ODYSSEE-MURE

Enerdata intelligence + consulting

Energy efficiency trends in transport in the EU

Odyssee-MURE webinar series on Energy Efficiency

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Life

ADEME AGENCE DE LA TRANSITION ÉCOLOGIQUE

Leonardo ENERGY

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About ODYSSEE-MURE

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About ODYSSEE-MURE

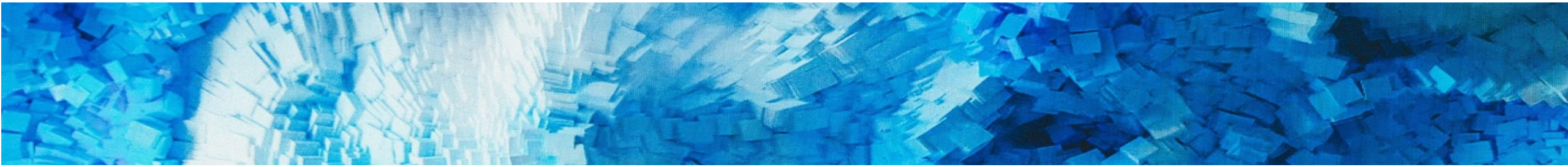
27 EU Member States + **9** Energy Community parties + Switzerland

Data up to 2021, from national sources + Early estimates for 2022, calculated by Enerdata

Enerdata **Available at www.odyssee-mure.eu**

Agenda

1. Energy consumption and emission trends
2. Energy efficiency trends
3. Conclusion and Q&As



1 Energy consumption and emission trends

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EU transport in short

Growing share in consumption and CO_2 emissions

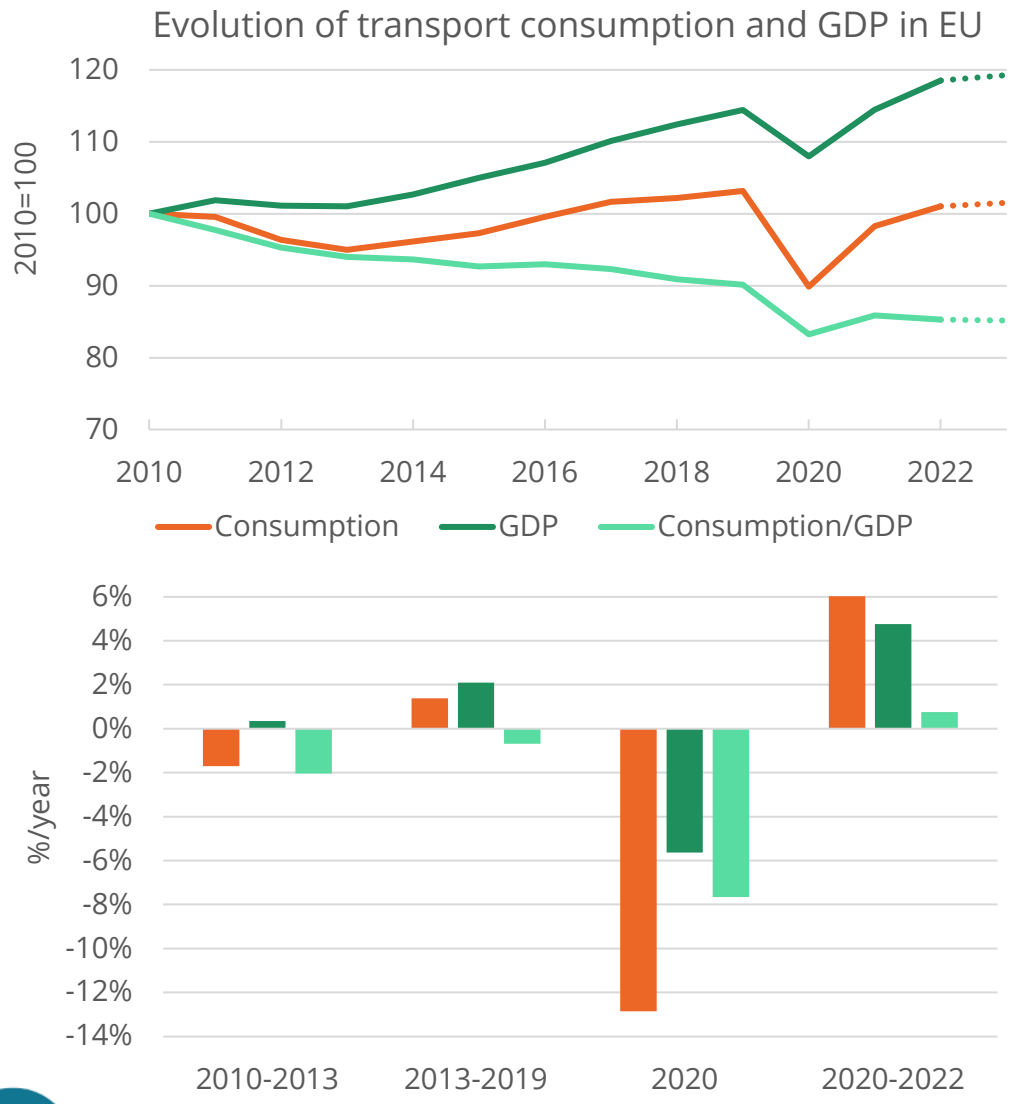
Limited decarbonisation

Top runner in transition

	2022	Trend since 2010 (2)	Top runner
Share of transport in final consumption (1)	**31%**	**+3 pp**	
Energy shares in transport			
% oil	**91%**	**-2.2 pp**	
% biofuels	**6.3%**	**+1.9 pp**	**26.5% (SE)**
% electricity	**1.7%**	**stable**	**4.7% (SE)**
Share of transport in CO_2 emissions (3)	**30%**	**+5.5 pp**	
Emission factor (tCO_2/toe)	**2.8**	**stable**	**2.1 (SE)**

(1) Final consumption without non energy uses; international air transport not included (equivalent to 8% of transport consumption).
(2) pp: percentage points
(3) CO_2 emissions from combustion

Transport energy consumption and GDP in the EU



- **Rebound in transport consumption** in 2021 (+9%) and 2022 (+3%) after the travel restrictions linked to Covid (-13% in 2020).
- **Regular increase in consumption** over 2013-2019 (**+1.4%/year**), slightly slower than GDP (as before the 2008 financial crisis), which led to a **0.7%/year** decrease in consumption per unit of GDP.
- First estimates show a **stabilisation in 2023**.

Sources: Eurostat (2010-2021), Enerdata (2022 and extrapolation based on 7 months for 2023).

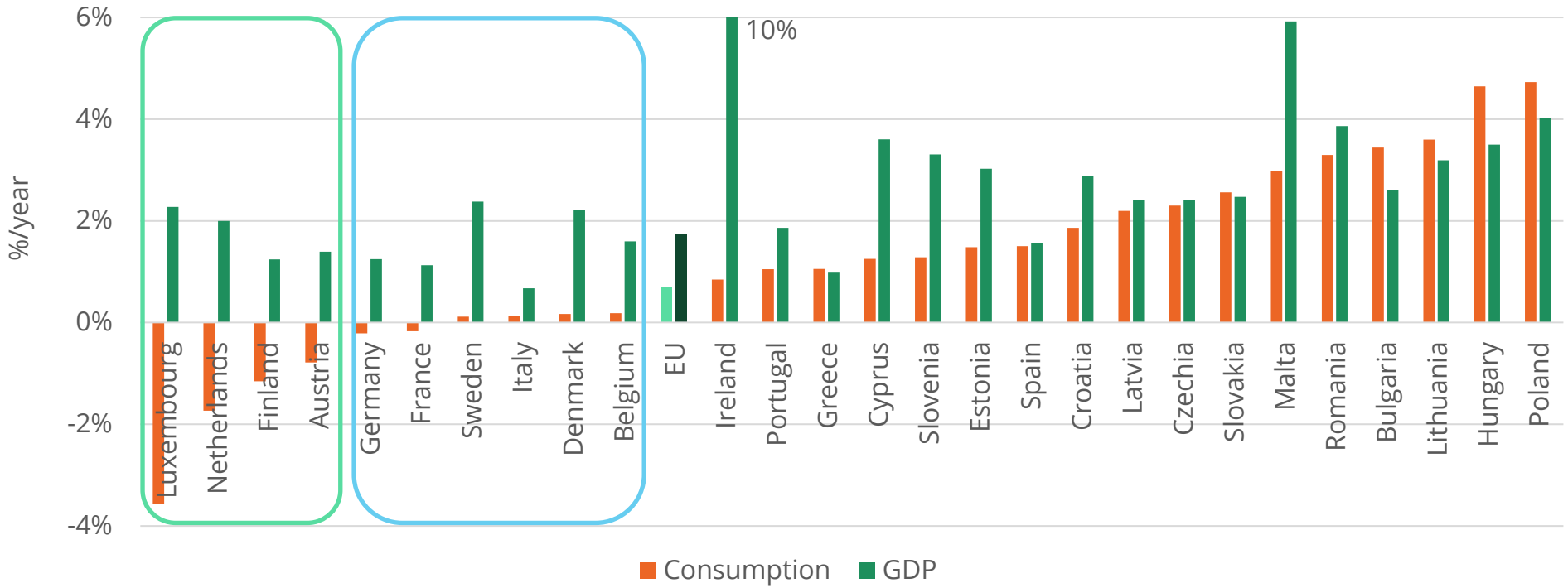
Transport consumption and GDP since 2013: contrasted trends

Since 2013, transport consumption remained roughly **stable** in **6** EU countries, and **decreased rapidly** in **4** countries, despite economic growth.

Consumption **increased less rapidly than GDP** in **8** countries (as in the EU) and grew **as GDP** in **5** countries.

