Feasible paths of road transport decarbonization in Italy

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MOST
CENTRO NAZIONALE PER LA MOBILITÀ SOSTENIBILE

TECNE
Sustainable Engineering

Hosted by Aiscat

15 December 2025
Rome, Italy

Organized by ASECAP

SUNRISE OBSERVOTARY

The **SUNRISE Observatory** is a shared platform among institutions, research bodies and sector stakeholders, aimed at analyzing in an integrated way **the transformations of road mobility and its emissions**

The Observatory stems from the collaboration of six partners but is open to additional stakeholders.

The Observatory involves numerous experts and companies active in the sector.

Methodology of Estimation

PAST - 2024

Multi-source data travel demand fleet composition fuel consumption

Multi-source Demand Estimation methodology

National road travel demand (passenger and freight) *[vehicle-km per class]*

Unit Consumption and Emissions

Greenhouse gas (GHG) Emissions and Energy consumption estimation methodology

Emissions and energy consumption

VEHICLE CLASS:
Veh. type, segment, power train, road type

2030 - 2034

Scenarios of demand evolution no-policy

High

Avoid

Shift

Improve

Save

Vehicles km by class

Emission and energy forecast

Low

Avoid

Shift

Improve

Save

Vehicles km by class

Emission and energy forecast

POLICIES

Demand reduction

Shift to sustainable modes

Shift to energy- CO_2 efficient power trains

Vehicle markets evolutions

More sustainable user behaviors (e.g., eco-driving, downsizing)

Evolution of energy sources

Scope of analysis (vehicle classes)

VEHICLE CATEGORIES ANALYZED

Passenger Cars
Large/SUV, medium, small/mini

Motorcycles
Two-stroke, four-stroke

Buses
Urban medium (≤15 t), urban standard (15–18 t), urban articulated (>18 t), standard coaches (≤18 t), articulated coaches (>18 t)

Freight Vehicles
Grouped by vehicle weight (tare) and average payload of <=7,5 t, 7,5 - 12 t, 12 - 14 t, 14-20 t, 20-26 t, 26 - 28 t, 28-34 t, 34-40 t, 40 - 50 t, 50 - 60 t

EMISSION CLASS

Euro 0 Euro 1, Euro 2, Euro 3, Euro 4, Euro 5, Euro 6

POWER SOURCE

Petrol, diesel, electric, petrol hybrid, diesel hybrid, methane (CNG), LPG, hydrogen

TYPES OF ROAD INFRASTRUCTURE

Highways
Extra-urban or urban roads with independent carriageways or separated by an impassable median strip, at least two lanes per direction, with no level intersections or private accesses, equipped with acceleration and deceleration lanes (Type A, Art. 2 of the Highway Code).

Urban Roads
municipal roads owned or managed by a Municipality (Types D, E and F under Art. 2 of the Highway Code).

Extra-urban Roads
extra-urban roads not belonging to the previous categories (Types B and C under Art. 2 of the Highway Code).

Road Transport Demand in 2024

	Mln Vehicles*km (2024)				Share of total (2024)				Share by Road Category (2024)			
	Urban	Extraurban	Highways	**Total**	Urban	Extraurban	Highways	**Total**	Urban	Extraurban	Highways	**Total**
Passenger Cars	93.162	243.226	78.575	**414.962**	18,0%	47,0%	15,2%	**80,2%**	22,5%	58,6%	18,9%	**100,0%**
Buses	977	1.394	513	**2.884**	0,2%	0,3%	0,1%	**0,6%**	33,9%	48,3%	17,8%	**100,0%**
Light Commercial Vehicles	11.477	36.459	8.374	**56.310**	2,2%	7,0%	1,6%	**10,9%**	20,4%	64,7%	14,9%	**100,0%**
Heavy Commercial Vehicles	1.752	16.356	10.942	**29.050**	0,3%	3,2%	2,1%	**5,6%**	6,0%	56,3%	37,7%	**100,0%**
Motorcycles and quadricycles	8.586	5.608	138	**14.332**	1,7%	1,1%	0,0%	**2,8%**	59,9%	39,1%	1,0%	**100,0%**
Total	**115.955**	**303.042**	**98.541**	**517.539**	**22,4%**	**58,6%**	**19,0%**	**100,0%**	**22,4%**	**58,6%**	**19,0%**	**100,0%**

