabs. **More than 80 per cent of the resources are for alternative drive buses** and their charging infrastructure.



INVESTMENT (of which for Alternative transactions)
2,200 Mln€ (2,200 Mln€)
1,216 Mln€ (1,216 Mln€)
398 Mln€ (398 Mln€)
379.9 Mln€ (0 Mln€)
1,915 Mln€ (1,915 Mln€)
600 Mln€ (600 Mln€)
900 Mln€ (0 Mln€)

Euro 2/3 phase-out and heavy-duty emission outlook

The Euro 2 and 3 phase-out imperative

From 1 January 2024, European, national and regional resources allocated to the regions for the renewal of the LPT bus fleet must be **used as a priority for the replacement of Euro 2 and Euro 3 buses.**

European new car CO2 emission reduction targets

URBAN BUSES

2030: **90% of** new buses will be **zero-emission**
2035: new vehicles registered **completely zero-emission**

SUBURBAN BUSES & COACHES

More gradual reduction of CO2 emissions of newly registered cars:
45% in 2030
65% in 2035
90% to 2040

Source: COUNCIL OF THE EU (2024): Heavy-duty vehicles: Council signs off on stricter CO2 emission standards - Consilium (europa.eu)

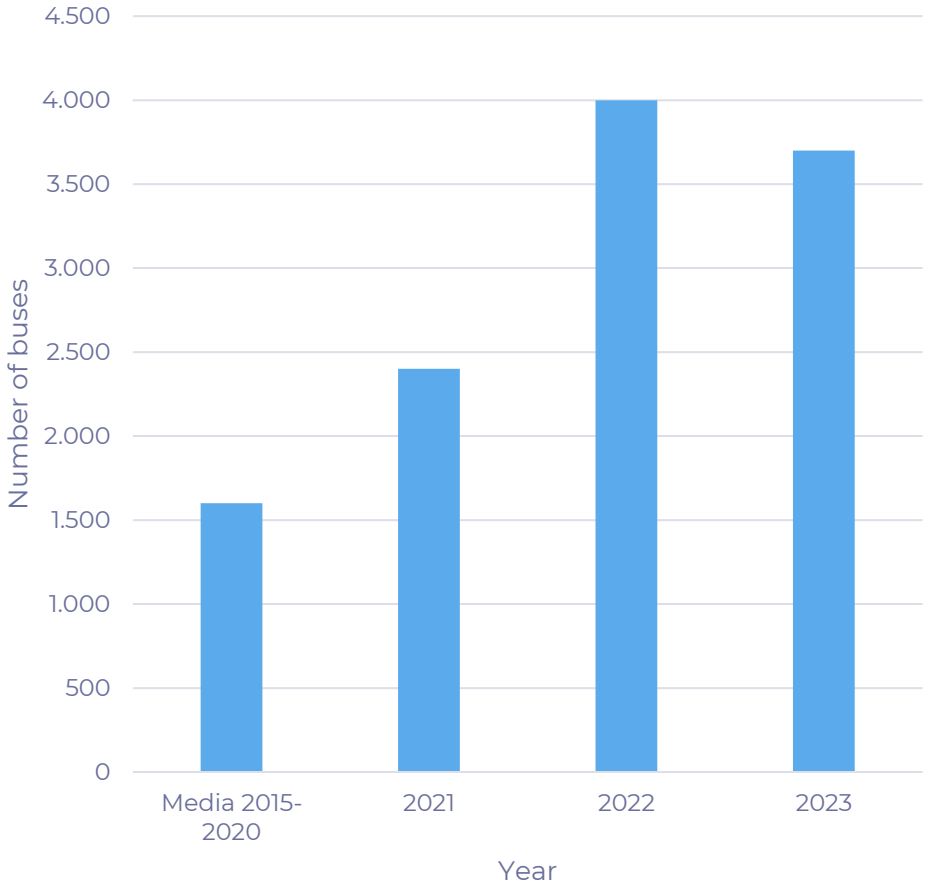
Tenders at city level and beyond

The years from 2021 onwards saw a sharp increase **in the volume of city buses put out to tender**.

In the **period 2015 - 2020,** the **average number of** Class I **vehicles** put out to tender in our country was **around 1,600**. **2021** saw around **2,400 units put out** to tender.

The following two-year period 2022 - 2023 saw an explosion in volumes due to the resources injected by the EU and the extremely strict timeframes for contracting (as discussed below). Consequently, **2022 and 2023** respectively saw **Class I volumes** of **4,000 and 3,700** (joined by over 3,000 Class II in 2022 and over 1,000 in the following year).

City buses put out to tender in Italy



The regulatory framework and funding

Considerations

In light of the strict timeframe of the PNRR (contractualisation for the purchase of buses by 31 December 2023), as far as vehicles are concerned, the **resources from the Next Generation EU** can be considered **exhausted.** The possibility **remains** to draw on for **the deployment of recharging** (by mid-2026). PSNMS resources for high-pollution municipalities (1.2 billion from DM 234/2020), available until 2023, are also exhausted.

It remains in place, until 2033 the National Strategic Plan for Sustainable Mobility, except for the 1.2 billion from DM 234/2020. The funds are disbursed annually. After the first five-year period ends in 2024**, 1.7 billion is available** for the purchase of alternative drive buses. Resources which, **considering the indefinite postponement of the co-financing obligation**, will be sufficient to purchase an estimated **350 to 400 e-buses per year**.

The future of post-2026 funding remains an unknown. The **Social Climate Fund** will soon be activated at European level. The financing plan will be worth **EUR 65 billion (86 including** 25 per cent **co-financing by** member states). **Italy will be the third beneficiary** after Poland and France with about **7 billion** for investments in energy efficiency in buildings, decarbonisation of transport (including LPT) and income support.

Tenders - Overview

Tenders distribution 2023 in Italy

ATAP Pordenone
6 E-bus
4.76 Mln€

MOM Treviso
21 E-bus
13.3 Mln€
SVT Vicenza
16 E-bus
19 Mln€

TPER Bologna
127 F-bus
129 Mln€
START ROMAGNA
114 E-bus
107 Mln€

GTT Turin
280 E-bus
178 Mln€

ATM Milan
258 E-bus
162 Mln€
ATB Bergamo
15 E-bus
14 Mln€
ATB Bergamo
11 E-bus
8.8 Mln€
APAM Mantua
5 F-bus
3.2 Mln€
APAM Mantua
4 E-bus
2 Mln€

TUA Abruzzo
4 E-bus
2 Mln€

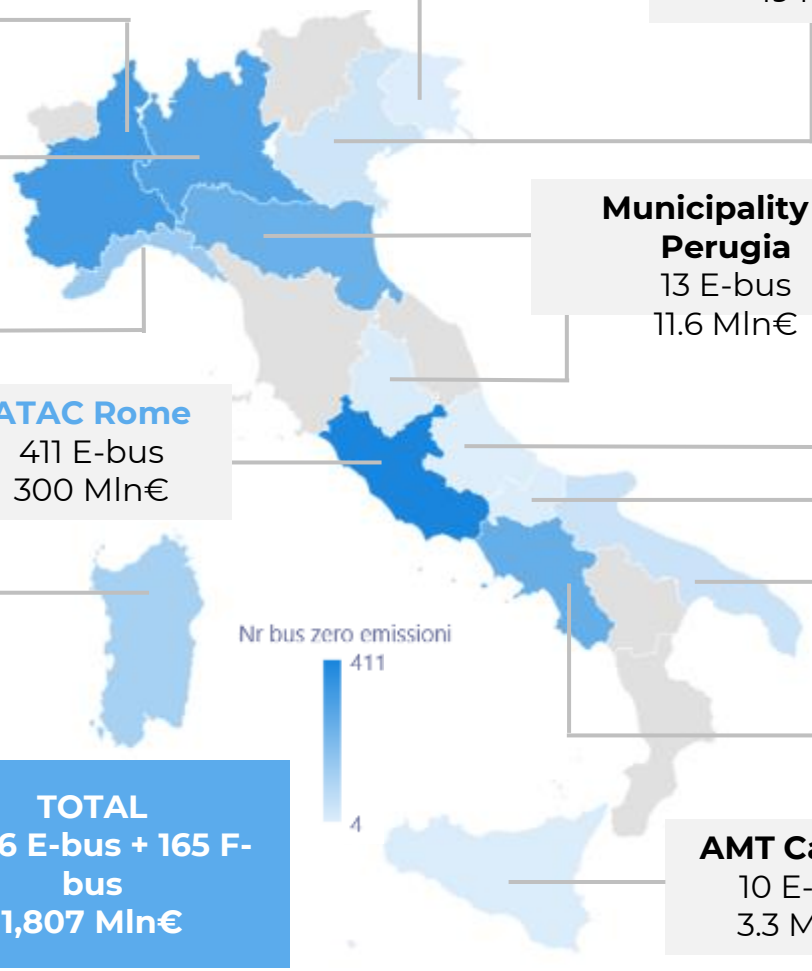
Municipality of Perugia
13 E-bus
11.6 Mln€

AMT Genoa
142 E-bus
123.8 Mln€

Municipality of Campobasso
6 E-bus
3 Mln€

ATAC Rome
411 E-bus
300 Mln€

ARST Sardinia
68 E-bus
38.7 Mln€
ARST Sardinia
46 E-bus + 3 F-bus
64.5 Mln€



Municipality of Lecce
6 E-bus
4.7 Mln€
Municipality of Taranto
45 E-bus
46 Mln€

ADDITIONAL COMPETITIONS
CONSIP: 470 E-buses + 30 FCVs (327 Mln€)
BUSITALIA: 70 E-buses (38 Mln€)
ARRIVAL ITALY: 12 E-buses (9.8 Mln€)

TOTAL
2,326 E-bus + 165 F-bus
1,807 Mln€

AMT Catania
10 E-bus
3.3 Mln€

ANM Naples
253 E-bus
172 Mln€

Source: Elaboration Sustainable Bus & Eurac Research

Tenders - Comments

During the year 2023, tenders were awarded for more than 2,300 buses zero-emission buses (all Class I except some 70 intercity vehicles banned by ARST Sardegna).

The amount of zero-emission buses placed in **2023 is close to EUR 2 billion**.

Hydrogen plays a marginal role, accounting for **6%** of the total volume, leaving **the remaining 94% to E-buses.**

Ultimately, **67 per cent of the city buses put** out to **tender in** 2023 are **zero-emission**.

Type	Value
Tendering city buses	About 3,700
E-bus to tender	2.326
F-bus to tender	165
Tot ZE buses to tender	2.491
Of which Class II	68
Share of ZE buses in urban competition in 2023	67%

Source: Sustainable Bus elaboration on tender data 2023

Tenders, perspectives, cities

CONSIP

Consip is the **national purchasing centre**, **100% owned by the Ministry of Economy and Finance**. In the bus and coach sector, Consip has set itself the objective of having "a role that is not antagonistic towards companies and administrations that are able to provide for their own needs, but rather to offer **support to all those companies that do not have the means or cannot dedicate resources to organising a tender .**

In October 2022, Consip published its **first tender for the** supply of electric buses, for a **total of 1,000 vehicles in five lots**, after having signed **four initiatives from 2018 onwards for** the purchase of buses with various fuel technologies (for 4,200 buses ordered).

*Statements by **Pascal Dell'Anno**, Head of Consip's Mobility Area, on the occasion of the Mobility Innovation Tour webinar on 16 February 2023 ([VIDEO] Review of the first stage of the MIT: the Italian bus market under the lens | AUTOBUS Web - The magazine of public transport in Italy consulted on 22 April 2024).

Tenders, perspectives, cities

CONSIP

The Framework Agreement Electric Buses 1, financed with PNRR funds, has to date seen **953 vehicles** ordered by public administrations. To this was followed **in May 2023** (awarded in November) by **the Framework Agreement Electric Buses 2, for 500 zero-emission buses** (including 30 hydrogen vehicles). As of 23 April 2024, 12 vehicles have been ordered.