In **4** countries, consumption growth was much **faster than GDP**.

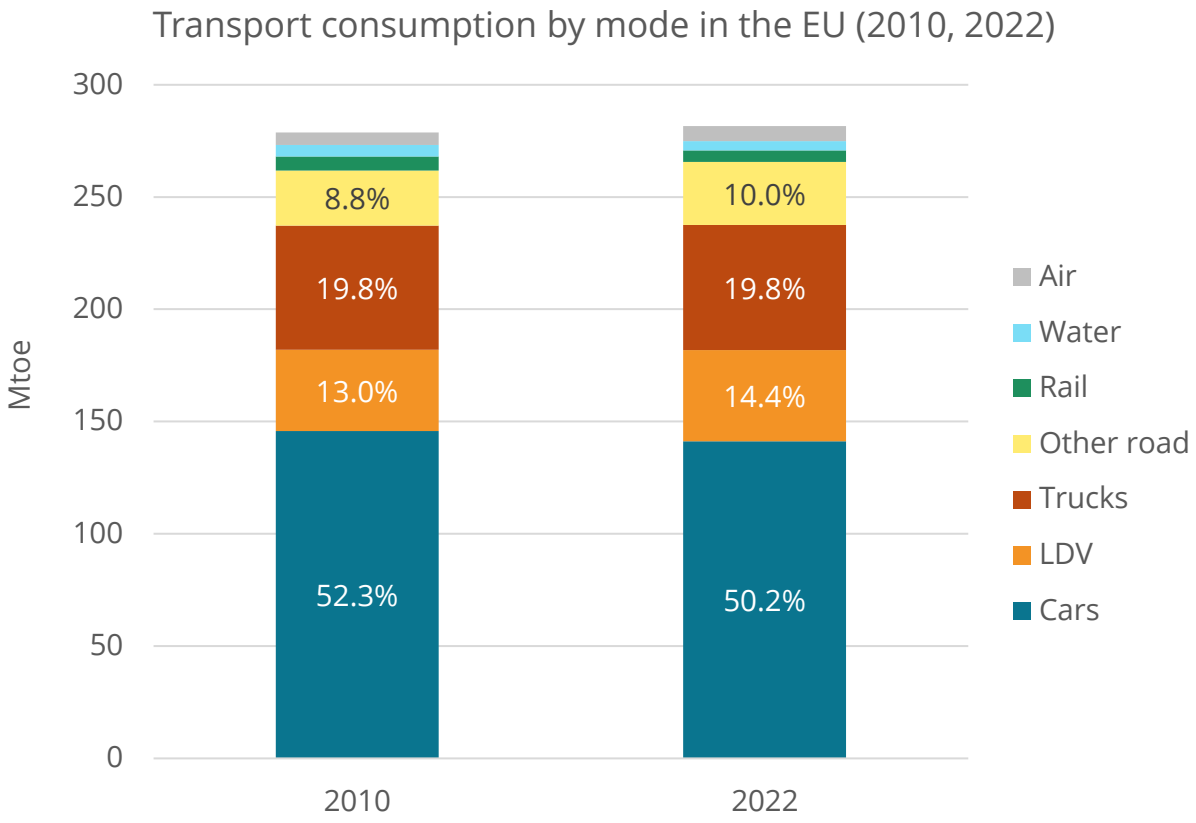
Transport consumption and GDP in EU MS (2013-2022)



Sources: Eurostat (2013-2021), Enerdata (2022).

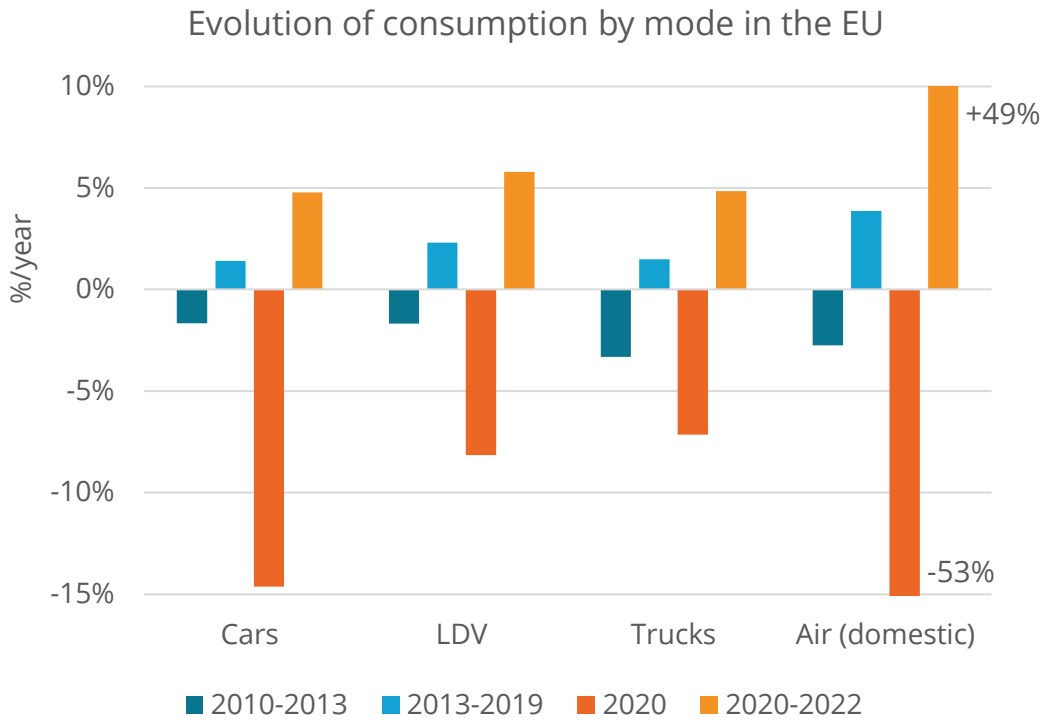
Transport consumption by mode in the EU

- Cars absorb around half of transport energy consumption, followed by trucks and LDV (a third).
- The **share of cars** in transport consumption has **slightly decreased** since 2010 (-2 pp).
- Domestic air and rail account for around 2% of the consumption each and water transport for 1.5%.



Sources: ODYSSEE (2010-2021), Enerdata (2022).

Transport consumption trends by mode in the EU



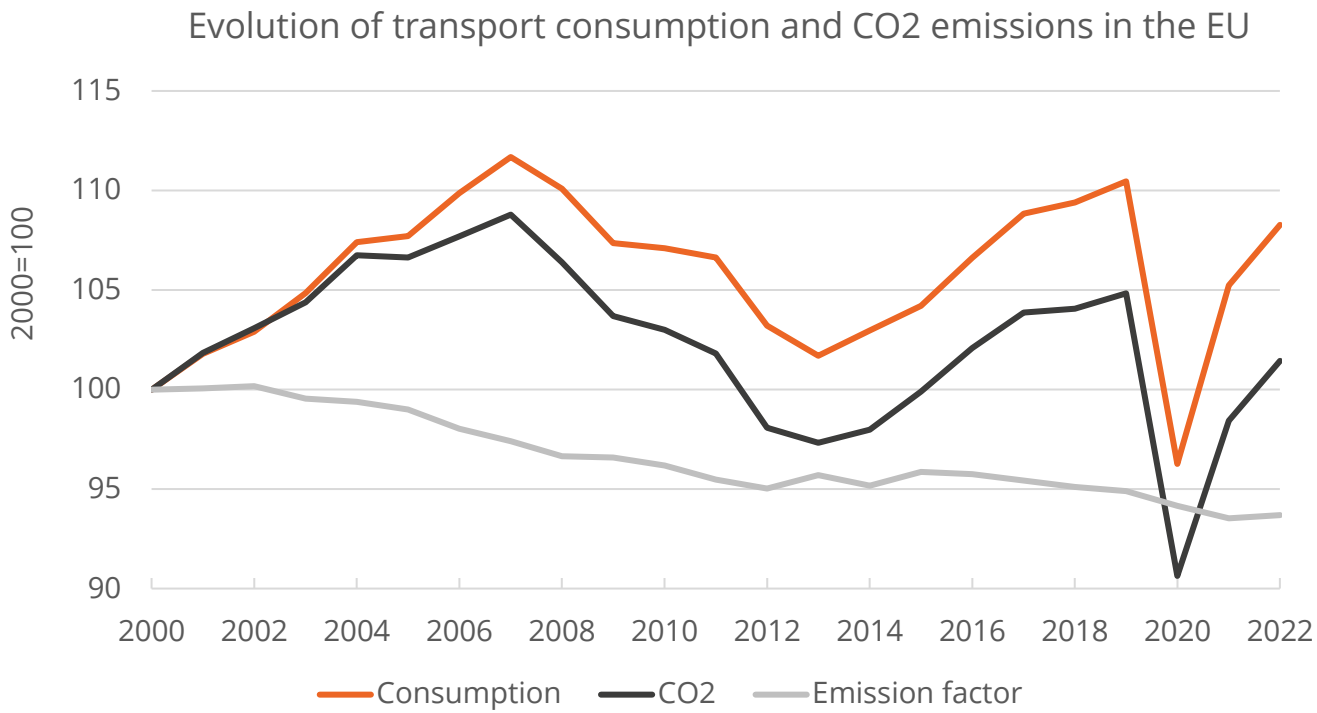
- **Slow increase** in consumption of **road vehicles** (cars, LDV and trucks) between 2013 and 2019.
- Passenger transport strongly affected by Covid (-15% for cars and -53% for air).
- **Strong rebound over 2020-2022 for all road vehicles** (> 5%/year) driven by equally strong economic growth, and for air transport by the end of restrictions (+49%).

Sources: ODYSSEE (2010-2021), Enerdata (2022).

