Energy efficiency trends in transport in EU countries

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Reviewers: *Draft*

Key questions

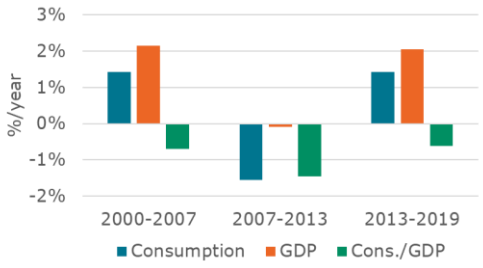
- **What is the overall trend in transport energy consumption in the EU and other European countries since 2000?**
- **What are the main drivers for the energy consumption variation in transport, and especially for energy savings?**

Energy savings in transport lag far behind those in other sectors.

Increasing energy consumption since 2013

Following the return to economic growth, the energy consumption of the transport sector has been increasing at EU level by 1.4% per year since 2013, back to the trend before the financial crisis. This follows a significant decrease of 1.6% per year between 2007 and 2013. Since 2013, transport energy consumption has been growing 0.7 times slower than GDP (almost as before 2007), which implies a decrease in consumption per unit of GDP of 0.6% per year (Figure 1).

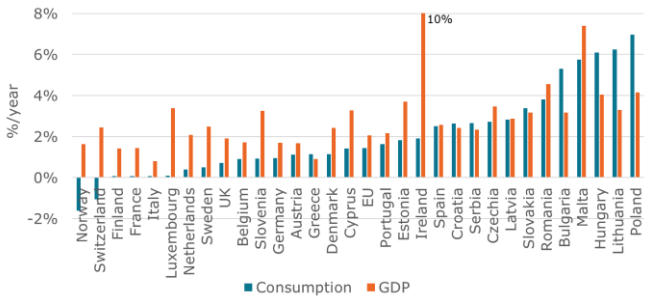
Figure 1: Transport energy consumption and GDP in EU27



Source: ODYSSEE[1]

In 15 EU countries, transport consumption has increased much less rapidly than GDP. In 4 eastern European countries, it has however grown much faster. In 4 EU countries, it has remained stable and has even decreased in Norway and Switzerland despite a sustained economic growth (Figure 2).

Figure 2: Trends in transport energy consumption and GDP over 2013-2019



Source: ODYSSEE[2]

[1] Up to 2018: Eurostat; 2019: early estimates by Enerdata: *https://www.odyssee-mure.eu/publications/other/early-estimates-methodology.html*

[2] Up to 2018: national data; 2019: early estimates by Enerdata.

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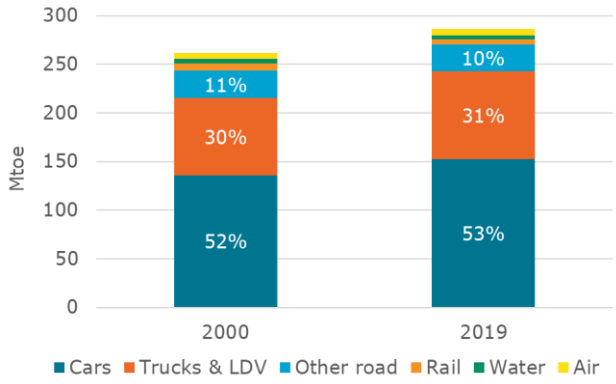
Half of the energy consumption from cars and 30% from trucks and light duty vehicles

The modal split of consumption has only changed slightly between 2000 and 2019: cars account for 53% and road freight transport (trucks and light duty vehicles) for 31% (Figure 3). Therefore, the analysis of energy efficiency trends will focus on road transport.

Figure 3: Modal split of transport consumption



Source: ODYSSEE

Consumption of domestic air transport and cars is growing since 2013 much faster than before the financial crisis (3 times faster for air, 50% faster for cars). In contrast, consumption of trucks and light commercial vehicles is only growing at half the rate it did before 2007.

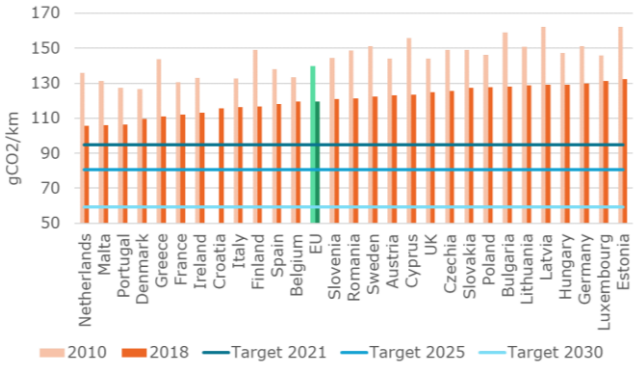
Regular decrease of the carbon emission factor between 2004 and 2012