Purchase	Date	Investment	Type	Charging technology	Quantity	Qualified offers	Buses ordered in April 2024	Ordering Deadline
AQ Electric Buses 1	Feb-23	660 M€	E-bus 6m	Plug-in	40	3	953	19 December 2024 (extendable by a further 6 months)
			E-bus 8-9m	Plug-in	280	5		
			E-bus 10m	Plug-in	250	3		
			E-bus 12m	Plug-in	380	7		
			E-bus 12m	Pantograph		5		
			E-bus 18m	Plug-in	50	5		
			E-bus 18m	Pantograph		4		
AQ Electric Buses 2	Nov-23	327 M€	E-bus 8-9m		150	2	12	23 May 2025 (extendable by a further 6 months)
			E-bus 12m suburban Class I		250	6		
			E-bus 12m suburban Class II		70	3		
			F-bus 12m suburban		30	3		
TOT					**1.500**		**965**	

PUMS - Urban Sustainable Mobility Plan

Credits: Unsplash

PUMS - Main objectives

The PUMS is a tool of strategic **planning** that, over a time horizon **medium to long term** (10 years), develops a system vision of **urban mobility** by proposing the achievement of **environmental, social and economic sustainability** objectives**,** generating benefits for local authorities and communities:

- **Improving accessibility for all**, without distinction of income or social status
- Improving **road safety** and public health
- **Enhancing the quality of life** and attractiveness of the urban environment
- **Reducing** air and noise **pollution,** greenhouse gas emissions and energy consumption
- **Economic feasibility**, **social** equity and **environmental** quality

PUMS - The current situation

Article 1(2) of Decree No. 397 of 4 August 2017 enshrines the obligation to adopt the PUMS as an essential condition to access state funding for new mass rapid transport interventions, **for all municipalities with more than 100,000 inhabitants**, except for **those that** fall within **a metropolitan city** that has provided for the **definition of its own PUMS.**

Region	Approved PUMS	PUMS adopted	PUMS in progress	Total PUMS
Apulia	8	16	18	**42**
Lombardy	11	3	8	**22**
Tuscany	10	2	7	**19**
Sicily	7	5	7	**19**
Emilia-Romagna	13	3	2	**18**
Sardinia	3	4	5	**12**
Lazio	3	2	6	**11**
Veneto	2	4	4	**10**
Marche	4	0	5	**9**
Piemonte	5	2	1	**8**
More	12	18	11	**41**
Total	**78**	**59**	**74**	**211**

PUMS - Proposed Actions

To achieve the objectives outlined above, the main Italian cities define a series of policy actions, covering different aspects of urban mobility:

1. **Increasing** the amount of **travel by public transport** and 'soft' mobility (as opposed to private cars)
2. **Reducing emissions** mainly at local level within cities
3. **Enlarge ZTL areas**, allowing **access** only to **zero-emission vehicles**
4. **Increasing** the **exchange nodes** between different means transport

MOTUS E

Contents

Example - Milan

Credits: Unsplash

Tenders, perspectives, cities

Milan

PUMS | VEHICLE FLEET | CHARGING INFRASTRUCTURE

The table shows the main information on the **Milan PUMS, approved on 12 November 2018** and providing an initial roadmap of the actions and objectives announced.

TIME HORIZON	INVESTMENTS dedicated solely to the LPT	ACTIONS	ENVISAGED OBJECTIVES
2020-2030	22 million	**Use of buses** powered by systems with a **lower environmental impact** and higher levels of capacity, safety and comfort	**The 6% increase in the amount of** daily **travel** will be entirely **covered by public transport**

Source: MUNICIPALITY OF MILAN (2024) Sustainable Urban Mobility Plan (cittametropolitana.mi.it)

Tenders, perspectives, cities

ATM Milan

PUMS | VEHICLE FLEET | CHARGING INFRASTRUCTURE

ATM Full Electric Plan
Launched in December 2017

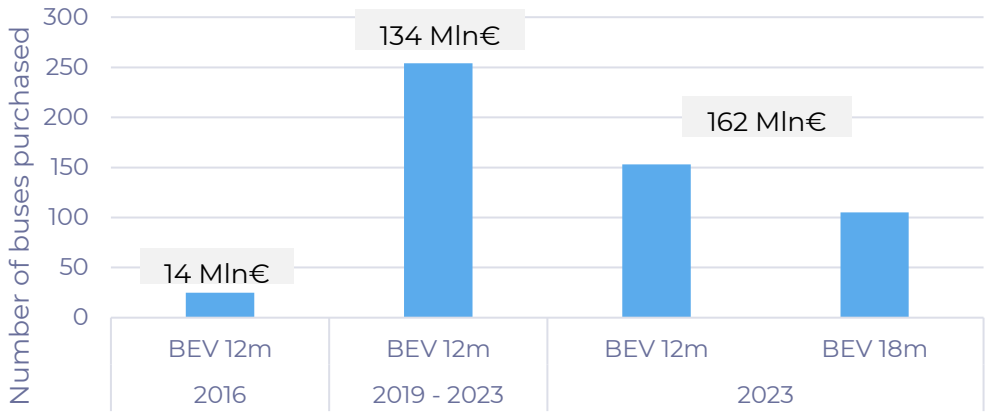
Objectives
Convert the entire fleet of around 1,200 buses to electric traction by 2030

Actions
550 electric buses will be purchased by 2026 with 293 million of public funding and 24 million in ATM resources.

Total investment
More than EUR 1.3 billion, of which EUR 340 million to date comes from public funds (EUR 273 million from PNRR funds, contracted by the end of 2023 deadline)

Benefits
a reduction in diesel consumption of 30 million litres per year and a reduction in CO2 emissions of 75,000 tonnes per year.

ATM bus investments Full Electric



Planned Action	ATM investments (Mln€)	Of which to date funding
1,200 electric buses	800	293
New deposits	400	
Renewal of deposits	100	47
Charging infrastructure		
TOT	**1.300**	**340**

Note: The investment graph shows the award values

Tenders, perspectives, cities

ATM Milan

PUMS > VEHICLE FLEET > CHARGING INFRASTRUCTURE

ATM Full Electric Plan
The ATM Full Electric plan also implies the **conversion of depots** and network infrastructure.

- **SAN DONATO**
  90 chargers (100 kW) + 2 chargers (200 kW)
- **SARCA**
  75 chargers (100 kW) + 2 chargers (200 kW)
- **GIAMBELLINO**
  75 chargers (100 kW) + 2 chargers (200 kW)
- **IN TOWN**
  14 chargers (200 kW)

Construction 2 depots
ex-novo (Viale Toscana & Viale Triboniano)

- 20,000 m2 surface area
- Green space as a roof
- 100 e-buses can be accommodated
- High Technology & Sustainability

Planned Action	ATM investments (Mln€)	Of which to date funding
1,200 electric buses	800	293
New deposits	400	
Renewal of deposits Charging infrastructure	100	47
TOT	**1.300**	**340**

Example - Turin

Credits: Unsplash

Tenders, perspectives, cities

Turin

PUMS | VEHICLE FLEET | CHARGING INFRASTRUCTURE

The table shows the main information on **Turin's PUMS**, **approved on 20 July 2022** and providing an initial roadmap of the actions and objectives announced.

TIME HORIZON	INVESTMENTS dedicated solely to LPT	ACTIONS	ENVISAGED OBJECTIVES
2019-2033	**72.9 million in total** (8.6 million in the period 2019-2023 + **64.2 million in the period** 2021-2033	**Renewal of the bus fleet** in urban public transport service with electric vehicles powered by batteries or hydrogen (fuel cell).	**Replacement of more than 100 buses** in urban service, amounting to at least 10% of the fleet used on the urban/suburban network of the capital city.

Source: CITTÀ METROPOLITANA DI TORINO (2024) Transport and sustainable mobility - Città Metropolitana di Torino... (cittametropolitana.torino.it)

Tenders, perspectives, cities

GTT Turin

PUMS | VEHICLE FLEET | CHARGING INFRASTRUCTURE

To date, GTT has **148 E-buses in operation**, plus **248 vehicles on delivery**. In addition, there are **62 e-buses under Framework Agreements that have been** awarded so far but have not yet been ordered.

Status	Purchase	Entry into service	Quantity	Type
In operation	2015	2017	20	E-bus 12 metres
	2017	2019	8	E-bus 8 metres
	2020	2021	50	E-bus 12 metres
	2021	2022	10	E-bus 12 metres
	2022	2023	60	E-bus 12 metres
On delivery	2023	Expected 2024	136	E-bus 12 metres
	2023	Expected 2024	90	E-bus 18 metres
	2023	Expected 2024	22	E-bus 6 metres
Foreseen in the framework agreement	2023	?	44	E-bus 12 metres
	2023	?	10	E-bus 18 metres
	2023	?	8	E-bus 6 metres

Notes: All buses shown in the table use plug-in charging technology

Tenders, perspectives, cities

GTT Turin

PUMS | VEHICLE FLEET | CHARGING INFRASTRUCTURE

As far as depot infrastructure is concerned, three depots are currently equipped with the following charging points:

- **66 at the Gerbido depot** (12 AC of 80 kW each, 4 DC of 60 kW each, plus 50 DC charging points for a **total of 800 kW**)
- **50 at the Venaria depot** (DC technology for **800 kW total** installed capacity)
- **22 at the Tortona depot** (AC technology).

To these are **added 10 stations charging stations at the terminals**: eight equipped with wireless induction charging technology and 2 with 80 kW charging power each on lines 84 and VE1.

Note: for the Gerbido and Venaria depots, the 800 kW value represents the maximum that can be delivered by the entire depot, the power is then distributed in a 'smart' manner depending on the number of vehicles connected at the same time.

Tenders, perspectives, cities

GTT Turin

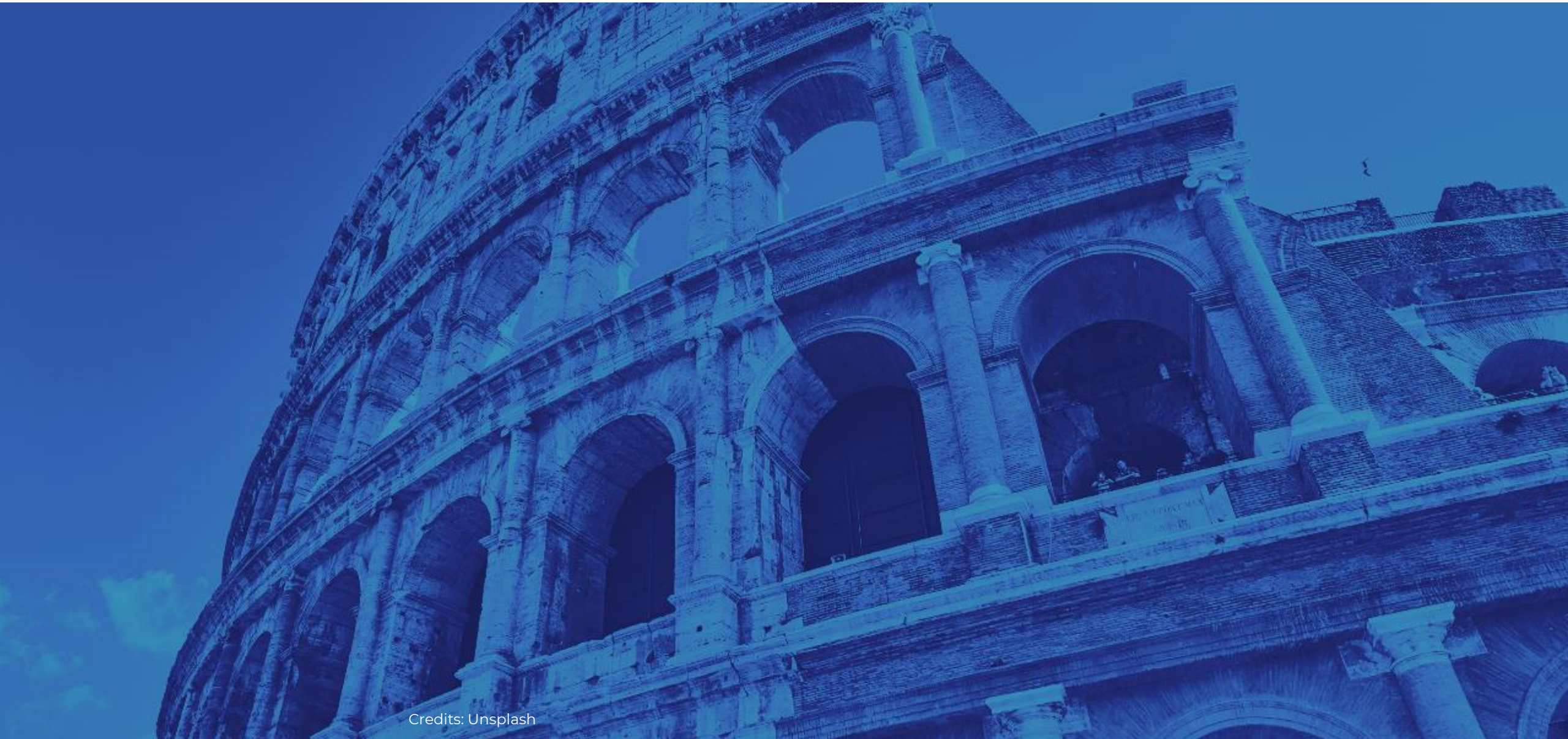
PUMS > VEHICLE FLEET > CHARGING INFRASTRUCTURE

Future projects, for which tenders were launched and closed using PNRR funds, include the installation of of additional charging infrastructure in Venaria depots, Nizza, San Paolo, Tortona with **battery system accumulation** (at San Paolo, Gerbido, Nizza and Venaria) **to be able to handle the charging of 226 12- and 18-metre buses, in addition to 22 six-metre minibuses**.

GTT planned to achieve an installed capacity of 1.75 MW for Venaria and 2 MW for San Paolo and Nizza.

Pantograph charging stations will also be set up **at seven terminals**, **each of which will be equipped with two pantographs** (500 kW installed power). There are also plans to implement self-generation systems from photovoltaics to be combined with charging infrastructure and storage batteries.