↓ Insight

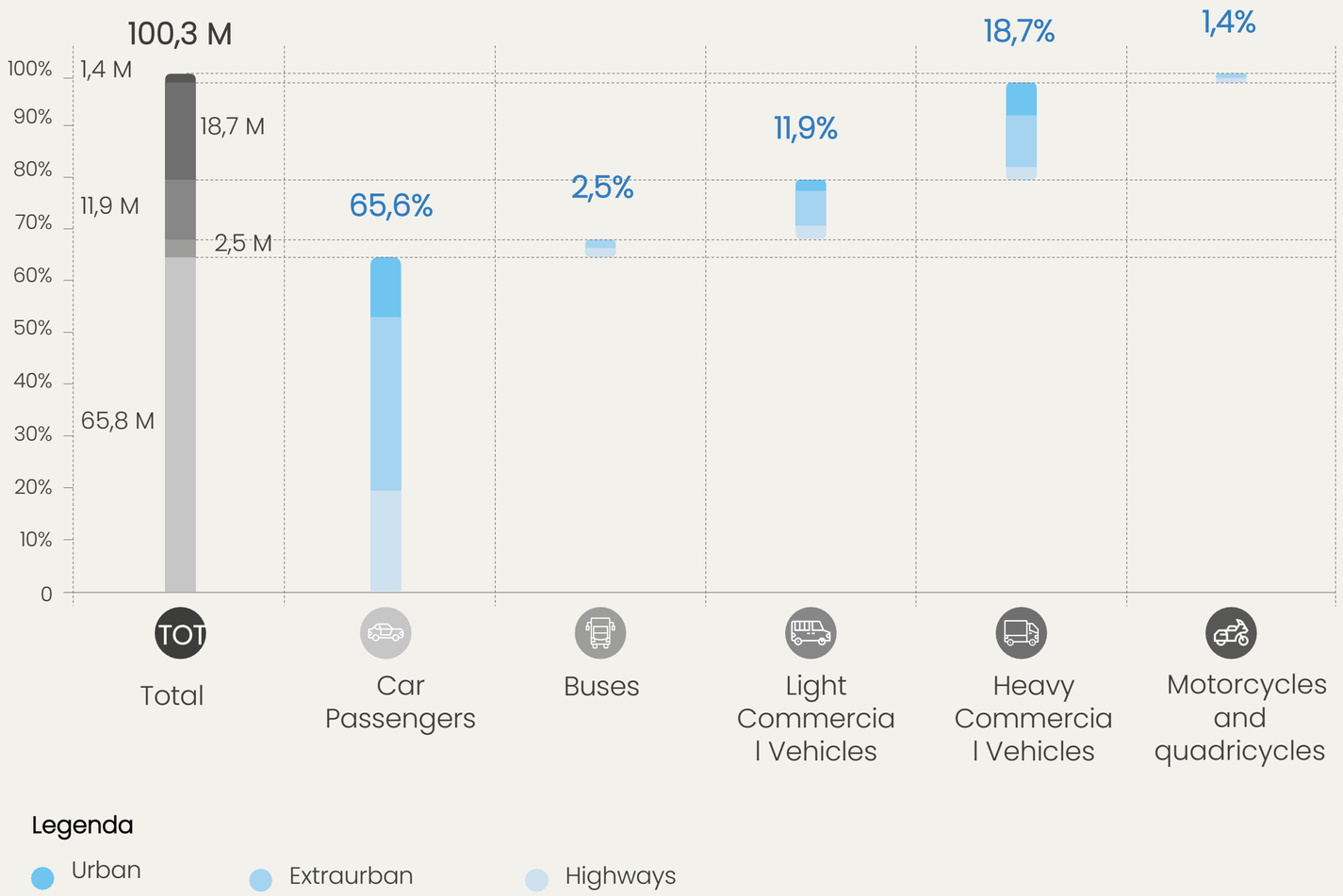
1. Approximately 84% of vehicle-kilometres on the road are attributable to passenger transport.

2. Approximately 10% is attributable to light commercial vehicles.

3. Approximately 5.6% of the total is attributable to heavy vehicles, but they account for 38% of motorway traffic.

Emission Inventory: CO2eq TTW (2024)

TCO2 EQ 2024 TTW AND SHARE OF TOTAL (2024)



SHARE BY ROAD CATEGORY (2024)

	Urban	Extraurban	Highways	**Total**
Car Passengers	31,1%	51,3%	17,6%	**100%**
Buses	36,2%	51,8%	12,1%	**100%**
Light Commercial Vehicles	29,3%	55,2%	15,5%	**100%**
Heavy Commercial Vehicles	11,7%	54,6%	33,7%	**100%**
Motorcycles and quadricycles	63,3%	35,4%	1,2%	**100%**
Total	**27,8%**	**52,2%**	**20,0%**	**100%**

Definition of Trend scenarios (current policies)

High Decarbo scenario

DEMAND EVOLUTION

Motorway network
Tendential growth in mobility based on a macroeconomic model calibrated on observed motorway-traffic data and applied using optimistic assumptions (from a decarbonisation perspective) for the macroeconomic variables found to be significant (GDP, population, and fuel price at the pump).