CO_2 emissions from transport followed consumption trends. A decoupling can be noted between 2004 and 2012 due to a steady decrease in the carbon emission factor (tCO_2/toe), thanks to the penetration of biofuels (from 0.7% of the energy mix in 2004 to 5% in 2012 and 5.5% in 2019); the situation has stagnated since then. Electricity share is around 2% and slightly decreased since 2000. [3]

Increase in specific CO_2 emissions of new cars since 2016

Measures on new vehicles have been the main policy tool to reduce CO_2 emissions in transport, combining European standards and labels on specific emissions (gCO_2/km) and national measures (fiscal and incentive). At EU level, emissions from new cars fell by 16% between 2010 and 2016 but have since increased, mainly due to the higher share of SUVs. The target for 2021 (95 gCO_2/km) is unlikely to be met and the targets for 2025 and 2030 remain ambitious (Figure 4). The situation is similar for vans.

Figure 4: Specific CO_2 emissions of new cars



Source: ODYSSEE from EEA data (test values)

New cars are less efficient since 2014

Different indicators can be used to assess the fuel efficiency of cars depending on the definition chosen. Their technical efficiency is best represented by l/100km, and their overall efficiency by koe/pkm[4], which takes into account the effects of load factor and fuel mix. The specific fuel consumption in l/100km may refer to test values for new vehicles or to values observed in real-life driving conditions and fuel composition.[5]

The specific fuel consumption of new diesel and gasoline cars has decreased everywhere until 2014, especially over 2007-2014 (Figure 5). Since then, a reverse trend has been observed in most countries,

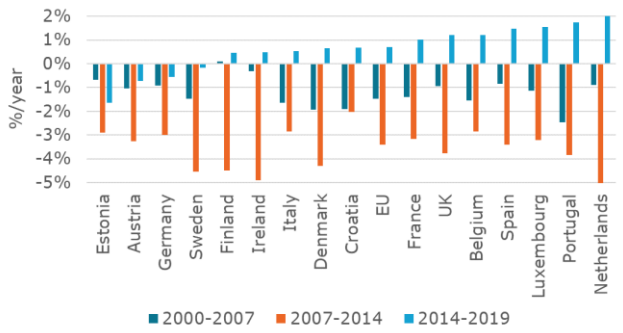
[3] Data on alternative fuel cars: *https://www.indicators.odyssee-mure.eu/market-diffusion.html*

[4] koe stands for kilogram oil equivalent (1 koe = 10^{-3} toe).

[5] Biofuel blend not taken into account in the test.

and a clear slowdown in the others, due to a decrease in the share of diesel cars (from 56% in 2012 to 34% in 2019 at EU level) and an increasing share of SUVs (from 25% to around 40%).

Figure 5: Trends in the specific consumption (l/100km) of new cars



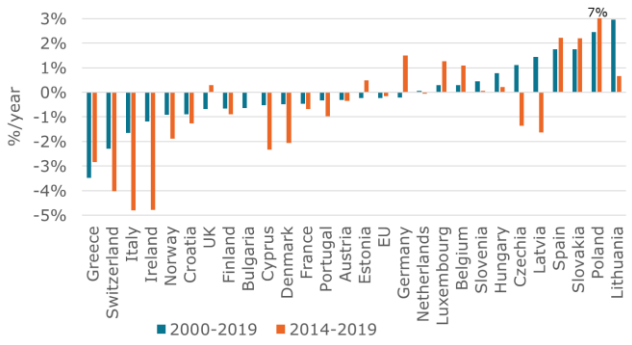
Source: ODYSSEE, based on CO_2 emission data from EEA[6]

Limited progress in car fleet energy efficiency

At EU level, the actual fuel consumption of the car stock follows the trend of new cars with a lag: it has continued to decrease since 2014, a very different trend from that of new cars. A simulation of the test value of the car stock, based on test values for new cars, estimates the gap between test and actual values to be around 10% in 2018 and this gap is widening. Focusing on overall efficiency (koe/pkm)[7], progress has been small since 2014 (0.2% per year). Technical efficiency has improved by 0.4% per year, while the decrease in car occupancy has contributed to lower efficiency progress by 0.3% per year; the change in fuel composition has had a limited effect. Prior to 2014, the overall efficiency improvement was similar, though with faster technical improvements (0.8% per year), partly offset by lower car occupancy and the effect of fuel mix.

Countries show contrasting situations (Figure 6). The energy efficiency of cars has improved considerably since 2000 in some countries (Greece, Switzerland, Italy, Ireland). Half of the countries have improved their results since 2014.