Example - Rome



Credits: Unsplash

Tenders, perspectives, cities

Rome

PUMS | VEHICLE FLEET | CHARGING INFRASTRUCTURE

The table shows the main information on Rome's PUMS, **approved on 28 December 2022** and providing an initial roadmap of the actions and objectives announced.

TIME HORIZON	INVESTMENTS dedicated solely to LPT	ACTIONS	ENVISAGED OBJECTIVES
2020-2033	Undefined	**Renewal of the** public transport **bus fleet** with clean vehicles	**Reducing emissions** and encouraging a **reduction in the ageing of** the fleet

Source: CITTà METROPOLITANA DI ROMA (2024)
pums.cittametropolitanaroma.it/sites/default/files/documents/PUMS Volume 3.pdf

Tenders, perspectives, cities

ATAC Rome

PUMS | VEHICLE FLEET | CHARGING INFRASTRUCTURE

Roma Capitale was the beneficiary of EUR 292 million in PNRR funds for the purchase of **411 e-buses**, 109 of which will be registered by the end of 2024. The vehicles were awarded in November 2023, for a unit price of € 529,900 for the 12-metre, € 729,000 for the 18-metre. These are buses for plug-in recharging in depot.

Beneficiary	Source of funds	Financing entity	Type	Entry into operation		Total quantity
				2024 By	June 2026	
			E-bus 12m	109	93	202
Rome Capital	DM 530/2021 PNRR	292.571.037 €	E-bus 12m		194	194
			E-bus 18m		15	15
TOT				**109**	**302**	**411**

Note: Full maintenance service for 10 years is provided for all buses, in addition to the option for ATAC to purchase a battery kit over the course of the 10-year period, specifically priced during the tender.

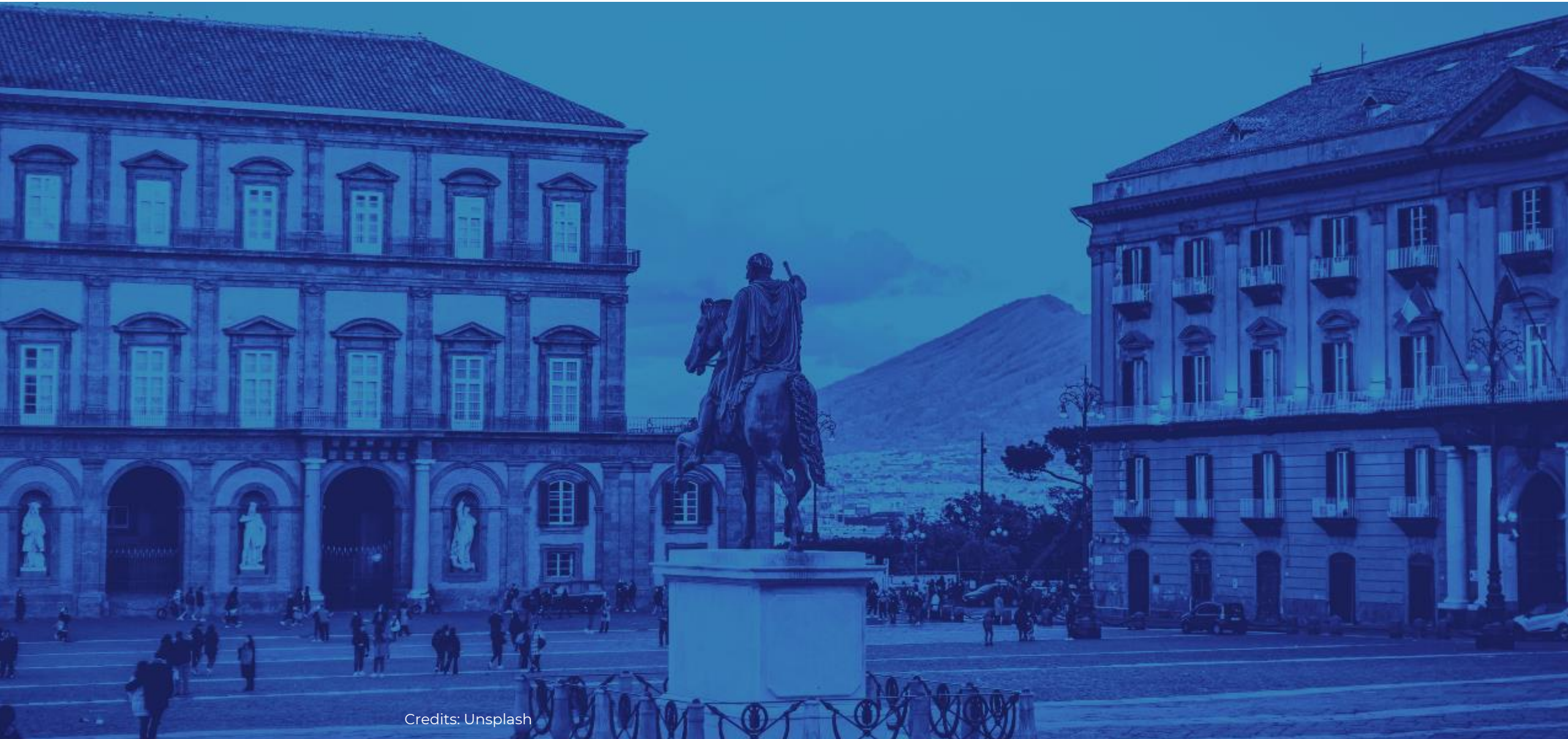
Tenders, perspectives, cities

ATAC Rome

PUMS > VEHICLE FLEET > CHARGING INFRASTRUCTURE

Regarding the **infrastructure of the depots**, **ATAC Rome** prepared the **preliminary design in cooperation with the Full Green Consortium** (composed of ATAC, ATM Milan, ANM Naples). The company chose to select, through a tender, a **single operator with which stipulate a Framework Agreement** for the executive design and execution of the works at the **depots in Portonaccio** (where the first 109 e-buses will be installed), **Grottarossa, Tor Sapienza and Trastevere**. Works to be completed by 30 June 2026, as per the PNRR deadline.

Example - Naples



Credits: Unsplash

Tenders, perspectives, cities

Naples

PUMS | VEHICLE FLEET | CHARGING INFRASTRUCTURE

The table shows the main information on the **Naples PUMS, approved on 27 December 2023** and providing an initial roadmap of the actions and objectives announced.

TIME HORIZON	INVESTMENTS dedicated solely to LPT	ACTIONS	ENVISAGED OBJECTIVES
Not Specified	**Approximately € 99.4 million in total**	**Renewal of the** road public transport **fleet**, mainly consisting of diesel and natural gas vehicles.	**Efficiency in the local public transport sector**, to ensure the **best efficiency** under the quality profile, safety and environmental sustainability.

Source: CITTÀ METROPOLITANA DI NAPOLI (2024) PUMS documents - Città Metropolitana di Napoli (cittametropolitana.na.it)

Tenders, perspectives, cities

ANM Naples

PUMS | VEHICLE FLEET | CHARGING INFRASTRUCTURE

In September 2023, ANM Napoli launched a six-lot tender for the **supply of a total of 253 electric buses with plug-in recharging** within the framework of PNRR funds, to be contracted by 31 December 2023, according to the deadline set by Ministerial Decree 530/2021.
A first tranche of 78 vehicles is expected to be delivered in 2024, to be followed by a subsequent delivery by the end of 2025. The largest part of the order, as many as 111 e-buses, will come into operation, according to ANM's plans, in the first half of 2026.

Type	Entry into service		
	2024	2025	by 30/06/2026
E-bus 5.8 - 7 m	20	10	
E-bus 7.1 - 8.6 m	30	5	
E-bus 8.7 - 9.7 m	15	10	21
E-bus 9.8 - 11 m		23	55
E-bus 11.1 - 12.3 m	13	16	21
E-bus 17.6 - 18.75 m			14
TOT	**78**	**64**	**111**

Note: All vehicles listed in the table were purchased through tenders in 2023 and have plug-in charging

Tenders, perspectives, cities

ANM Naples

PUMS > VEHICLE FLEET > CHARGING INFRASTRUCTURE

In parallel, the company awarded, again before the end of 2023, an integrated contract for the construction of recharging infrastructure, the installation of which will affect **three depots** (Cavalleggeri Aosta, Carlo III and via Puglie).

More than **253 charging points** will be set up (112, 96 and 45 for each shed), **with powers between 50 and 150 kW for each charging point** (more precisely: a minimum of 50 kW for mini and short e-buses, up to a maximum of 150 kW for articulated buses).

For this last tender **ANM developed in-house the Technical-Economic Feasibility Project**, while the **final project was carried out** within the of the **Full Green consortium** of which ANM is part together with to ATAC Rome and ATM Milan.

MOTUS-E

Contents

Product evolution and industrial strategies

Evolution of the e-bus product from the **DRIVELINE** point of view **(1/2).**

Division of the market between two prevailing options:

Electrified axle with hub motors
In this case, the vehicle's drive wheels have **electric motors integrated directly into the wheel hubs.** This allows the wheels to be powered electrically and **eliminates the need for a centrally positioned motor** or conventional transmission.

Advantages: small interior footprint, can also be installed on the centre axle of an 18m

Central electric motor
In the case of a mid-engine, **the electric motor transmits power to the wheels via a drive shaft or transmission system**, similar to that used in vehicles with internal combustion engines.
The **engine** is therefore **located separately from the drive axle**, close to it.

Advantages: easy maintenance, energy recovery efficiency

According to an analysis of **32 12-metre E-bus models** available on the European market, the **mid-engine** is adopted by **71% of the models**, **the electrified axle** by the remaining **29%.**

It should be noted that one manufacturer offers both options on the same model.

Product evolution and industrial strategies

Evolution of the e-bus product from the **DRIVELINE** point of view **(2/2).**

The **greater design flexibility** offered by **electric motors,** which have a **smaller footprint** than thermal motors, allows OEMs to make changes to vehicle layouts.
Of particular note are:

- **the gradual elimination of the rear engine tower, i.e.** the encumbrance, generally on the left side of the rear of the bus, intended to house the combustion engine, in favour of **full occupation of the rear by the seats**
- **moving the battery modules away from the rear** (a solution favoured in the first e-bus generations) in **favour of roof placement.**

The **next steps**, already embraced by some manufacturers, are:

- integration of the **battery modules directly into the chassis** (**under the floor of** the bus)
- increasingly widespread adoption of a **fully lowered passenger compartment floor with** no steps along the entire length of the bus.

Product evolution and industrial strategies

Evolution of the e-bus product from a **BATTERY** point of view:

Increased autonomy: the maximum available capacity on 12-metre e-buses increased by 34% in 4 years (figure 2024 vs figure 2020). The offer of e-buses with a capacity of more than 400 kWh increased from 3 to 27 (+800%)

Chemistry batteries: LFP formula on the rise. Reasons: higher cost-effectiveness compared to NMC, important developments in terms of energy density

Progressive **increase in energy density** (benchmark 2024: +170 Wh/kg)