Urban areas
A substantial stability of demand is assumed, with no growth compared to current levels.

Extra-urban areas
Average trend between the motorway and urban assumptions.

AVOID

Reduction in demand driven by a **broader adoption of smart working**. Share of smart workers in 2030 equal to **25% of employees** (maximum post-Covid values by sector), with **8 days per month of remote work.**

SHIFT

Modal shift in favour of collective transport, with a reduction in car vehicle-km due to:
1. **PNRR investments** and complementary fund → -3% reduction in average vehicle-km;
2. **Implementation of PUMs** in metropolitan cities → -18% car use for 36% of the population (based on SUMP estimates for Turin, Naples and Bologna);
3. **Growth of sharing mobility**.

Low Decarbo Scenario

Motorway network
Tendential growth in mobility based on a macroeconomic model calibrated on observed motorway-traffic data and applied using conservative estimates (from a decarbonisation perspective) for the macroeconomic variables found to be significant (GDP, population and fuel price at the pump).

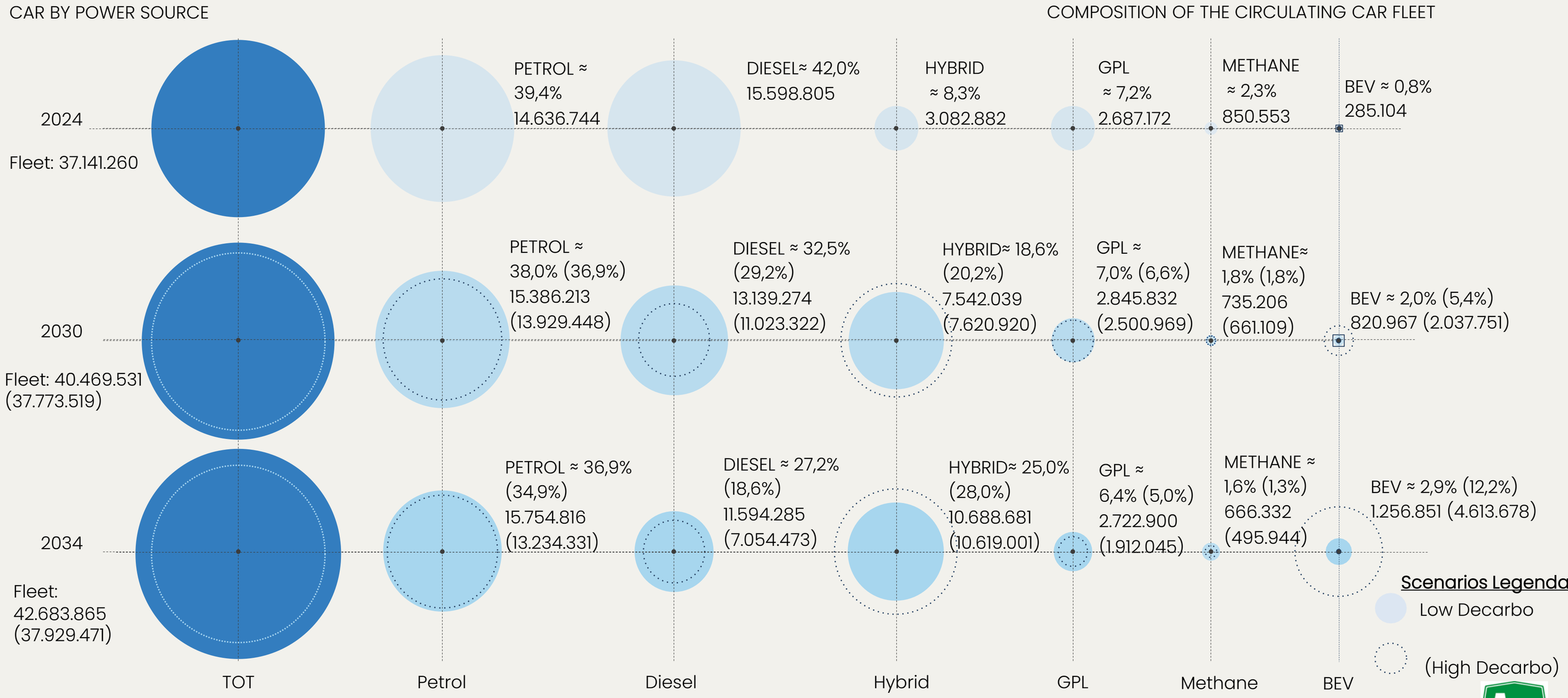
Urban areas
An increase in demand is assumed, based on the average values of per-capita distance observed over the period 2002–2018.