Figure 6: Trends in energy efficiency of car stock (koe/pkm)

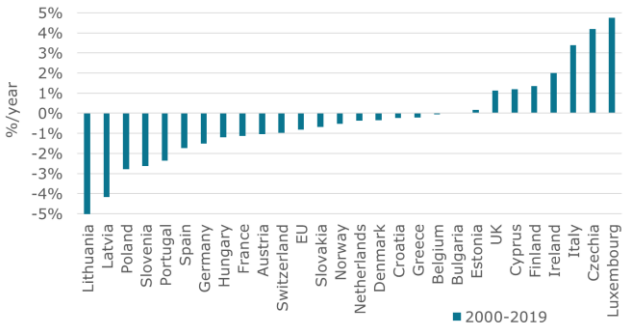


Source: ODYSSEE[8]

Efficiency of road freight transport is improving

In most countries, the unit consumption of road freight transport (trucks and light commercial vehicles) has decreased since 2000, reflecting improvements in energy efficiency; at EU level, it has decreased by 0.8% per year. It has however increased in seven countries (Figure 7).

Figure 7: Trends in energy efficiency of road freight transport (koe/tkm)



Source: ODYSSEE[9]

[6] Based on data collected by EEA from car manufacturers and based on test values for diesel and gasoline cars. They therefore differ from real consumption on road.

[7] Proposed as "preferred" indicator by the European Commission for monitoring ESD.

[8] Up to 2018: national data; 2019: early estimates by Enerdata.

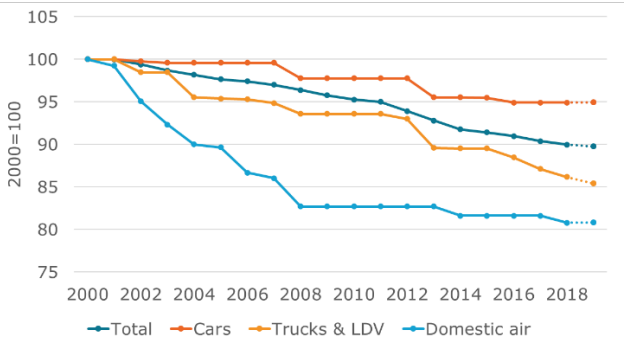
[9] Up to 2018: national data; 2019: early estimates by Enerdata.

Energy efficiency improved by 10% since 2000

From the different energy efficiency trends measured for each transport mode, an energy efficiency index for the whole sector, called "ODEX"[10], is derived in ODYSSEE. It is calculated based on 8 transport modes.[11] The average index for the sector is obtained by weighting the indices of variation of specific consumption by mode by the share of each mode in transport consumption. Specific consumptions are expressed in different physical units to better assess energy efficiency.[12]

Since 2000, energy efficiency in transport has improved by 0.6% per year in the EU, i.e. by 10% compared to the 2000 level (Figure 8). Greater progress has been achieved in domestic air transport although there has been a stagnation since 2008. Progress stopped for trucks and light vehicles between 2008 and 2012 due to less efficient operation of trucks (less loaded or even empty running) because of the financial crisis, but it is back. There is no further progress for cars since 2013.

Figure 8: Energy efficiency progress in transport in the EU[13]



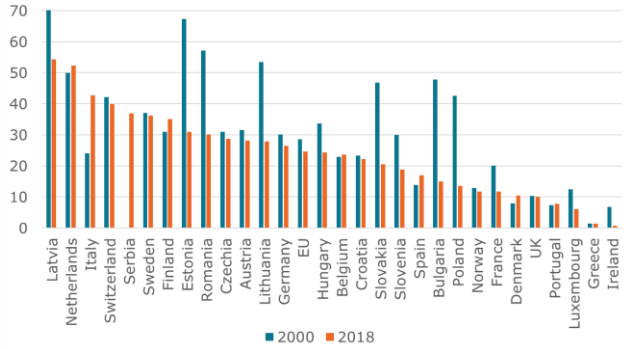
Source: ODYSSEE

Energy efficiency progress has enabled additional savings of around 1.5 Mtoe per year on average since 2000, and even 2.3 Mtoe per year over 2008-2013, i.e. twice as much as since 2014. Cumulated since 2000, these savings have reached 28 Mtoe in 2019, i.e. 10% of transport consumption: without these savings, transport consumption would have been 10% higher. Trucks and LDVs are over-represented, accounting for half of the savings, well above their share of consumption (31%). Conversely, the share of cars in savings is much below their share in consumption (26% vs. 53%), which is all the more surprising as most measures target cars (and more recently LDVs).