Availability of cell-to-pack products with the possibility of frame integration

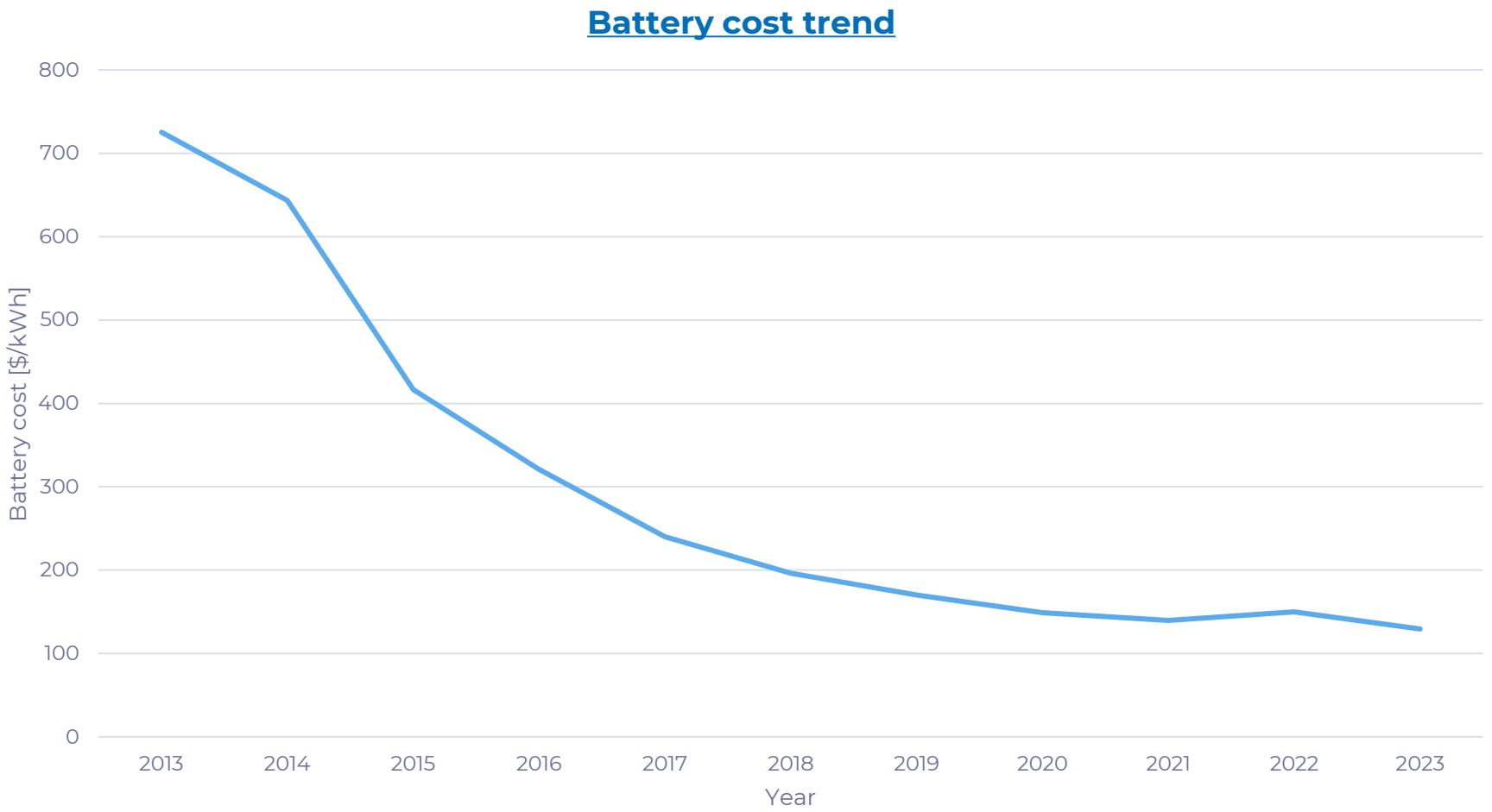
	2020		2024	
	Bus No.	**% of total**	**Bus No.**	**% of total**
E-bus models 12m	19		32	
Max. battery capacity +400 kWh	3	16%	27	84%
Max. battery capacity +500 kWh	1	5%	8	25%
Medium max. capacity	329 kWh		441 kWh	
Max. average capacity increase in 4 years		34%		

Product evolution and industrial strategies

BATTERIES technology trend

Recent years have seen a strong and continuing trend of cost cutting. This is based on **technological developments** and **economies of scale** in all areas of the value chain.

In 2023, the upward trend of cheaper **LFP batteries** continues, reaching a price per **battery pack** and **cell** of **$130/kWh** and **$95/kWh** respectively



Source: Eurac Research data processing on BloombergNEF Lithium-Ion Battery Pack Prices Hit Record Low of $139/kWh | BloombergNEF (bnef.com) and X-Change: Batteries - RMI

Product evolution and industrial strategies

End-of-Life Batteries 1/3 - Uses

At the end of their useful life, electric bus batteries can provide significant benefits both in the case of 'second life' (reuse or reconditioning) and in the case of component recycling

Second Life

Storage for private use	Storage of energy from renewable sources in private buildings to maximise self-consumption
Accumulation for public use	Creation of renewable energy storage facilities to decouple production and consumption
Network Balancing	Stabilisation of the electricity grid to ensure service flexibility
Prevention of blackouts	Countering energy peaks to prevent blackouts in energy-intensive buildings
Charging for electric vehicles	Energy storage at charging points during periods of lower demand
Other vehicle applications	Application in vehicles with lower energy performance requirements (e.g. ferries/lift trucks)

Recycling

Supply chain resilience	Reducing the risk of market shocks through the creation of a new supply chain
National Independence	Sourcing raw materials from a local supply chain at the expense of imports
Demand coverage	Supporting the coverage of raw material demand, even in the event of reduced availability of virgin materials
Cost of raw materials	Availability of raw materials at potentially lower prices than virgin materials
Environmental impact	Reducing energy requirements and greenhouse gas emissions associated with mining and refining operations
Social Impact	Creation of new jobs in the processing industry at national and European level

Source: MOTUS-E Report Electric vehicle battery recycling @2050: evolutionary scenarios and enabling technologies - Motus-E

Product evolution and industrial strategies

End of Life Batteries 2/3 - Market Opportunities

The **batteries** inside local public transport buses do not completely lose their value **at the end of their useful life** (around 8 years), representing a **potential asset for** public transport companies, as they can reduce the cost of battery changes.

Market opportunities

- **Battery capacity** for **'second life'** applications is growing and will reach **77 GWh by 2050**
- **Revenues generated** from the sale of recycled nickel, cobalt and lithium will **amount to EUR 400 - 600 million in Italy**, with a margin of EUR 100 - 300 million

(Values refer to total recycled potential, including batteries used for LPT)

Intermediate solutions

- Already at the tender stage, city bus companies can **agree with manufacturers for the management of the 'second-life' of the** batteries, as carried out in the recent tenders of ATM Milan (20 January 2023).

Technical and Regulatory Future Steps

- From a **technical point of view, it** is planned to **build collection and treatment points for batteries** (including those used for electric vehicles) in order to recover raw materials or treat batteries destined for a second life, as in **the** case of **Cobat's Ecofactory in Abruzzo**, which is scheduled to open in 2024.
- **From a regulatory** point of view, **recent European directives** aim to **simplify and speed up the end-of-life management of** batteries (focus in next slide)

CASE STUDY

The company Connected Energy, commissioned in February 2020 a 720 kWh stationary storage, using only batteries previously belonging to Renault Kangoo Z.E.

Source: MOTUS-E Report Electric vehicle battery recycling @2050: evolutionary scenarios and enabling technologies - Motus-E
COBAT (2023): Batteries and material recovery. Europe asks, Cobat Ecofactory responds.
ATM Milan (2023) CHIARIMENTI V - 12 January 2023_3600000159.pdf (atm.it)
RENAULT GROUP (2020) A second life for batteries: from energy usage to industrial storage - Renault Group

Product evolution and industrial strategies

End-of-Life Batteries 3/3 - New European Regulation

The new European Regulation 2023/154 on batteries and their waste has an application date of 18 February 2024, from which date the scope and the new definitions are to be considered in force, while the provisions on the management of waste batteries (Chapter VIII) will apply from 18 August 2025, the date of repeal of Directive 2006/66/EC.

Applications Regulation

- **Portable** batteries
- Batteries for **motor vehicles** (simple lighting or ignition)
- Batteries for **light transport vehicles**
- **Electric vehicles**
- **Industrial** batteries

Main Novelties

- Requirements concerning the **minimum content of recycled material** in certain batteries;
- **New labelling of** batteries with obligation among other information, to indicate the **presence of hazardous substances** (other than cadmium, lead and mercury) and CRMs (critical raw materials);
- **Duty of due diligence for** economic operators on the business strategy for battery raw materials and associated social and environmental risk categories;
- Enhanced **Extended Producer Responsibility;**
- **New provisions in the management of** waste batteries;
- Introduction of the **digital battery passport**.

Fixed Objectives

- The **collection targets for waste** portable **batteries:**
  (a) 45 % by 31 December 2023;
  (b) 63 % by 31 December 2027;
  (c) 73 % by 31 December 2030;
- The specific collection **target for waste of batteries for light transport vehicles:**
  (a) 51 % by 31 December 2028;
  (b) 61 % by 31 December 2031.
- The **levels of materials recovered from waste batteries,** specifically: for lithium 50% by 2027 and 80% by 2031; for cobalt, copper, lead and nickel 90% by 2027 and 95% by 2031.

Product evolution and industrial strategies

Developments in terms of **INDUSTRIAL STRATEGIES**

The European **bus industry** is facing a phase of significant change related to the **need for of investments for the provision of alternative drive vehicles**. Investments that risk undermining the economic viability of companies in a **sector** such as the bus and coach industry with **low margins and growing competition**.
In particular, **several European manufacturers** have decided to abandon the supply of complete buses in favour of **concentrating on the manufacture of chassis** and **outsourcing the bodywork to external partners** (a model very much in vogue until a couple of decades ago).

While it is true that the first generation of electric buses were essentially vehicles derived from the combustion models, with few modifications in terms of layout, **the major manufacturers** have prepared or **are preparing platforms and chassis developed** from the outset with the aim of **exploiting the benefits offered by electric traction** (listed in slides 62-63: lowered floor, smaller footprint, etc.).

Product evolution and industrial strategies

Developments in terms of **INDUSTRIAL STRATEGIES**

The **decarbonisation targets set by the European Union, in** particular the 90 per cent zero-emission city bus registration rate by 2030 (and 100 per cent in 2035) **require manufacturers to increase production capacity** for electrically driven vehicles, which are generally manufactured on dedicated production lines and in many cases in specialised plants. According to **the targets just mentioned, an estimated 12,500 zero-emission city buses will be registered in Europe in 2030** (+100% compared to 6,000 registered in 2023).

The **rapid spread of electric drives** has generated a sudden need for operators to **adapt** their **organisation and expertise**. This has generated a **demand for 'turnkey' solutions that include**, in addition to the **supply of vehicles**, a range of ancillary services such as **advice** on **electrification of lines, planning of recharging infrastructure, power organisation**, and so on. Leading manufacturers have set up specialised departments for consulting services aimed at the adoption of electric fleets.

Charging infrastructure evolution

Credits: Abb.com

Product evolution and industrial strategies

Evolution of **RECHARGE INFRASTRUCTURES (1/3)**

Propensity for **depot charging via CCS2** (lower investment, ease of use and management)

Use of **pantograph** recharging not motivated by insufficient autonomy. It is chosen in metropolitan contexts (to distribute energy demand or as a backup solution to cope with extraordinary service conditions, see the case of ATM Milan) and for **Bus Rapid Transit** projects (increasing)

High power development charging through use of **liquid-cooled cables**

First experiments of **Megawatt** Charging**,** to further increase achievable charging powers

Focus on **partnerships** with OEMs for joint offerings in single specifications e-bus + infrastructure

Note: The term Bus Rapit Transit (BRT) refers to mass public transport systems in which large-capacity buses (at least articulated) run on lines separated from vehicular traffic

Product evolution and industrial strategies

Evolution of **RECHARGE INFRASTRUCTURES (2/3)**

The **ever-increasing number of electric vehicles** to be recharged **in depots** implies the development of an **'ad-hoc' recharging strategy.** In contrast to 'traditional' diesel-powered buses, electric vehicles require innovative solutions to **combine the increased recharging times** required **without** causing **excessive demands on the grid**, also placing an economic burden on companies due to the high power peaks.

SINGLE VEHICLE

With this in mind, many companies use **'smart charging'** systems, in which software is used to **optimise the charging of individual vehicles**, reducing the charging power **by exploiting all** the time the e-bus is stalled **in the depot.**

FULL FLEET

Optimisation can also be **further developed** by considering **the entire fleet of vehicles** in storage. In this case (as also shown in the GTT Turin example), **the overall power** that can be requested from the network can be limited, **distributing it** according to the quantity of **vehicles connected at the same time**, **thus also containing** vehicle recharging **costs.** A further possible step (where applicable) is to favour recharging at times of lower energy costs, to further reduce the costs of LPT companies.

Product evolution and industrial strategies

Evolution of **RECHARGE INFRASTRUCTURES (3/3)**

Considering the tenders shown in the study, it is planned to **install charging points for** electric buses with a **total capacity of approximately 72 MW** (summing up columns AC and DC and using only the values explicitly defined within the competitions).

If we also consider for these tenders the number of E-buses purchased (approximately 1,060 vehicles), the ratio of installed capacity to purchased buses can be calculated, resulting in an **average of approximately 68 kW of installed power for each bus** in the the fleet.

This value can be useful to provide an **indicative benchmark** for local public transport operators, depending on their current fleet.