CO_2 emissions and consumption in EU transport

Decoupling of CO_2 emissions and consumption, with a decrease in the carbon emission factor since 2018 (-0.4%/year), and from 2004 to 2012 (-0.6%/year), thanks to a **progression of the share of biofuels and electricity**.

In 2022, CO_2 emissions are only 1.5% higher than in 2000, while consumption is 8% higher.



Only direct CO_2 emissions, which do not include emissions due to electricity supply to electric vehicles.
Sources: Eurostat (2013-2021), Enerdata (2022).

2 Energy efficiency trends

Enerdata

How is energy efficiency progress measured in ODYSSEE?

Energy efficiency is first assessed at the level of each **mode** and **types of vehicles** with indicators of specific consumption measured in **different physical units**, e.g. l/100 km, koe/km, koe/pkm for passenger transport, koe/tkm* for freight.

A special focus is given on **cars**, which absorb **half of the consumption of the sector**, with a monitoring of the efficiency of the car stock and new cars.

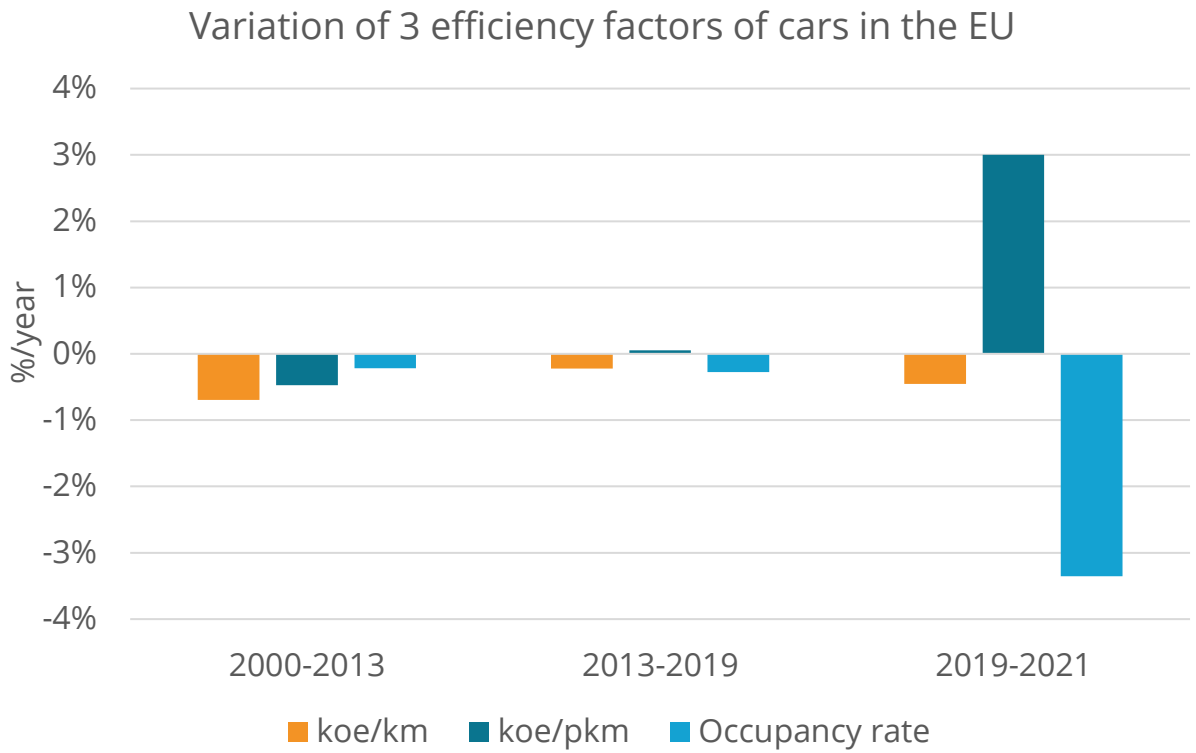
- For the **car stock**, different indicators can be used depending on the definition of energy efficiency:
  - l/100 km or koe/km to capture their technical efficiency
  - koe/pkm to measure their overall efficiency (i.e. including the effect of change in load factor) ➔ "preferred indicator" proposed by the European Commission to monitor top-down energy savings.
- For **new cars**, specific consumptions correspond to test values: l/100 km for thermal vehicles, goe/km for electric cars and the average of new cars.

*koe: kilogram oil equivalent (1 koe = 10^{-3} toe)

How to assess the energy efficiency of cars?

The efficiency of vehicles, measured by the indicator in **koe/km**, has been **decreasing by 0.5%/year** until 2013 and since 2019.

If the focus is on the **overall efficiency** (koe/pkm), there has been almost **no progress since 2014**. It has even much deteriorated between 2019 and 2021, with a significant **decrease in the occupancy rate** in 2020 (-8%) and almost no rebound in 2021, which raised the indicator by 3%/year.

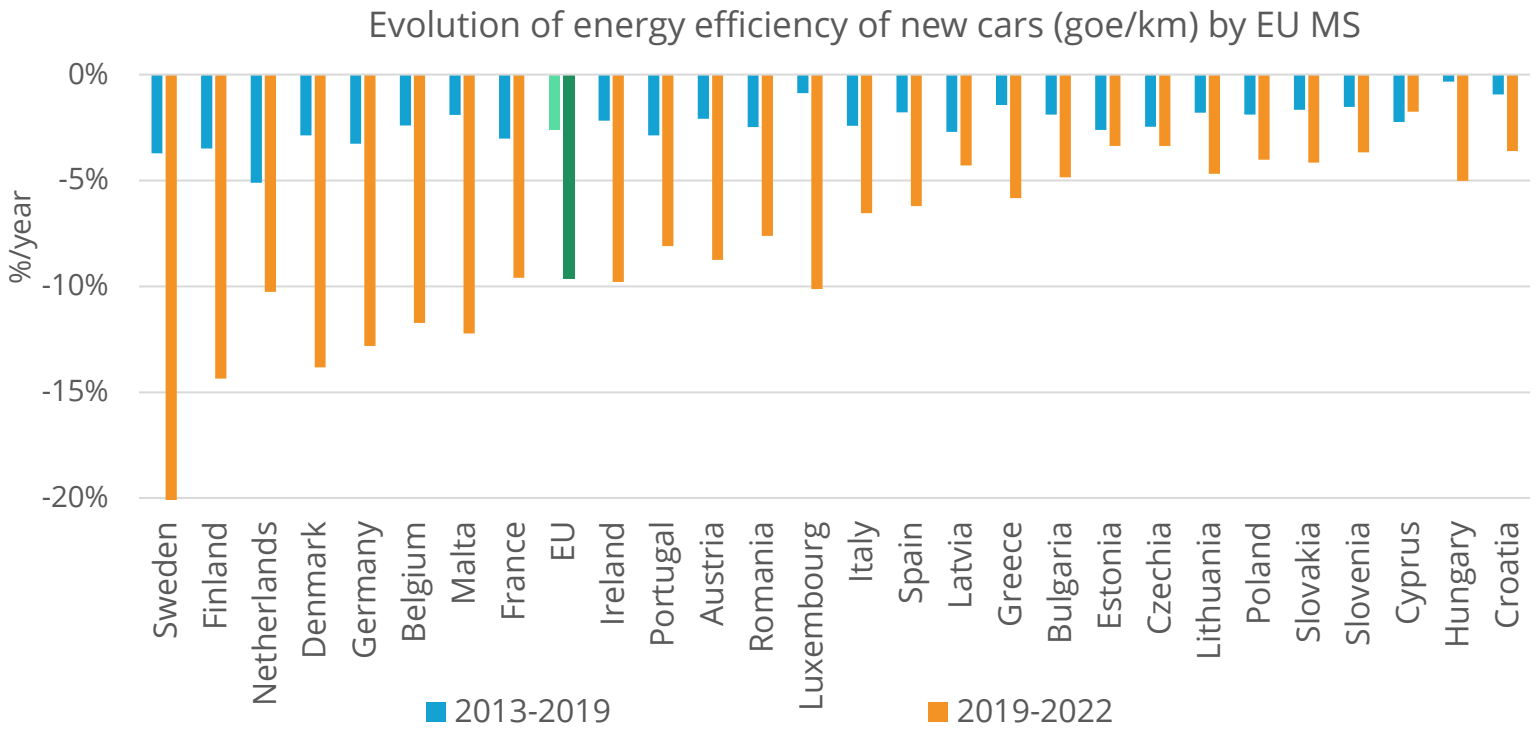


Source: ODYSSEE

Energy efficiency of new cars (goe/km)

The specific consumption of **new thermal and electric cars** has **decreased rapidly** (-5%/year at EU level over 2013-2022), with the greatest progress in **Sweden** (-10%/year), followed by **Finland**, the Netherlands and Denmark (-7%/year).

The reduction in specific consumption has **accelerated since 2020** with the rapid **penetration of electric and hybrid cars**: from 3% in 2019, to 22% in 2022 at EU level (12% BEV).



Source: ODYSSEE from EEA, WLTP standard.