Freight modal shift is going the wrong way

At EU level, the share of rail and waterways in freight traffic has fallen by 4 points since 2000, from 28.5% to 24.6%. Indeed, this share has declined in 19 Member States since 2000. The downward trend has been slower since 2010 (-1 point at EU level). A few countries have experienced a significant shift from road to rail and water, including Italy (+19 points thanks to the sea motorways), Czechia (+7 points since 2010), Finland, Spain and Denmark (+3 to 4 points). Latvia and the Netherlands are leading with a share above 50% thanks to good quality rail lines to ports, combined with high maritime traffic for the later.

Figure 9: Share of rail and water in freight traffic (%)



Source: ODYSSEE

[10] https://www.odyssee-mure.eu/publications/archives/odex-indicators-database-definition.html

[11] Car, bus, motorcycle, truck, light vehicle, rail, water, and domestic air.

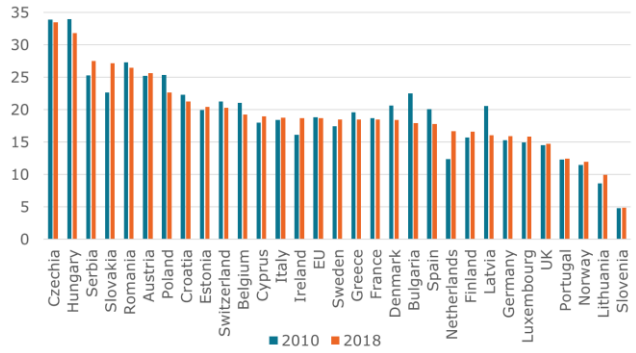
[12] koe/pkm for cars, buses, aviation, koe/tkm for trucks, water and rail, koe/km for light vehicles, toe/veh for motorcycles.

[13] Buses, motorcycles, water and rail not shown on the graph.

The modal split of passenger traffic is stable

In most countries, no significant shift to public transport is observed since 2010 (Figure 10). At EU level, the share of public transport in passenger traffic has been stable since 2010 at almost 19%, following a one-point drop compared to 2000. Slovakia and the Netherlands have achieved the greatest improvement since 2010 (+4.5 points). Czechia and Hungary have the highest share of public transport (over 30%), followed by Serbia, Slovakia and Romania (around 27%).

Figure 10: Share of public transport in passenger traffic

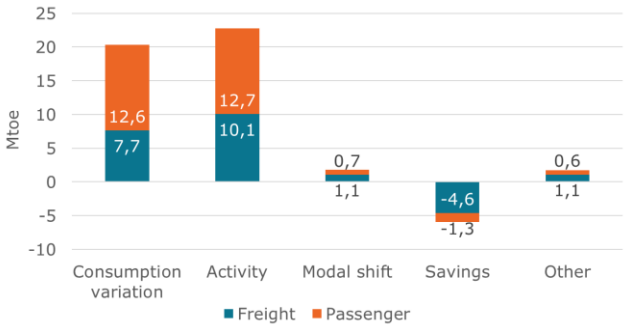


Source: ODYSSEE

Energy savings do not offset the traffic growth

Between 2014 and 2019, the traffic increase (activity effect) contributed to raise transport consumption by around 23 Mtoe. The growing share of trucks in freight traffic and, to a lesser extent, of cars in passenger traffic (modal shift) also contributed to increasing consumption (by almost 2 Mtoe). Energy savings only offset a quarter of these effects, thus limiting the rise in consumption to 20 Mtoe (Figure 11). Since 2000, transport consumption has grown by 25 Mtoe. Energy savings (28 Mtoe) have compensated half of the activity and modal shift effects (by respectively 46 Mtoe and 5 Mtoe).

Figure 11: Drivers of transport consumption variation in the EU (2014-2019)



Source: ODYSSEE Decomposition tool[14]

Transport is lagging behind other sectors in terms of energy efficiency improvements

Energy efficiency progress for new cars has slowed down or even stopped and reversed since 2014, due to the rising number of SUVs and the declining share of diesel cars. Progress for the car fleet is very low in most countries, and far from the theoretical performance of new vehicles, which does not take into account real driving conditions and the increasing share of biofuels. Trucks and LDVs perform better and account for half of the total energy savings in transport, well above their share in consumption (31%). The objective of increasing the share of efficient modes of transport (public transport versus private cars, and rail or waterways versus trucks for freight) is far from developing positively, except in a very few countries. All these factors explain why consumption and CO_2 emissions have returned since 2014 to their pre-financial crisis trend.

For further reading or information, please visit https://www.odyssee-mure.eu/

[14] *https://www.indicators.odyssee-mure.eu/decomposition.html*