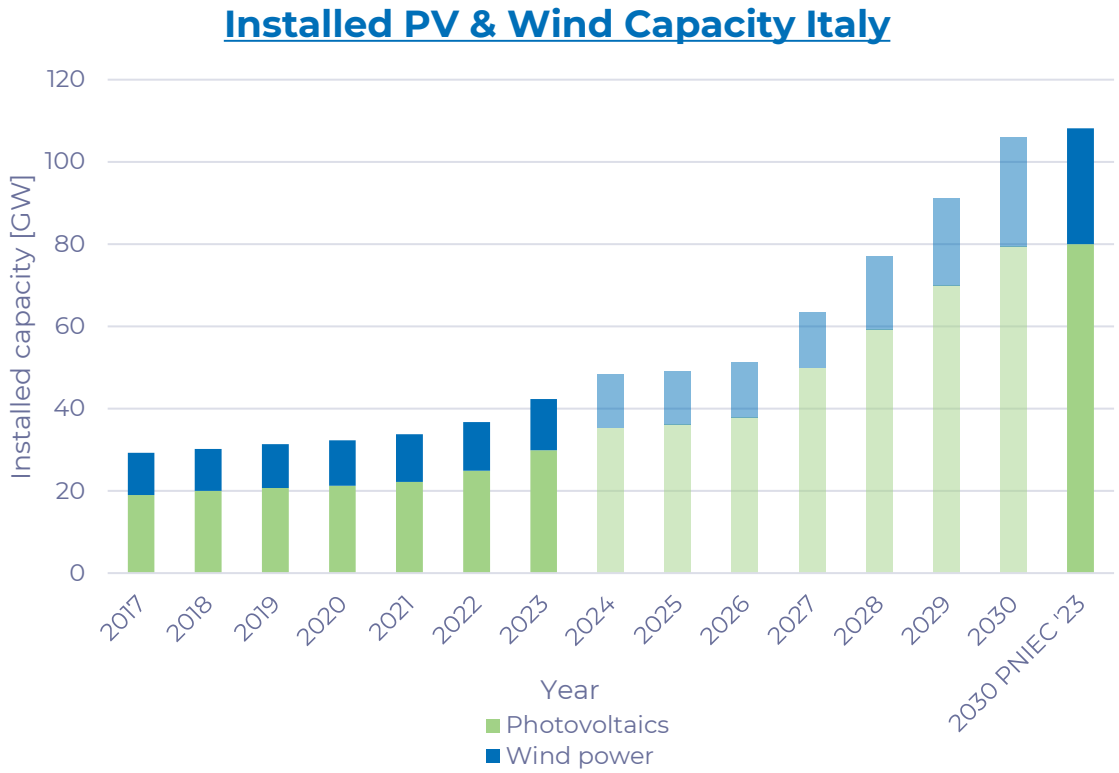
Evolution of the Italian electricity system

Credits: Unsplash

Goals & Expectations: PNIEC & TERNA

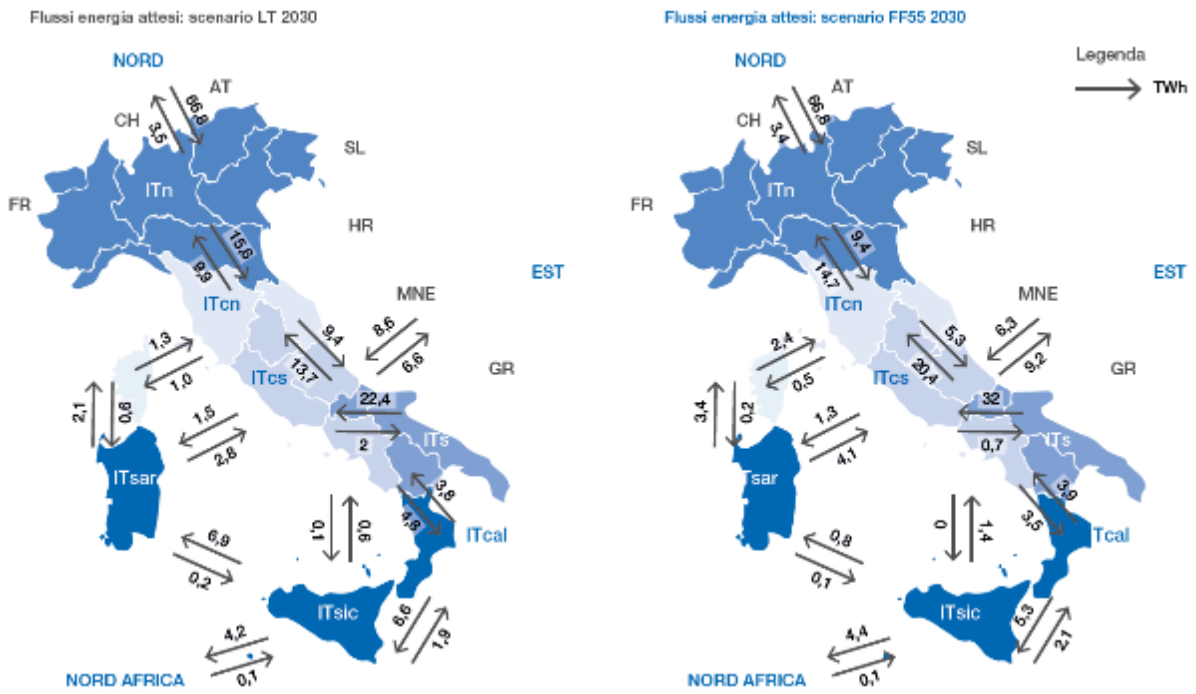
The **National Integrated Energy and Climate Plan (PNIEC)** places particular **emphasis** on **reducing consumption and CO2 emissions**, including through a **modal shift towards public transport, which will be increasingly electrified**.

In order to support the changes in the Italian energy system, an **increase in installed capacity on the Italian territory is** foreseen, with a total of about **131 GW of renewable energy plants** (of which about 80 GW photovoltaic and about 28 GW wind power) to be installed by 2030. To support this increase in installed capacity, **TERNA** also **foresees an increase in** overall grid **exchange capacity of +60% in 2030 and +125% in 2040**



Source: CLIMA ENERGY PLAN 2030 (2023): WEB_ENERGIACLIMA2030.pdf (mimit.gov.it)
RENEWABLE ENERGY REPORT 2024: Home - Energy Strategy
TERNA NETWORK DEVELOPMENT PLAN (2024) Terna Driving Energy - Terna spa

Investment comparison: TERNA



Energy flows in Italy expected for two scenarios in 2030:
Late Transition (left): December 2019 PNIEC targets maintained
Fit For 55 (right): European targets to reduce CO2 emissions by 55% achieved

MAIN OBJECTIVES

- Integrating Renewable Energy Sources
- Increasing transport capacity
- Developing Interconnections with Foreign Countries
- Improving the safety, quality and resilience levels of the electricity system
- Ensuring network robustness

EXPECTED BENEFITS

- Increased inter-zonal trading capacity from about 16 GW today to over 30 GW
- Reduction of congestion hours (particularly in the south)
- Total reduction of CO2 emissions up to almost 12,000 kt/year
- Improving network robustness

INVESTMENTS

Economic investment of EUR 2.3 billion planned in 2023 (+30.4% compared to 2022) [7].

Goals & Expectations: E-Distribution

STRUCTURAL INTERVENTIONS

388 structural interventions to upgrade the High Voltage (HV) and Medium Voltage (MV) network in the years 2021-2022
333,000 new installations of renewable energy producers connected to the grid in 2023 (compared to 204,000 in 2022)

CAPACITIES OF NETWORK

Objective to **increase network capacity** to host and integrate additional Distributed Generation **from renewable sources of** at least **1,000 MW** by 31 December **2024** and at least **4,000 MW** by 30 June 2026

ECONOMIC INVESTMENT

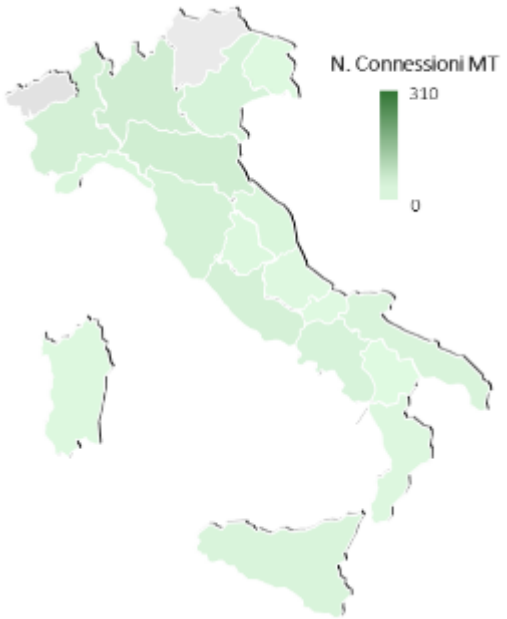
Investment of **EUR 3.5 billion** planned **in the period 2023 -2026**

Source: E-DISTRIBUTION: DEVELOPMENT_PLAN 2023 (2023) DEVELOPMENT_PLAN_2023_ARERA.pdf (e-distribuzione.it)

Investment comparison: E-distribution

NUMBER OF CONNECTIONS

2022



2025

Distribution of Managed Medium Voltage Connections by E-Distribution in 2022 with forecast 2025 values

POWER REQUIRED

REASONS

- Overall development of the national economy
- Electrical Penetration: shifting energy needs associated with industrial processes, human activities and services from non-electrical to electrical.

INTERVENTIONS

Overall increase in the number of connections in Italy (both low and medium voltage) from 3,500 in 2023 to 5,600 connections in 2025

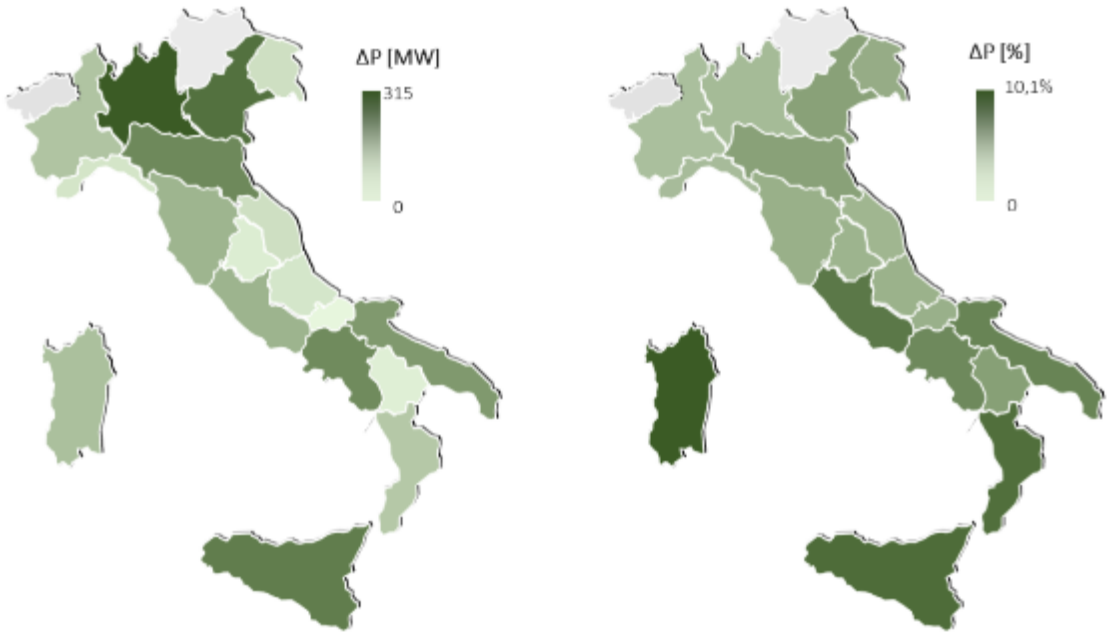
Source: E-DISTRIBUTION: DEVELOPMENT_PLAN 2023 (2023) DEVELOPMENT_PLAN_2023_ARERA.pdf (e-distribuzione.it)

Investment comparison: E-distribution

NUMBER OF CONNECTIONS

POWER REQUIRED

2025



Estimated percentage and absolute increase in maximum power on a regional basis in the year 2025 compared to 2022

REASONS

- Electrification of industrial processes
- Increased consumption by civil users
- Diffusion of e-mobility and increase in energy required for charging vehicles

INTERVENTIONS

Increase in power connected to the grid from 337 MW in 2023 to 670 MW in 2025

Source: E-DISTRIBUTION: DEVELOPMENT_PLAN 2023 (2023) DEVELOPMENT_PLAN_2023_ARERA.pdf (e-distribuzione.it)

MOTUS-E

Contents

Simulation scenarios of market developments in Italy

DEFINITION OF FUTURE FLEET

Data Input 2023

- LPT bus fleet analysis in 2023
- Registered 2023 and future sales forecasts

Assumptions & Recruitment

- Number of vehicles on the road constant over the years (MIMS data)
- 1:1 fleet replacement

Output (2023-2050)

Distribution of circulating fleet for the time range considered (2023-2050)

Definition of time needed for fleet conversion

ENVIRONMENTAL & ENERGY IMPACT

Data Input 2023

- Kilometres travelled annually
- Vehicle emission factor
- Electricity and fuel consumption
- Italian energy mix emission coefficient

Output (2023-2050)