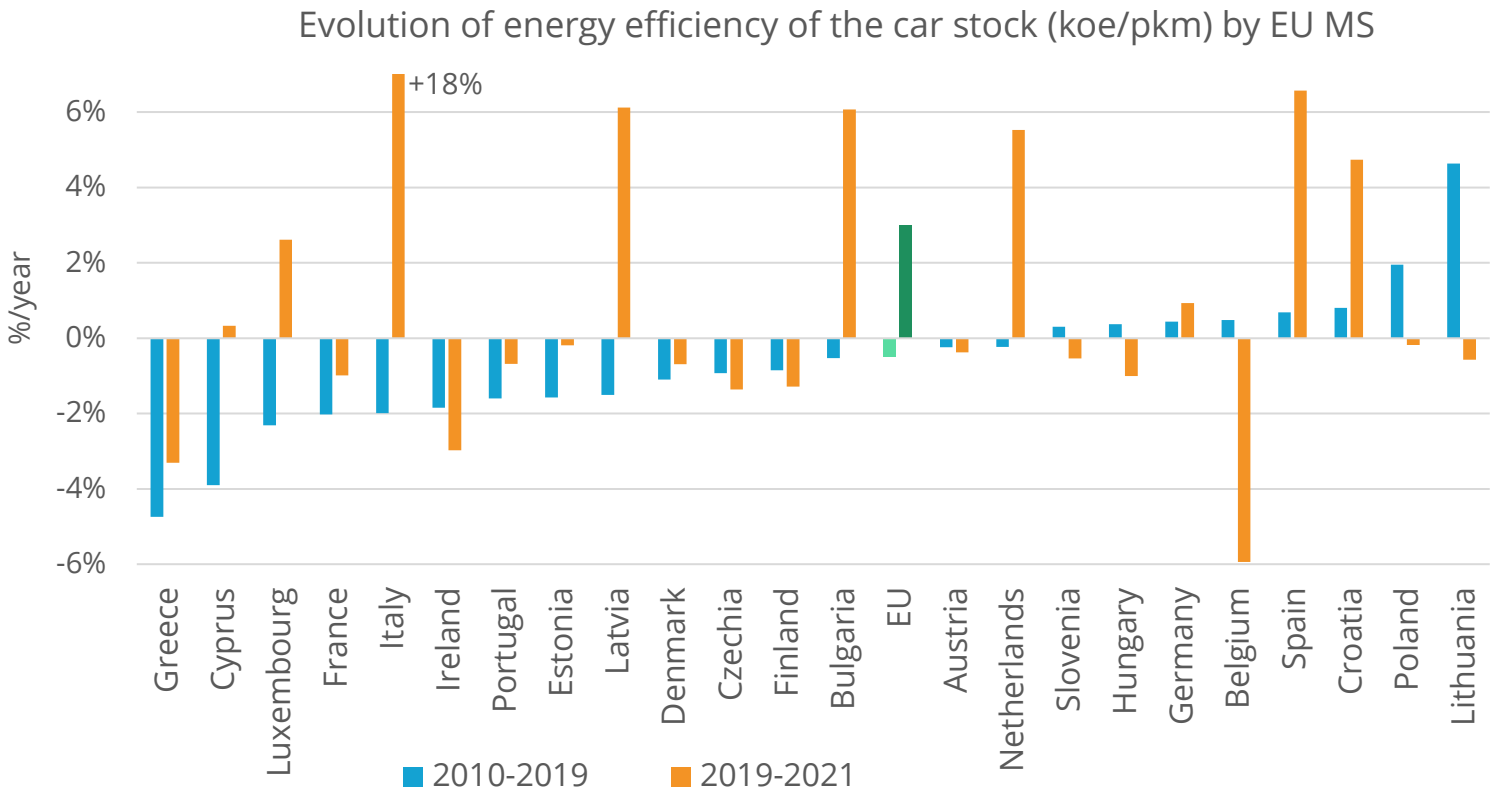
Energy efficiency of car stock (koe/pkm)

Energy efficiency improvements for cars have been **limited until 2019** and have deteriorated since then.

At country level, there are **contrasted situations**, with significant improvements over the whole period in some countries (Greece, Ireland or France).

Such improvements are linked to different factors: more efficient cars, smaller cars (France and Ireland), or also behaviours (Greece).

This contrasts with the situation observed for **new cars**, which correspond to **test values**, and do not include load factors effects.



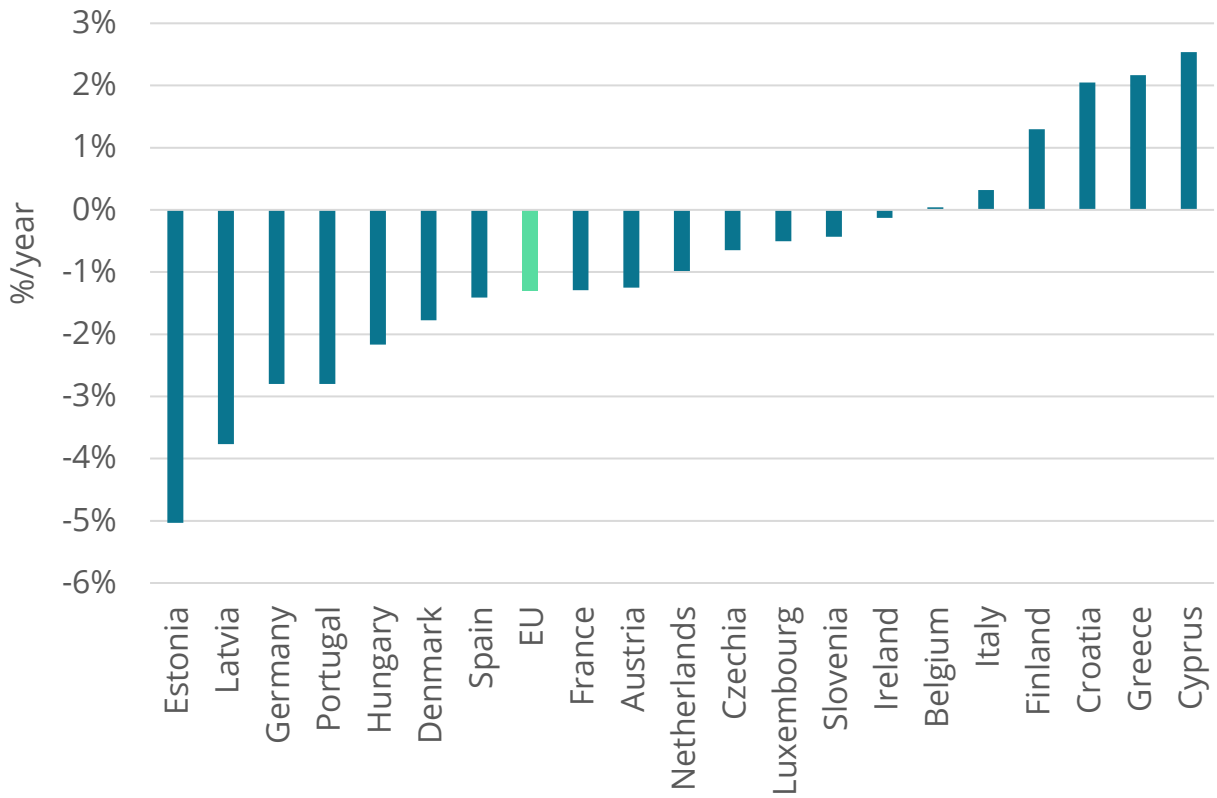
Source: ODYSSEE

Energy efficiency of road freight transport (goe/tkm)

At EU level and in many countries, the **unit consumption of transport by trucks** has **decreased** by more than 1%/year since 2000, reflecting energy efficiency improvements.

This trend has generally accelerated since 2014 (to around 1.6%/year at EU level), with the combined effect of an increase in load factors (i.e. tkm/veh) and more efficient vehicles.

Evolution of energy efficiency of transport by trucks (goe/tkm) in EU MS (2000-2021)



Source: ODYSSEE. Only countries with data on trucks are represented.

How to assess the overall energy efficiency of transport?

From the different energy efficiency trends measured for each transport mode, ODYSSEE calculates an **energy efficiency index** for the whole transport sector, called "**ODEX**".

ODEX is calculated:

First, by expressing trends in specific energy consumption by mode, as seen before for cars and trucks, as an index of variation;

Then by calculating an average index for the sector weighted by the share of each transport mode in the sector's consumption.

ODEX is calculated based on **8 modes of transport***.

Specific consumption are expressed in **different physical units** so as to be as close as possible to energy efficiency (koe/pkm for cars, buses and aviation, koe/tkm for trucks and water, koe/vehicle-km for light duty vehicles, toe/vehicle for motorcycles, koe/tkbr for rail).

* Rail, water, domestic air, cars, buses, motorcycles, trucks and light vehicles.

For more information on ODEX: https://www.odyssee-mure.eu/publications/archives/odex-indicators-database-definition.html

Energy efficiency trends in transport in the EU

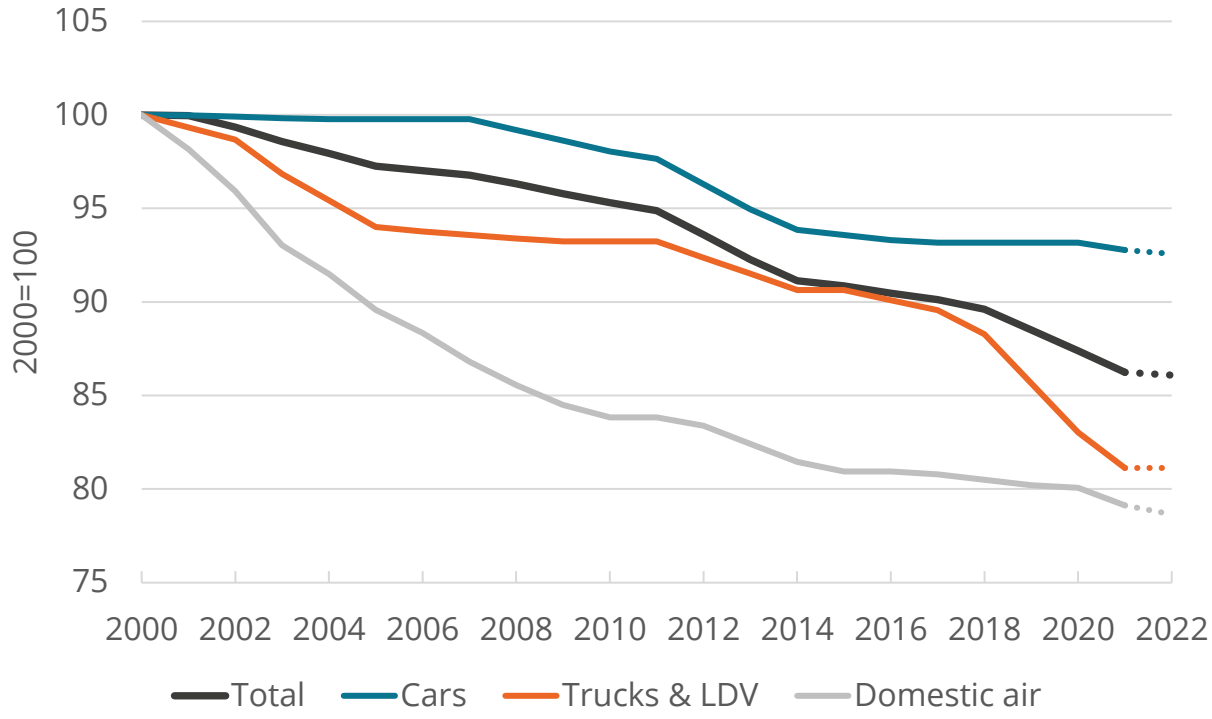
The energy efficiency of transport **improved by 0.7%/year** since 2000 in the EU (i.e. by 13% compared to 2000 level).