Extra-urban areas
Average trend between the motorway and urban assumptions.

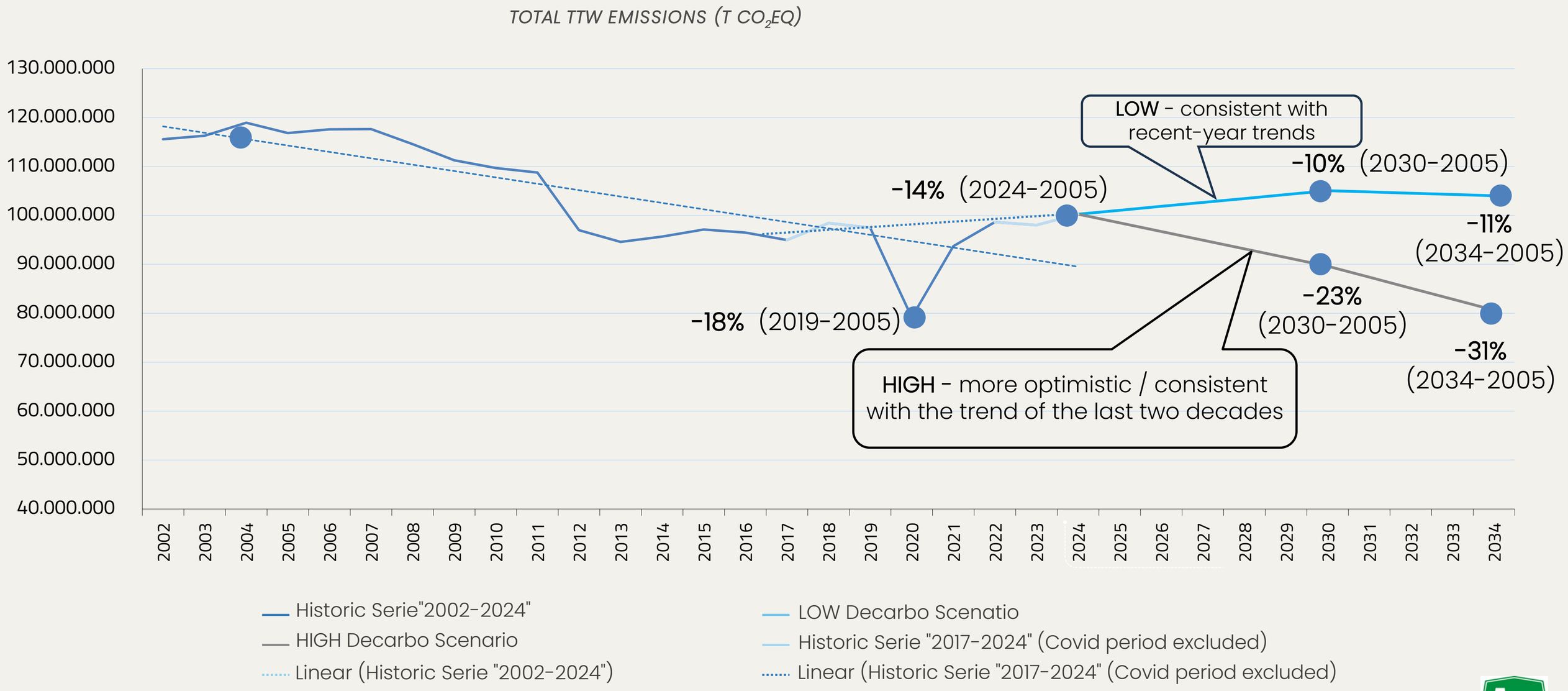
It is assumed that the **number of smart workers in 2024 will remain constant in the coming years,** with no resulting change in vehicle-km.

Modal shift equal to 50% of that assumed in the optimistic scenario for points 1 and 2, due to possible infrastructure delays, funding constraints for public transport and lower user responsiveness.

Estimate of the Vehicle Fleet Composition



Total TTW Emissions (T CO2EQ)



Main Conclusion from the Italian case - study

- The **road system** has been experiencing a **re-carbonization phase since 2019** after two decades of decarbonization
- **Current policies are not able to achieve medium term UE objectives of CO2 reductuion** even under the more optimistic assumptions
- **Travel demand levels will out- perform CO2 reductions** due to electrification (Hibrid + BEV) of fleets at least till 2034
- **Shift to rail** has a **limited** range of **contribution** both for passengers and freight
- **Freight vehicles will increase** significantly their share of **CO2 emissions**
- **Additional policies** (e,g, energy saving push and pull)and a WTW approach **are needed** in order to close CO2 reduction targets

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