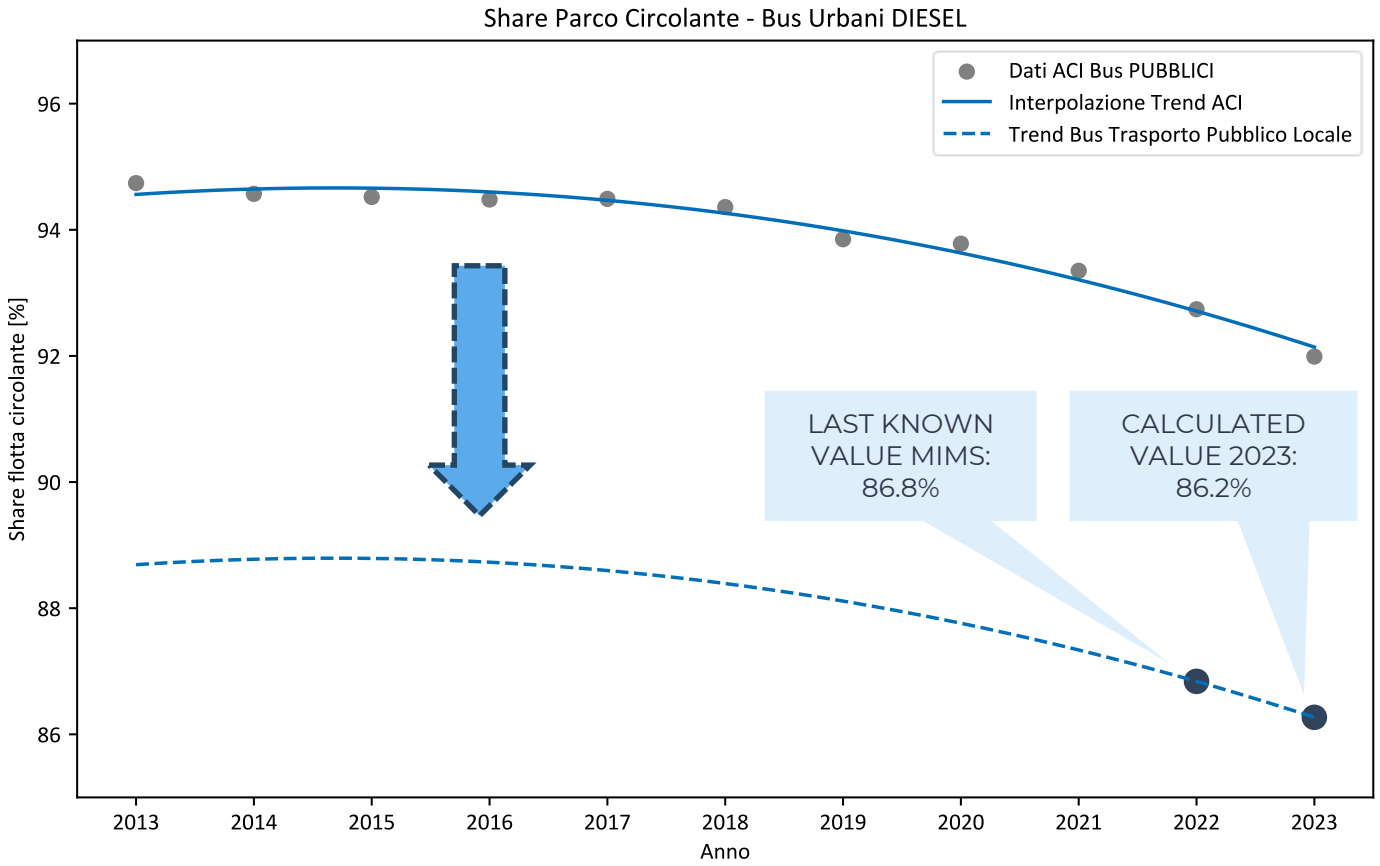
Reducing CO2 emissions from vehicles on the road
Reducing fuel consumption

Increased electricity demand (E-bus power supply and F-bus hydrogen production)

Definition of diesel city buses in circulation 2023

The most recent description of the circulating city bus fleet dates back to September 2022, in a study developed by MIMS. In order to "**update the starting point**" for future simulations, setting it **at 2023**, the trend of **public buses (urban and suburban) provided by ACI was taken into account**, as it is based on a longer time horizon.

This trend was **then applied to the value provided by MIMS in September 2022,** in order to be able to calculate the bus fleet circulating in December 2023.



Source: Eurac Research elaboration on MIMS data PARCO AUTOBUS.pdf (mit.gov.it) and ACI data: ACI Studies and Research - Self-portrait

Vehicle fleet 2023

The process shown for the case of diesel buses was then **repeated for the other fuels**, evaluating for each the trend over the last decade.
The resulting vehicle fleet for the year 2023 is shown in the table.

Power supply	Share [%]
Diesel	86,2
Petrol	0,9
LPG	0,4
Methane	8,7
Hybrid Diesel	2,0
Petrol Hybrid	0,0
Plug-in Hybrid	0,0
F-bus	0,0 *
E-bus	1,8

*The document prepared by MIMS indicates the presence of 12 hydrogen buses in September 2022

Sales Recruitment 2023

The **2023 registration quota is based on ANFIA data for urban registrations**, the **share of sales from 2024 onwards is based instead on the roadmap described by the European Union,** in terms of reducing emissions from the local public transport sector, then holding constant from 2035 onwards.

ASSUMPTIONS & CONSIDERATIONS

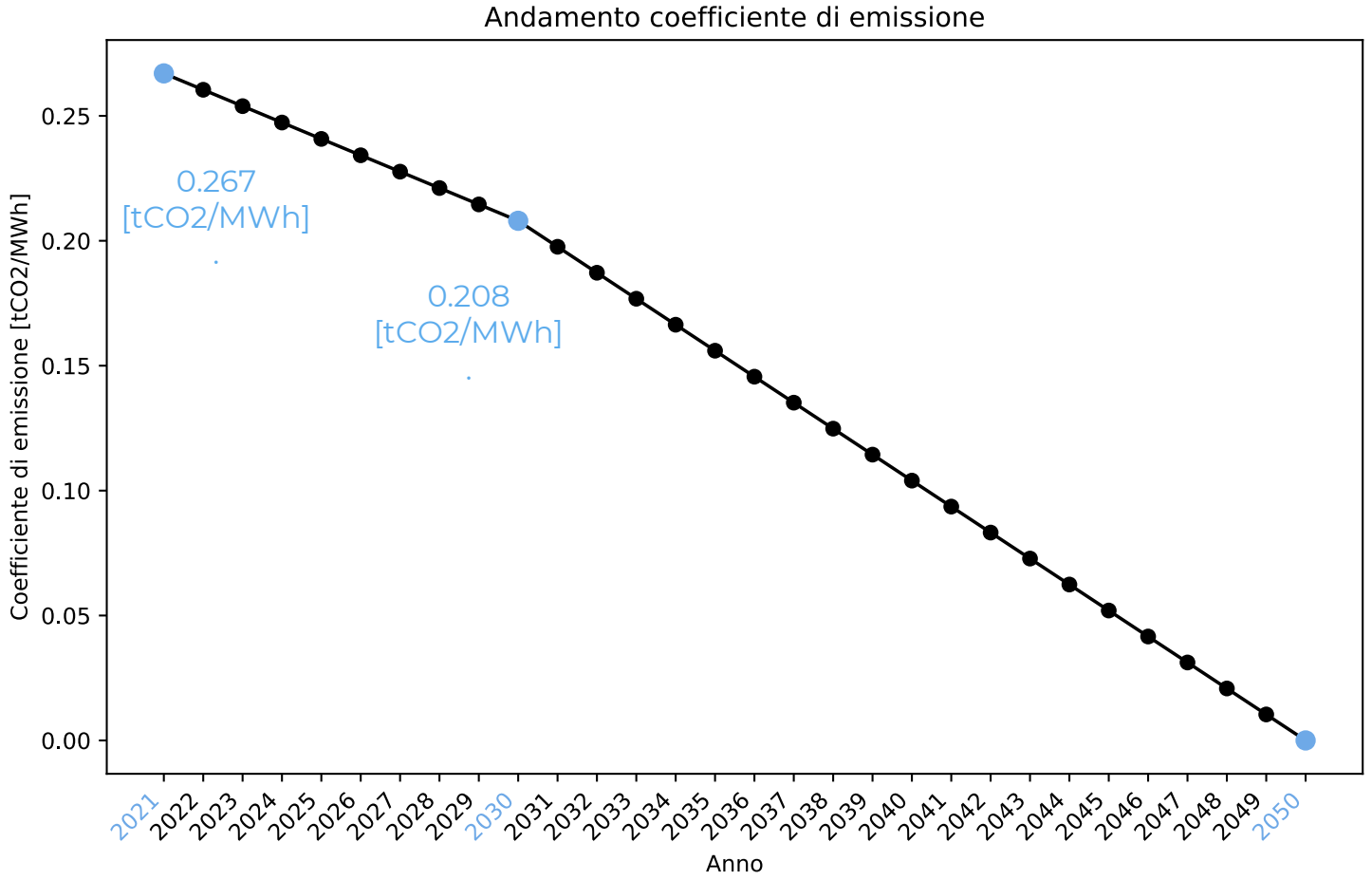
A gradual development of hydrogen fuel cell buses has been considered, as part (even with lower percentages) of zero-emission buses required by the European Union from 2035 onwards.
The value of sales is in line with the share of F-buses in the total number of tenders awarded in 2023 (about 7%)

SUPPLY	2023	2030	2035	2040	2050
Diesel [%]	22.1	5	0	0	0
Petrol [%]	0	0	0	0	0
LPG [%]	0	0	0	0	0
Methane [%]	14.8	0	0	0	0
Hybrid Diesel [%].	36	10	0	0	0
Hybrid Petrol [%].	0	0	0	0	0
Plug-in hybrid [%].	0	0	0	0	0
F-Bus [%].	0	5	10	10	10
E-Bus [%].	27.1	80	90	90	90

Source: COUNCIL OF THE EU (2024): Heavy-duty vehicles: Council signs off on stricter CO2 emission standards - Consilium (europa.eu)

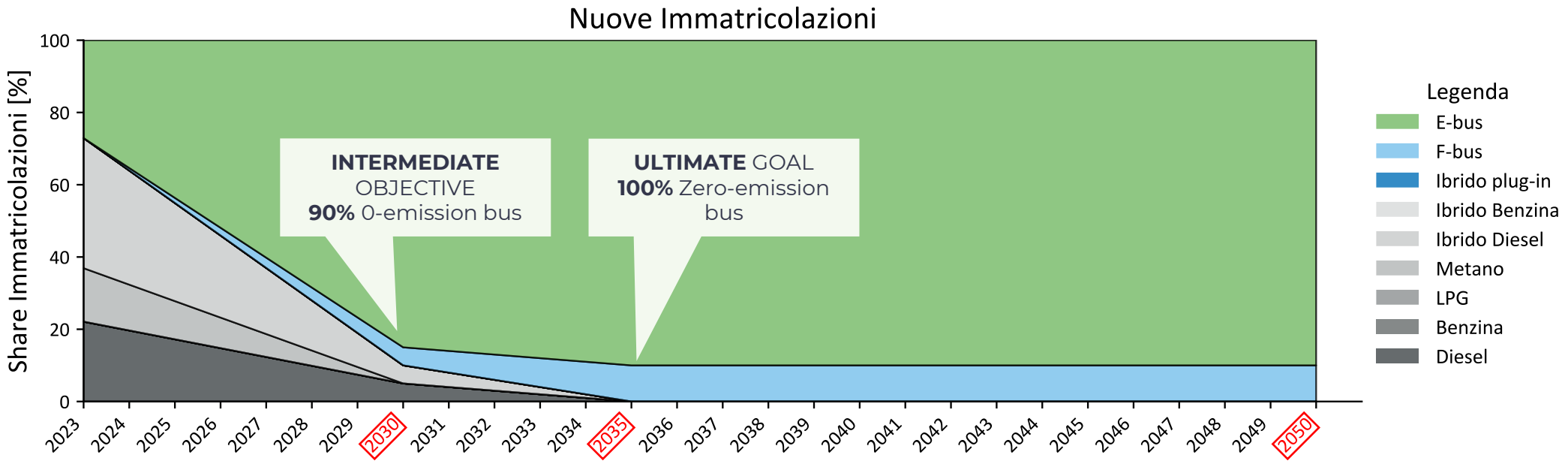
CO2 emission coefficient eq. electricity

In the analyses shown in this study, an **emission factor was taken from the 2021 values provided by the JRC and the PNIEC targets of** an initial reduction in **2030 and** a zero emission value in **2050**.
Intermediate values were derived through a **linear interpolation** from the known targets.