Slight progress for cars since 2013.

Energy efficiency progress has been **significant for trucks and light vehicles since 2012**, after no progress between 2008 and 2012 following the financial crisis (less efficient operation of trucks with lower load and empty running).

Greater progress was achieved for domestic air transport.

Energy effiency index by mode of transport in the EU



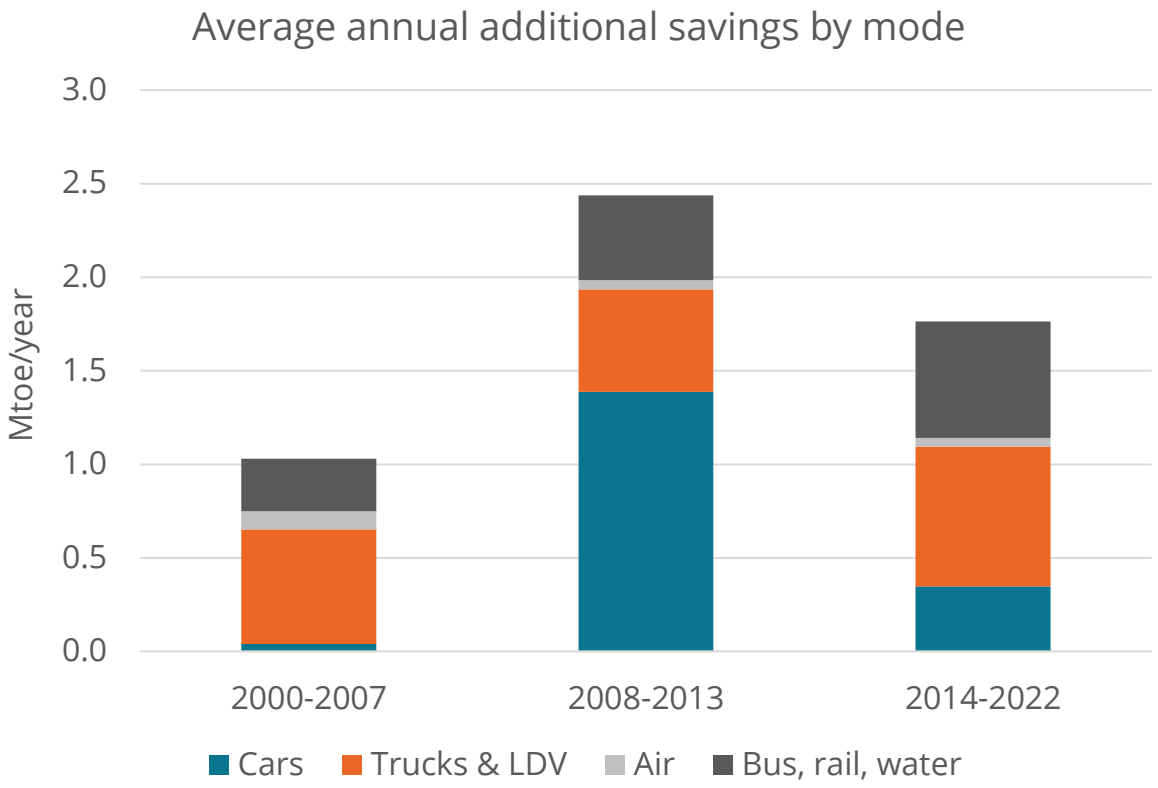
Only most important modes and vehicles are represented.
Sources: ODYSSEE (2000-2021), Enerdata (2022).

Trends in energy savings

Energy efficiency progress has saved **every year** since 2000 an additional volume of around **1.7 Mtoe**. Annual savings have decreased by **40%** since 2014 at EU after a peak at 2.4 Mtoe/year over 2008-2013.

Cumulated since 2000, these savings reached **39 Mtoe** in 2022 (i.e. 14% of transport consumption): without these savings, transport consumption would have been **14% higher**.

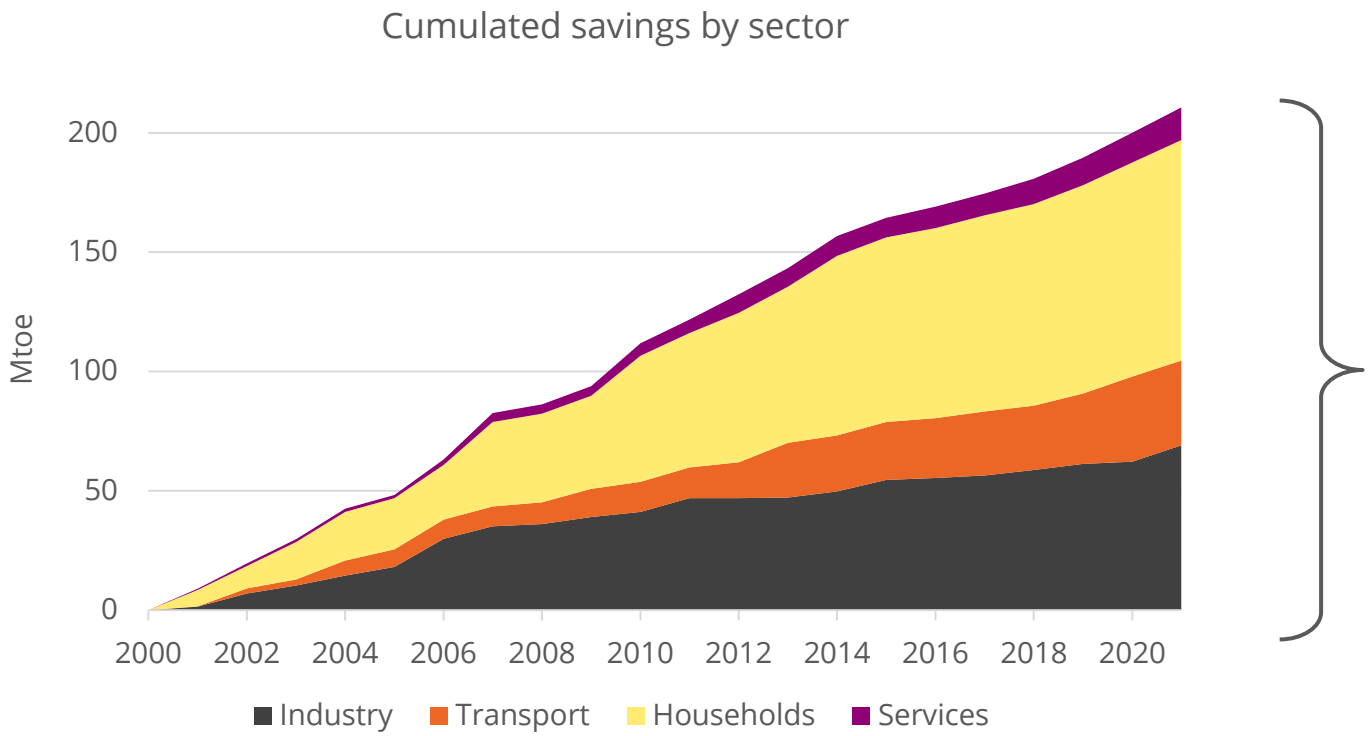
Trucks and LDV are over-represented, with 40% of total savings while they represent only a third of transport consumption. Conversely, savings of cars are much lower than their share in consumption (30% vs 50%), which is all the more **surprising as most measures target cars** (as well as LDV).

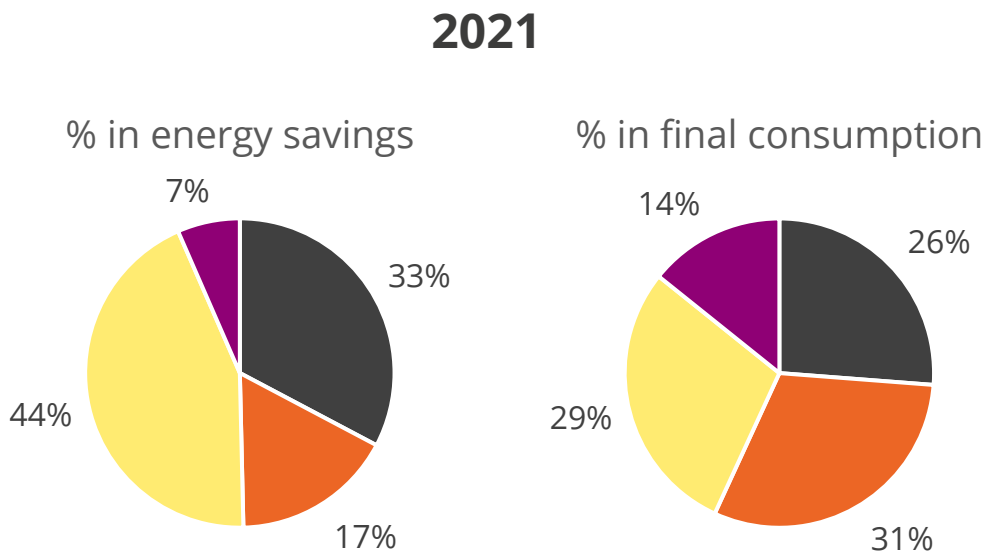


Sources: ODYSSEE (2010-2021), Enerdata (2022).