Source: JRC emission factors. Index of /ftp/public/JRC-OpenData/CoM/LATEST (europa.eu)
PNIEC. Objectives (mise.gov.it)

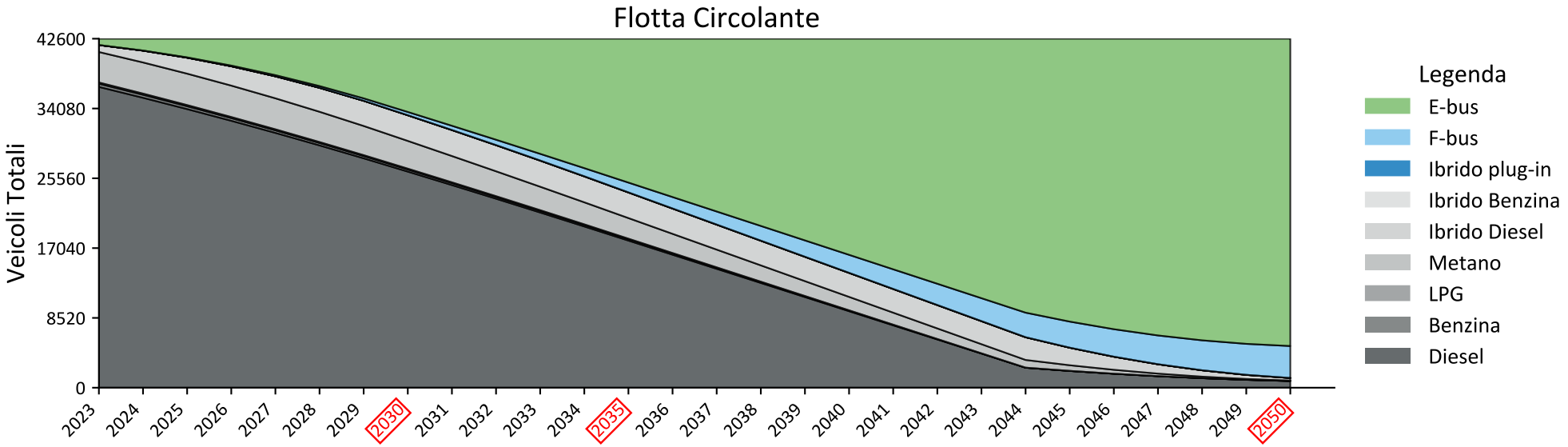
Future trend assessment - New registrations



Following **current European targets for reducing emissions in** the transport sector**, only zero-emission city buses** (electric and hydrogen) **may be sold from 2035 onwards.** To achieve these targets, a **linear reduction in the share of** new registrations has been assumed for other types of power supply (mainly **endothermic engines**).

Source: COUNCIL OF THE EU (2024): Heavy-duty vehicles: Council signs off on stricter CO2 emission standards - Consilium (europa.eu)
Note: Considering that the data provided by MIMS do not define the number of city and suburban buses, the more 'stringent' city bus targets were applied for all vehicles considered

Future trend assessment - Fleet



ASSUMPTIONS & RECRUITMENT

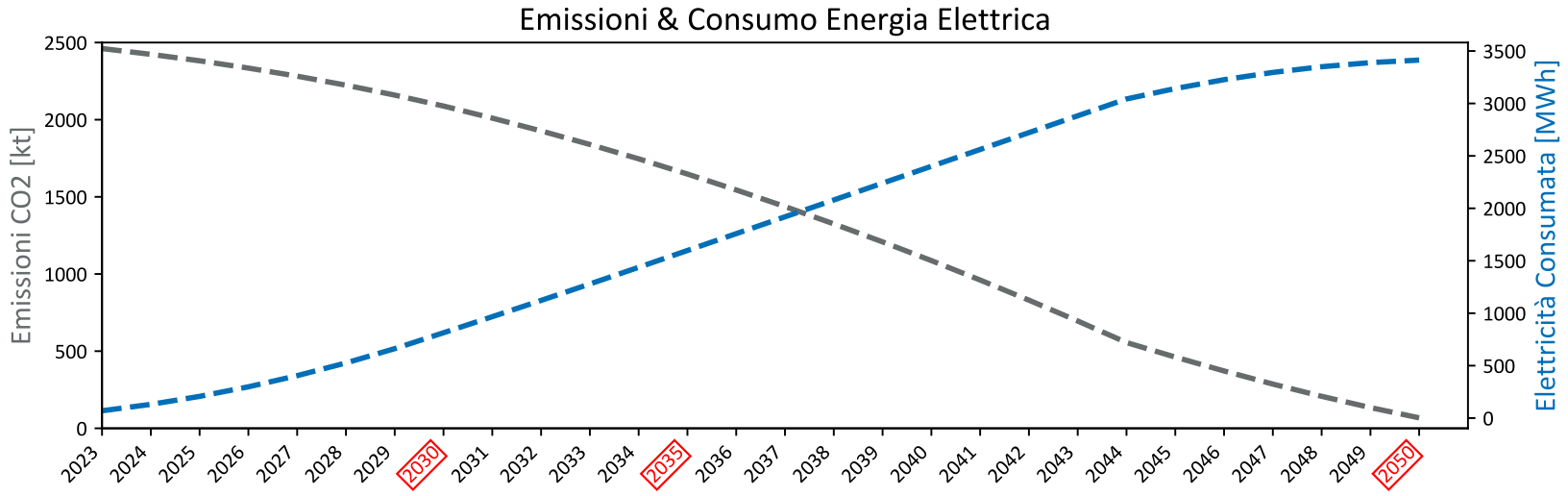
The **total number of vehicles on the road** is assumed to be **constant over the** years, based on an average of the values provided by MIMS.

Vehicle service life = 21 years
This gives a value of approximately 2000 registrations per year

CONSIDERATIONS

Assuming a vehicle lifetime in line with the values provided by MIMS, **the share of zero-emission vehicles on the road in 2050 is 97% (88% E-bus + 9% Fuel Cell).** Although the fleet will not achieve a complete shift from endothermic to zero-emission vehicles by 2050, the reduction of endothermic vehicles is clear.

Future Trend Assessment - Emissions & Consumption



In the calculation**, emissions** related to the production of **electricity for the operation of** electric **vehicles** are **included,** while **emissions for the production of batteries are excluded from the calculation,** which, however, thanks to the new European Regulation on batteries will be increasingly optimized thanks to the increasingly higher **percentages of recycled content to be used**.

The **reduction in emissions** is achieved through a **reduction** in the amount of **endothermic** motor **vehicles** (with a corresponding reduction in the use of fossil fuels) and a simultaneous **reduction in the emission factor** of the Italian electricity mix.

Zero emissions are not reached in 2050, despite the fact that an Italian energy mix has been achieved 'zero-emission', due to the diesel and mild hybrid vehicles still on the road.

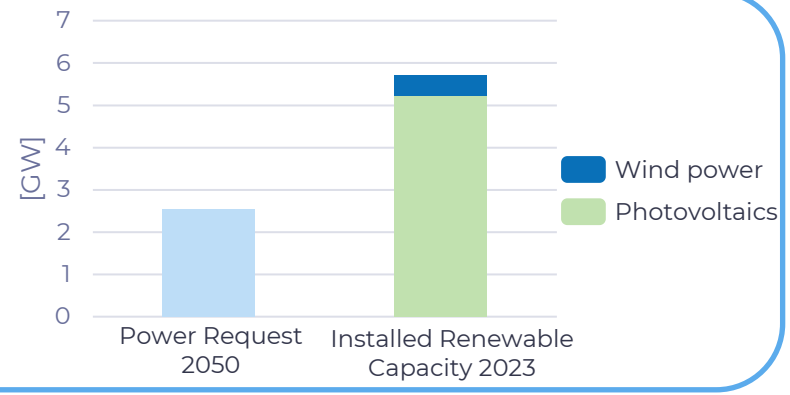
Future Trend Assessment - Grid Impact

Considering the fleet renewal process reached in the year **2050** (end of the simulated time period), the increase in **power and energy required from** the grid was **compared to the increase in renewables capacity installed in recent years**, in order to check its feasibility.

POWER REQUIRED

Assuming a value of approximately **37,500 electric buses circulating in 2050** and a required capacity of 78 kW per bus, this gives a **total required capacity of approximately 2.55 GW.**

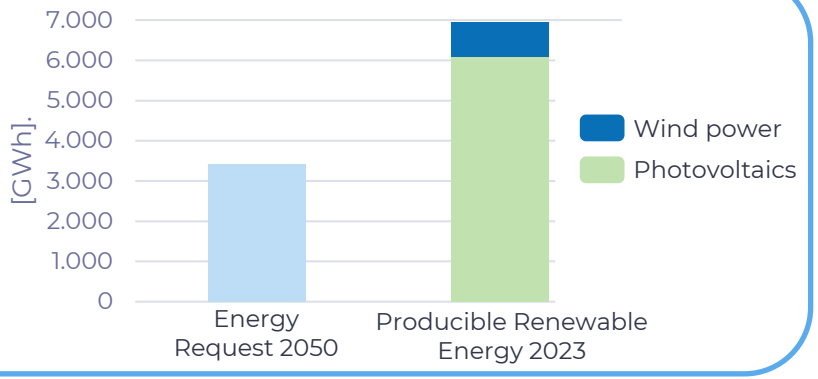
Installed in Italy in 2023: 5.23 GW Photovoltaic + 488 MW Wind



ELECTRICITY REQUIRED

The electrical energy required for recharging E-buses and producing the hydrogen needed for F-buses reaches a value of **approximately 3,412 GWh in 2050**

Considering a value of equivalent hours of operation in line with the trend of previous years, the systems installed in **2023** would generate **6,094 GWh** from **photovoltaics** and **861 GWh** from **wind power**



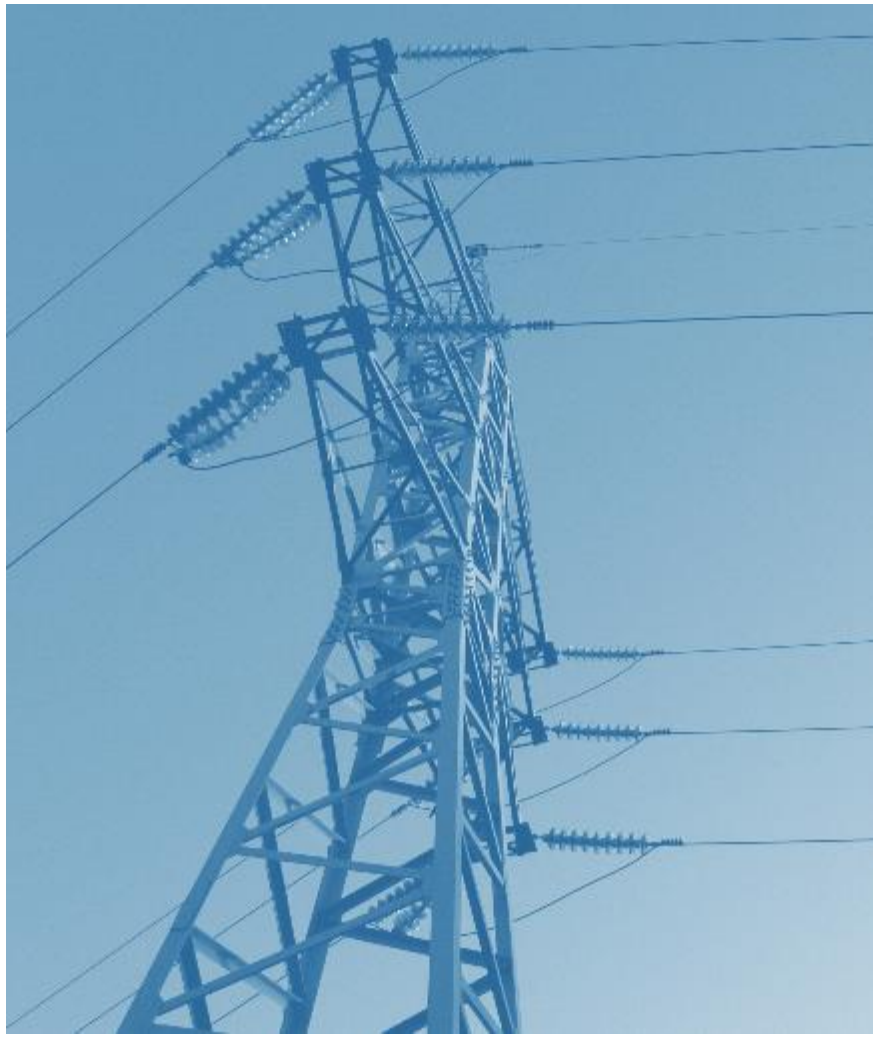
Future Trend Assessment - Electricity System

Considering **TERNA's recent analyses** and the **targets set by the PNIEC**, the **installed capacity** of plants based on **renewable energy sources is** expected to increase **sharply** year by year to reach the targets set for 2030.

As far as network operators are concerned, equally decisive **investments** are planned in **order to be able to manage the new power installed** from renewable energy sources, guaranteeing both domestic and foreign electricity exchange.