Transport lags behind the other sectors in terms of energy efficiency improvements

- In 2021, total final **energy savings** reached 211 Mtoe in the EU.
- The share of transport in these savings was only **17%**, a share almost **twice lower** than its share in consumption (31%), due to much slower energy efficiency progress than in other sectors.

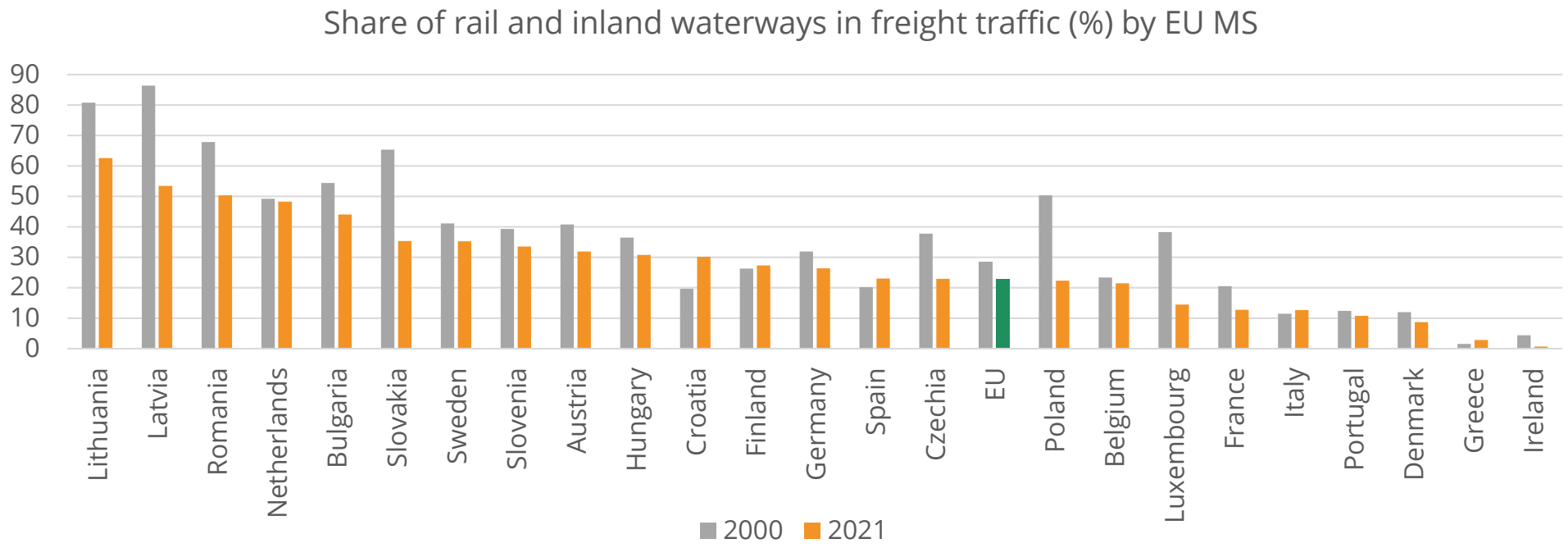




Source: ODYSSEE

Modal shift - Freight

- In 2/3 of EU MS the **share of rail and inland waterways** is **decreasing** since 2000; the trend is in general slower since 2010 (only -2.7 pt since 2010).
- A few countries have experienced a shift from road to rail & water: Spain (+3 pts), then Finland and Italy (~+1) .
- **Lithuania, Latvia, Romania and the Netherlands are the leading countries** with a share reaching around 50% or more, due to good quality of rail lines to seaports combined with high maritime traffic.

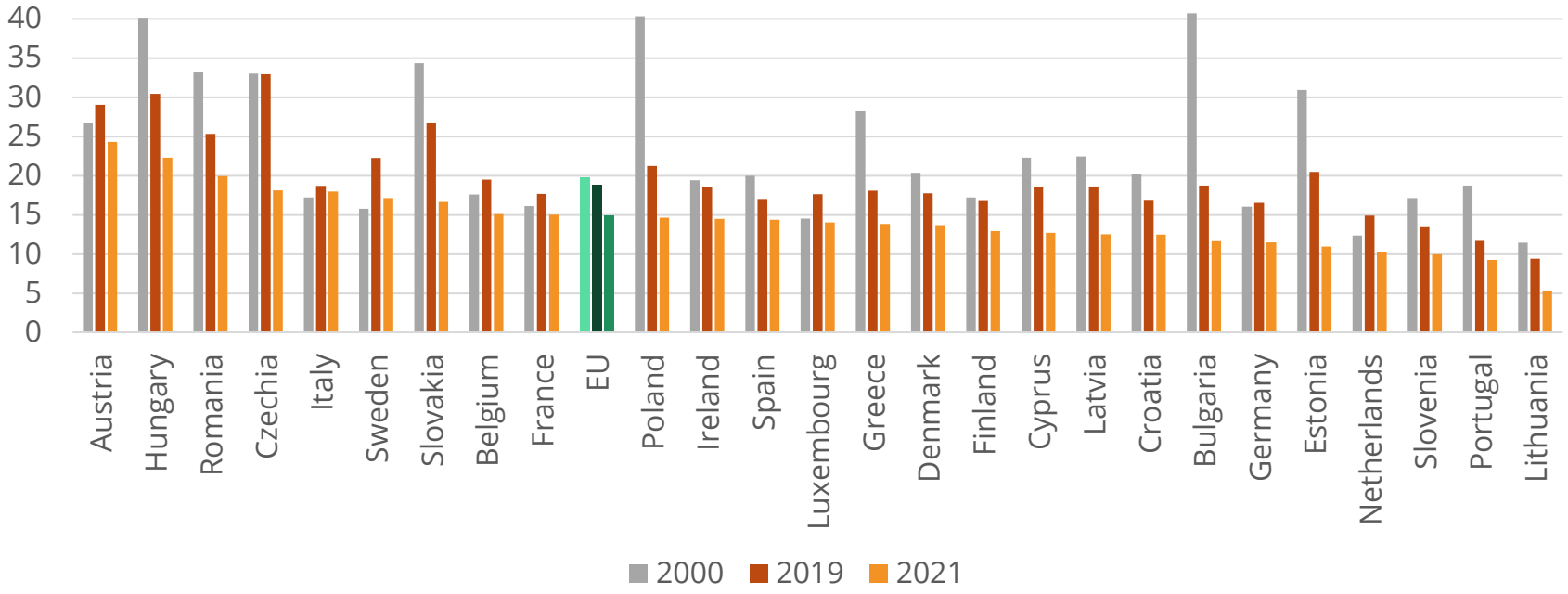


Source: ODYSSEE

Modal shift - Passenger

- **Significant reduction of the share of public transport** in most countries **after 2019** (-4 pts at EU level, to 15% in 2021).
- Decreasing share over 2000-2019 in **70% of countries** (-1 pt at EU level; stable over 2010-2019).
- Progression of public transport between 2010 and 2019 in half of the countries, especially in Sweden (+5 pts) and Slovakia (+4 pts).
- Czechia, Hungary and Austria had the highest share of public transport in 2019 (~30%).