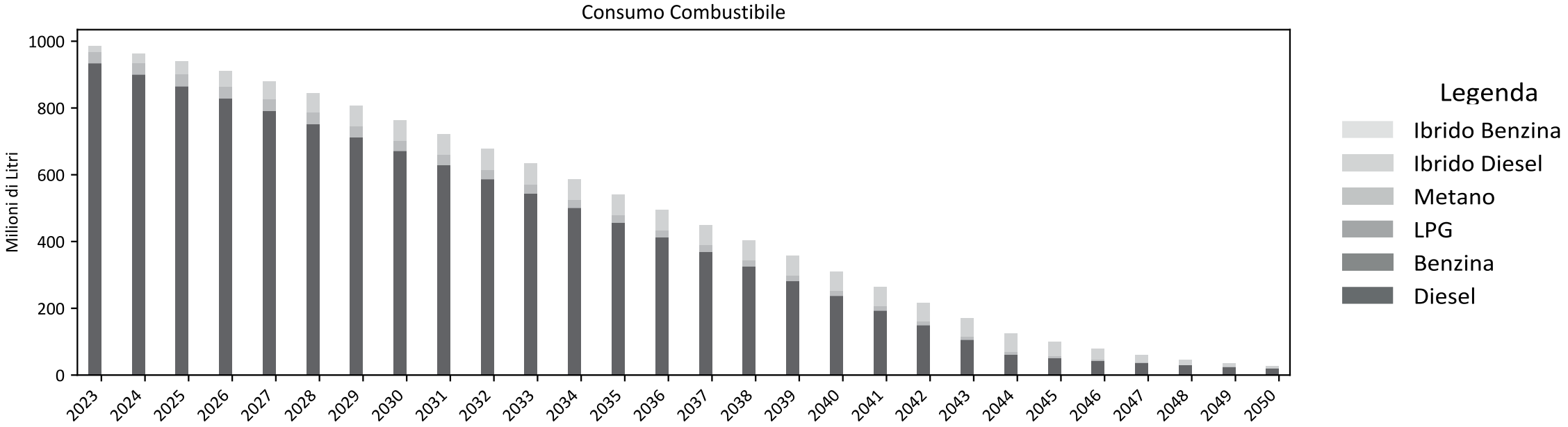
Although an increase in the power required by zero-emission buses is expected in the coming years, this increase **still lags behind the growth in renewables**: considering values in 2050 when an almost complete conversion of the fleet takes place, the values are lower than those already installed in recent years.

The electrification of the city bus fleet is therefore not a problem from the point of view of overall electricity consumption.
It is also true that an **adaptation of** the network at **local** level will be **required, as far** as recharging within the **individual depot is concerned.**



Future Trend Assessment - Fossil Fuel Reduction

Following the progressive renewal of the fleet and the phasing out of vehicles with endothermic engines, future years will see a gradual **reduction** in the amount of **fossil fuels consumed** annually by the **circulating bus fleet.**



Future Trend Assessment - Environmental Impact

Within an **'environmental impact' assessment, the reduction in fuel** consumed and **tonnes of CO2 emitted** is reported, **comparing the values** obtained for **2050 with the starting values for 2023**.

ENVIRONMENTAL IMPACT

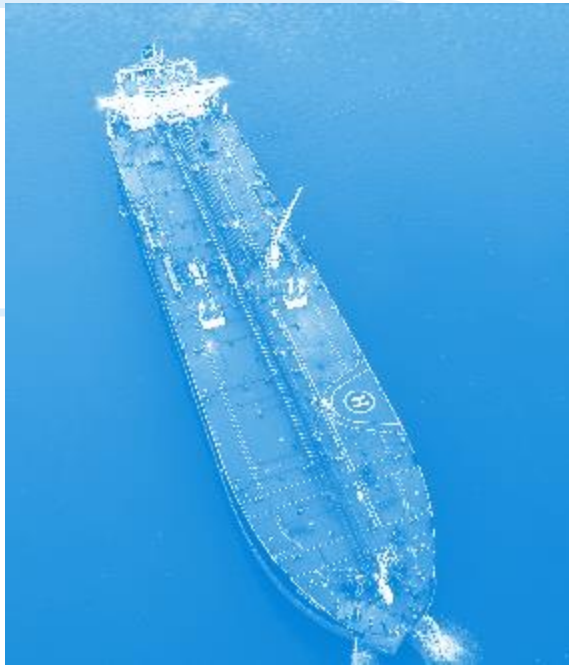
- **Decreased fuel consumption litres**
- **Decrease in tonnes of CO2 emitted**

Compared to 2023 values

- 957 million litres
of fuel (mainly diesel)

Equivalent to the contents of: approximately 10 SUEZMAX tankers of 175,000 tonnes capacity

- 2,393 kt CO2
emitted by vehicles



Credits: Pexels

Notes: For the calculation, the following were assumed:
0.43 kg petrol/kg oil, 1 barrel of oil equals 159 litres and 140 kg

Contents

Recruitment - Fleet characteristics

Hiring	Value	Source
Number of Vehicles	**42.600**	MIMS study 'Bus fleet for LPT' (September 2022)
Service life	**21 years**	
Average km/year	**65.000**	LCA standard value for local public transport buses (Directive 2009/33/EC)

Recruitment - Vehicle Consumption

Power supply	Consumption [kWh/100km]	Source
Diesel	183.38 (20L / 100km)	http://dx.doi.org/10.1109/ICASET.2018.8376784
Petrol	202.78	
LPG	44.31	
Methane	184.61	Assumption based on Eurac Research data processing
Hybrid diesel	150.20	
Hybrid petrol	119.56	
Plug-in hybrid	170	
Electric Vehicles	140	https://doi.org/10.1016/j.est.2023.108411
Hydrogen	316	https://doi.org/10.1016/j.est.2023.108411

Assumptions - Emission Coefficients

Power supply	Emissions [tCO2/MWh].	Source
Diesel	0.26972	https://www.covenantofmayors.eu/IMG/pdf/technical_annex_en.pdf
Petrol	0.25017	
LPG	0.22700	
Methane	0.20200	
Hybrid diesel	0.26972	
Hybrid petrol	0.25017	
Plug-in hybrid	0.02001	
Electric Vehicles	Dependent on the Italian energy mix	Linear interpolation between PNIEC objectives
Hydrogen		

The regulatory framework and funding

1. The National Strategic Plan for Sustainable Mobility

The push to renew the bus fleet with zero-emission technologies was given in **2019** by the launch of the **National Strategic Plan for Sustainable Mobility** (PSNMS), worth more than **EUR 3.7 billion over fifteen years** (until 2033).

The PSNMS enshrines a clear technological choice, directing all funding **on electricity and gas**.

The PSNMS also funds recharging **infrastructure to** the extent of 80 per cent.

The regulatory framework and funding

2. New rules for co-financing

DPCM **30.04.2019** establishes the **stop of co-financing for the purchase of diesel buses**. These are the planned co-financing quotas:

Class I: 60 per cent in the case of gas buses and 80 per cent in the case of E-buses and F-buses
Class II: 80 per cent in the case of gas buses and E-buses, 50 per cent in the case of diesels and hybrids 'in the cases provided for in the plan'.

The regulatory framework and funding

3. Covid slips the roadmap

Decree-Law No. 34/20 'Relaunch' (Art. 200), in the light of the LPT crisis resulting from the **Covid**, intervenes on the PSNMS by establishing that 'The provisions concerning the obligation to use alternative fuelled vehicles, if there is no suitable infrastructure for the use of such vehicles, do not apply until 30 June 2021'. And the **suspension of the co-financing obligation until 31 December 2024**.

The obligation to renew fleets with alternatively powered buses thus slipped to mid 2021, without prejudice to the possibility of introducing diesel buses in the absence of 'alternative' bus infrastructure until 2024.

The regulatory framework and funding

4. The PNRR

In addition to the 3.7 billion PSNMS (up to 2033), there is the MIMS **Ministerial Decree 530/2021** on green buses, which allocated **1.92 billion euro** from the **PNRR** to regional/autonomous province capitals, metropolitan cities and municipalities with high PM10 and nitrogen dioxide pollution (Mission 2, Component 2, Investment 4.4.1). It provides that **only zero-emission city buses** are to be purchased.

The measure provides for 'on pain of withdrawal of funding
- at least 717 electric (or fully battery-electric or hydrogen range extender) buses in delivery by 31 December 2023,
- at least a further 2,690 zero-emission buses to be delivered by 30 June 2026, 'on pain of revocation of funding'.

It accompanies the **complementary PNRR** regulated by **Ministerial Decree 315/21**, for EUR 600 million earmarked for E-buses, F-buses, CNG (or LNG) for the intercity and suburban segment (mainly identifiable with Class II vehicles)

The PNRR also provides for an investment of **EUR 300 million for national bus chain R&D projects** through the use of development contracts (managed by Invitalia), as per Ministerial Decree No. 478/21.

Resources to 'support the implementation of around 45 industrial transformation projects aimed at developing the bus production chain to produce electric and connected vehicles through development contracts'.

The measures must be completed in such a way as to "ensure the activation of production of buses and/or their components by 30 June 2026'.

The regulatory framework and funding

5. The Clean Vehicle Directive

In 2021, in December, the European **Clean Vehicle Directive** was implemented at national level, which provides for a quota of zero-emission buses among those put out to tender for public service:

- 22.5% until the end of 2025
- 32.5% from 2026

6. PNSMS resources also for Class II

Prime Minister's Decree 11.12.2023 states that PNSMS resources can also be used to 'purchase methane- and hydrogen-powered buses and, from 2024, also electric-powered buses for extra-urban public transport'.

Tenders, perspectives, cities

TUSCAN AUTOLINEE #1

Autolinee Toscane (RATP group) has managed the local public road transport of the Region of Tuscany since November 2021. A service that 'embraces' over 950 lines, 24 thousand km of network, 2,600 buses, 37 thousand stops.

Beneficiary	Source of funds	Financing entity	Type	Entry into operation				Notes
				2023	2024	2025	2026	
Tuscany Region	DM 81 - PSNMS	10.688.933 €	BEV 8m	2				Consip order
	DM 81 - PSNMS		BEV 12m		16			AT tender
Municipality of Florence	DM 530 - PNRR	35.000.000 €	BEV 12m		25	27	18	Consip order
Metropolitan City of Florence	PON METRO	6.000.000 €	BEV 6m		12			
	DM 71 - PSNMS	2.440.000 €	BEV 12m			2		AT tender
	DM 71 - PSNMS		BEV 10.5m			2		AT tender
Municipality of Prato	DM 234 - PSNMS	4.411.615 €	BEV 10.5m			9		Consip order
	DM 530 - PNRR	6.510.000 €	BEV 10.5m		4		9	Consip order
Municipality of Lucca	DM 234 - PSNMS	5.169.774 €	BEV 8m			11		Consip order
	DM 530 - PNRR	4.690.000 €	BEV 6m		6			Consip order
			BEV 8m				8	Consip order
TOT		**74.910.322 €**		**2**	**63**	**51**	**35**	

Tenders, perspectives, cities

TUSCAN AUTOLINEE #2

In parallel with the purchase of the electric vehicles, Autolinee Toscane contracted, until April 2024, 153 charging stations for an investment of EUR 27.8 million.

Beneficiary	Source of funds	Financing entity	No. of columns	Deposit	Notes
Tuscany Region	DM 81 - PSNMS	1.952.507 €	2	Arezzo Setteponti	Consip order
			16	Pisa Ospedaletto	AT tender
Municipality of Florence	DM 530 - PNRR	13.411.560 €	72	No. 20 Florence Peretola No. 52 Florence Olmatello	AT tender
Metropolitan City of Florence	PON METRO	6.000.000 €	12	No. 12 Florence Cure	Tender CM Florence
	DM 71 - PSNMS	130.000 €	2	No. 2 Florence Peretola	
Municipality of Prato	DM 234 - PSNMS	882.323 €	10	No. 23 Lazaretto Meadow	AT tender
	DM 530 - PNRR	1.604.071 €	13		
Municipality of Lucca	DM 234 - PSNMS	1.058.376 €	12	No. 26 Lucca Luporini	
	DM 530 - PNRR	2.781.861 €	14		
TOT		**27.82.698 €**	**153**		

Tenders, perspectives, cities

TARANTO

The municipality of Taranto is planning to build a **71-kilometre BRT network**, consisting of two partially overlapping lines of approximately 9 kilometres. The project aims to provide a high-frequency, high-capacity public transport service on two urban corridors on dedicated lanes. The **service will be provided by means of 18-metre articulated electric buses**: a tender for 45 vehicles (+ 9 optional) was awarded at the end of 2023 **for approximately EUR 46 million**, including **16 pantograph recharging points and 67 plug-in recharging stations for storage**.

The new vehicles will be integrated into Kyma Mobility's fleet, which as of 31 December 2023 consisted of 165 buses, with an average age of 5 years and 11 months (all Euro 4 or higher except for 6 Euro 3 buses).

Contracts for executive design services and infrastructure works were awarded in the course of 2023 for a total of more than EUR 157 million financed with PNRR funds.

Tenders, perspectives, cities

AMTS CATANIA

AMTS Catania has included a series of investments, including the purchase of electric buses and related recharging infrastructure, in its 2023 - 2025 business plan.

In particular, **EUR 3.5 million from PON Metro 2014-2020 funds** were allocated in December 2021 for the purchase of **11 8-metre electric buses**, to be delivered in early 2023. A **further 7 electric buses, this time in standard 12-metre size, were** ordered in January 2022, again thanks to PON Metro funds (3.8 million).

From the same line of funding comes the **10 million invested in the construction of the bus recharging infrastructure, with** an **installed capacity of 5 MW and 45 recharging points**, opened in March 2024. A total of 45 charging points for the new electric buses, plus a further 20 charging points for electric cars, were built in the shed. **By 2026, 145 charging points will be installed for an installed capacity of 15 MW, tripling the current**

At the end of 2023, the company also ordered 42 electric buses through the Consip purchasing centre. They are part of a total of 112 e-buses ordered with PNRR funds.

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eurac research

MOTUS-E

Sustainable BUS