Share of public transport in passenger traffic (%) by EU MS



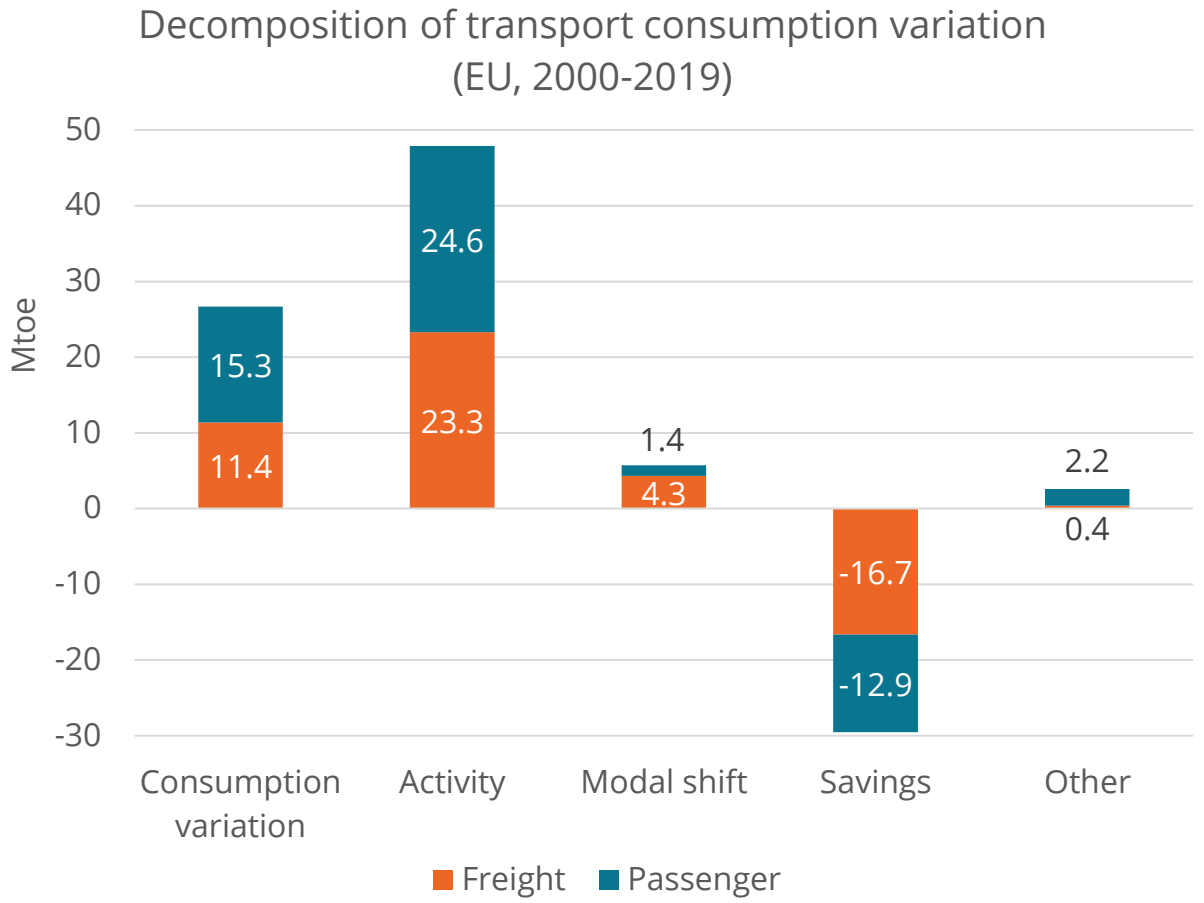
Source: ODYSSEE

Drivers of transport consumption variation - 2000-2019

Between 2000 and 2019, the increase in traffic (**activity**) contributed to raise transport consumption by 48 Mtoe, with an equal contribution of freight and passengers.

The growing share of trucks in freight traffic and, to a lesser extent, of cars in passenger traffic (**modal shift**) also contributed to increase consumption (~6 Mtoe).

Energy savings offset half of the activity and modal shift effects, lowering the consumption increase to 27 Mtoe.



Source: ODYSSEE Decomposition tool
https://www.indicators.odyssee-mure.eu/decomposition.html

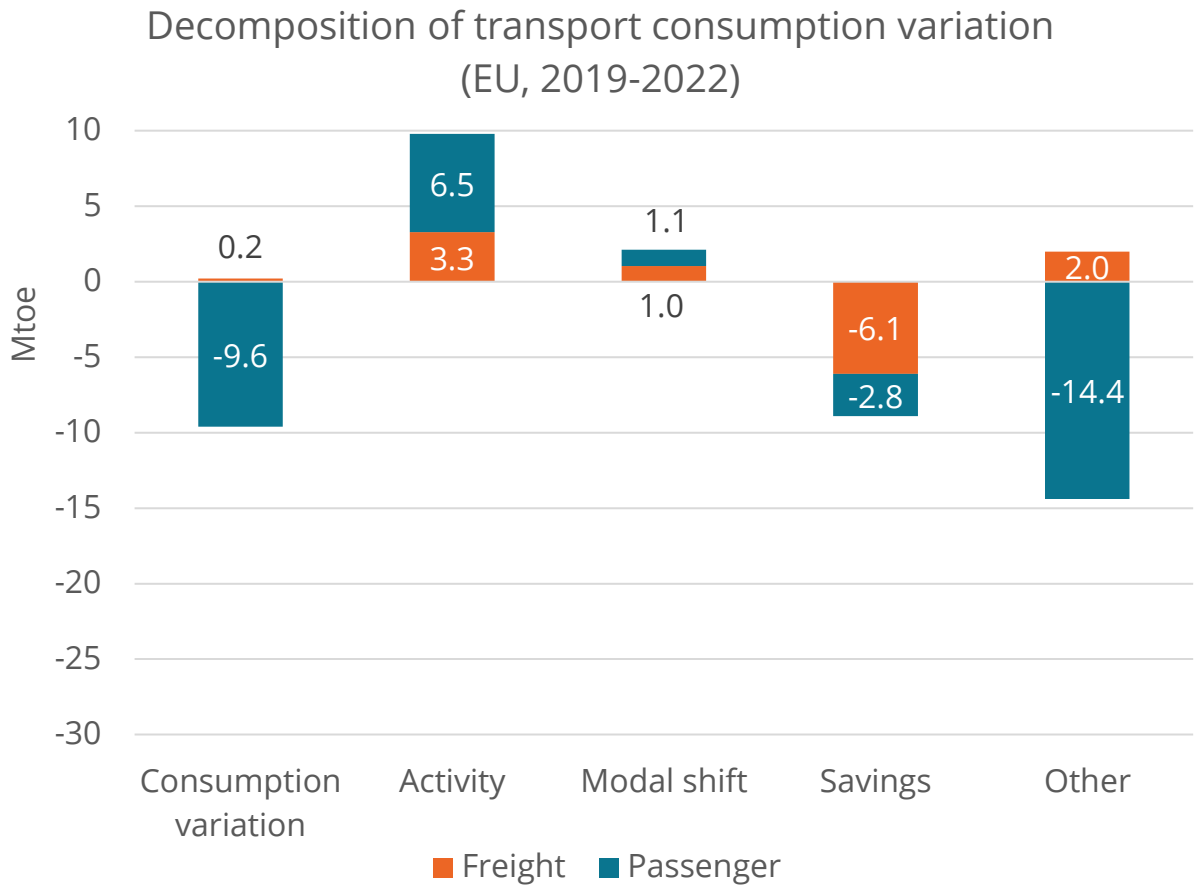
Drivers of transport consumption variation – 2019-2022 (first estimates)

Between 2019 and 2022, the increase in passenger traffic has contributed to raise final consumption by 6.5 Mtoe, while freight traffic increased it by 3 Mtoe.

Modal shift increased consumption by 2 Mtoe.

Energy savings offset 75% of activity and modal shift effects.

2022 is marked by **motor fuels price hikes (15%-20%)**, which results into a significant consumption reduction ("constrained sufficiency"), as shown in "**others**".



Sources: ODYSSEE Decomposition tool (2000-2021), Enerdata (2022).
https://www.indicators.odyssee-mure.eu/decomposition.html

3 Conclusions

Enerdata

Lower energy efficiency than expected

-2.5%/year

Decrease in final consumption required according to a scenario based on achieving the NDCs by 2030

- Transport has been much affected by the Covid crisis in 2020 with remaining effects in 2021.
- Energy efficiency progress for cars has much deteriorated since 2019, mainly due to behavioral factors (decreasing occupancy rate).
- The transition to alternative fuels is hardly visible in consumption but has accelerated since 2020, with a rapid penetration of electric cars.
- Trucks and LDV have better results and represent half of total energy savings in transport, i.e. much more than their share of consumption (31%).
- Transport lags behind the other sectors in terms of energy efficiency improvements.
- Only very few countries have managed to raise the share of efficient modes of transport (public vs cars for passenger, or rail or water vs trucks). The Covid crisis has much reduced the share of public transport in 2020 and 2021.
- All these factors explains why consumption and emissions are back since 2014 to their trend before the financial crisis.

More information about EnerFuture on https://www.enerdata.net/research/forecast-enerfuture.html

Enerdata

4 Annexes

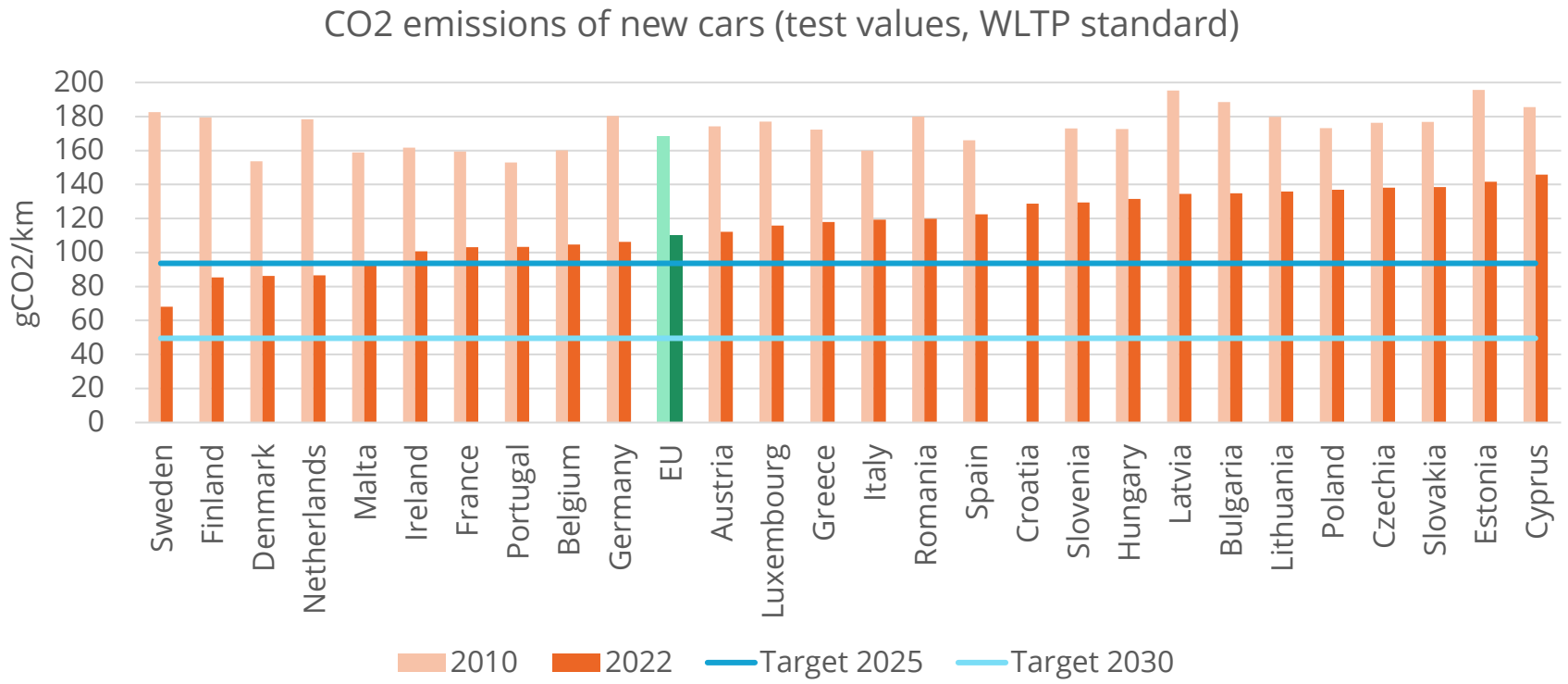
Enerdata

CO_2 emissions of new cars (gCO_2/km)

At EU level, emissions from new cars fell by 35% between 2010 and 2022 down to 110 gCO_2/km, thanks to EU standards & labels and national measures (fiscal and incentive).

The targets for 2025 and 2030 will require a very rapid electrification of the fleet.

In 2022, 5 countries had already reached the 2025 target.



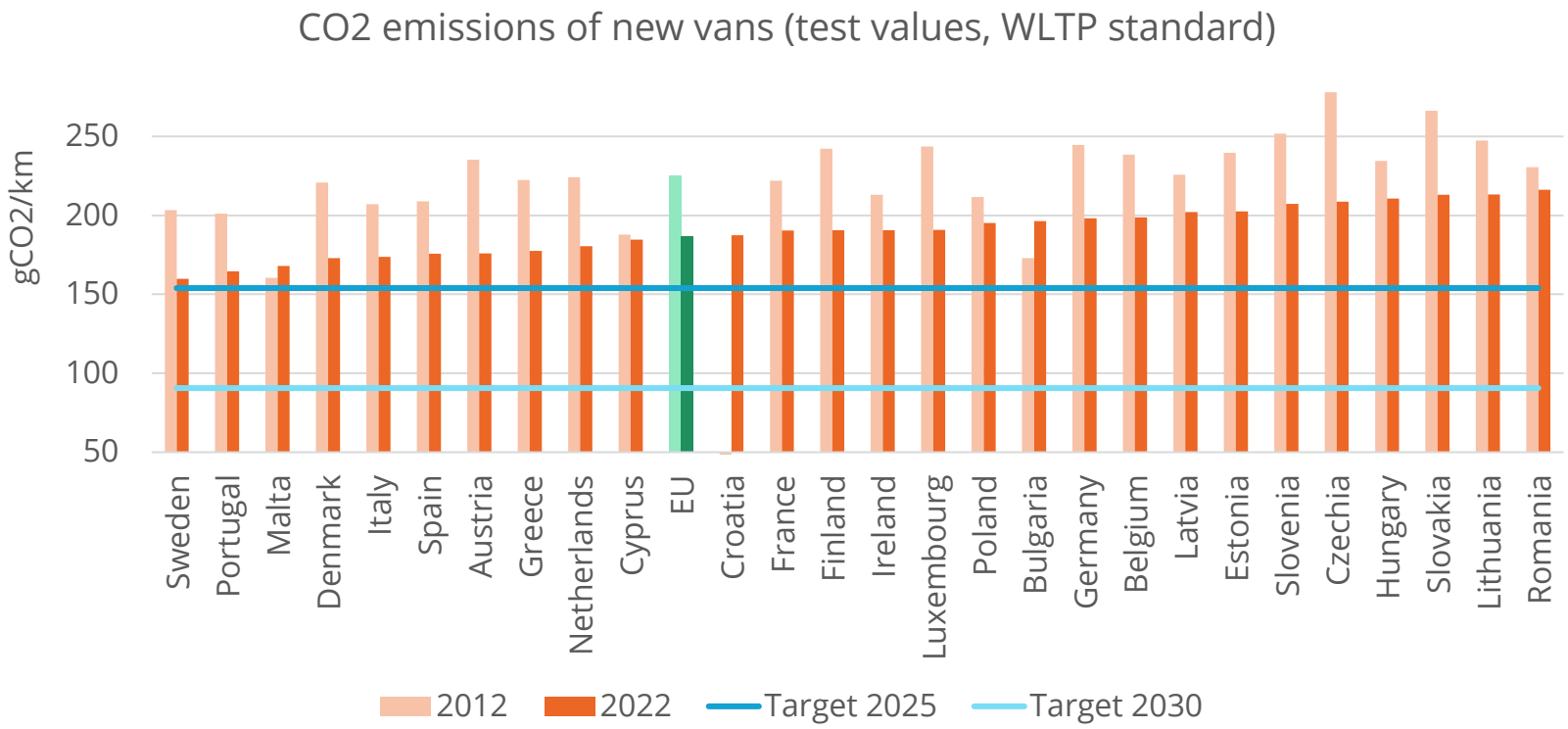
Source: ODYSSEE from EEA, test values according to WLTP standard.

CO_2 emissions of new vans (gCO_2/km)

At EU level, emissions from new vans has fallen by 17% since 2012 down to 187 gCO_2/km, thanks to European directives.

At this rate, 2025 target (154 gCO_2/km) may not be reached.

Achieving of the 2030 (90.6 gCO_2/km) will require a rapid electrification.



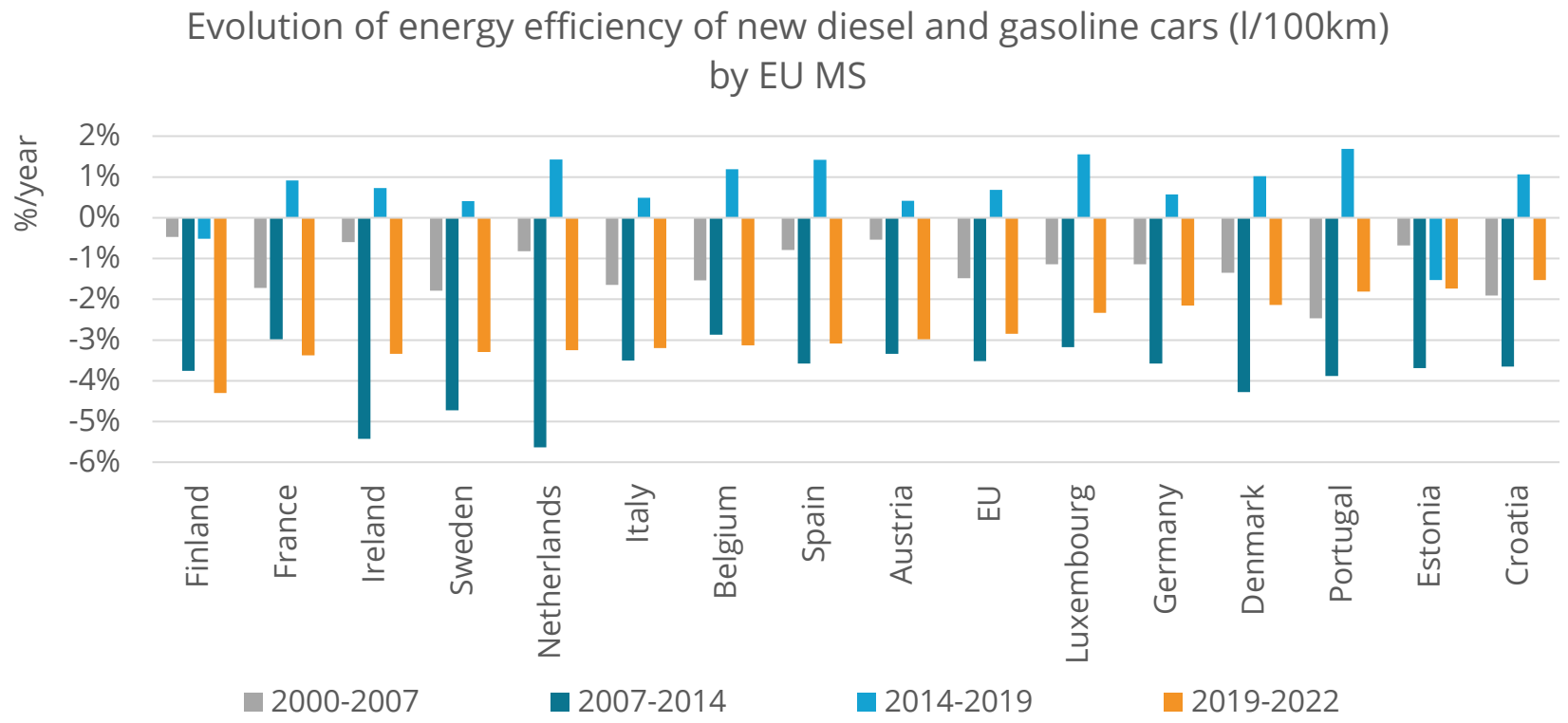
Source: ODYSSEE from EEA, WLTP standard. 2021 value for Malta.

Energy efficiency of new diesel and gasoline cars (l/100km)

The specific consumption of new diesel and gasoline cars **decreased everywhere until 2014**, especially over 2007-2014.

Between 2014 and 2019, a reverse trend has been observed in most countries due to two main factors: a **decrease in diesel** shares (from 56% in 2012 to 34% in 2019 at EU level) and a **growing share of SUV** (from 25 to ~40%).

Since 2019, the trend is downwards again (-3%/year at EU level).



Source: ODYSSEE from EEA, WLTP standard. 2021 value for Malta.