EU Energy, Transport and GHG Emissions Trends to 2050

Reference Scenario 2013

This Reference Scenario was finalised in July 2013 and published in December 2013. It makes projections up to 2050, but also mid-term projections up to 2020 and 2030. All projections made are based on current trends observed since late 1990s and adopted policies using various models. The assumption is made that the legally binding GHG and renewable energy targets for 2020 will be achieved and that the policies agreed at EU level as well as relevant adopted national policies will be implemented in the Member States. The Commission wants to see this Reference Scenario not only as a projection, but also as a benchmark for the future development.

Trends in the different transport modes

The activity of the transport sector is growing significantly with the highest growth rates occurring from 2010 to 2030, driven by developments in economic activity. This concerns both passenger and freight transport. Freight transport in particular is growing at higher rates than passenger transport, following more closely the GDP developments.

Beyond 2030, the activity of passenger transport continues to grow albeit at slow rates, as a result of stagnant and after 2040 decreasing population, deceleration in GDP growth and saturation of passenger car demand.

Freight transport follows a similar trend to passenger activity after 2030, resulting from the slow-down of GDP growth as well as from the shift of economic activities towards services and limits to distant sourcing and off-shoring.

Road transport is expected to maintain its dominant role in passenger transport by 2050, despite growing at lower pace relative to other modes (0.6% p.a.). Passenger cars alone would represent about 67% of total passenger transport activity in 2050 although their modal share would decrease by about 7 percentage points between 2010 and 2050. As previously mentioned, the growth slowdown for passenger cars activity could be explained by the car ownership which is close to saturation levels in many EU15 Member States but also by the high congestion levels, the increase in fossil fuel prices and the ageing of the EU population. Transport activity of buses and coaches and powered 2-wheelers would grow at slightly higher rates than passenger cars activity by 2050, 0.7% p.a. and 1.1% p.a., respectively. Overall, the share of road transport (including buses and coaches and powered 2-wheelers in addition to passenger cars) in total passenger transport activity would go down from about 84% in 2010 to 76% in 2050.

Air transport is projected to be the highest growing of all passenger transport modes, going up by 133% between 2010 and 2050 (2.1% p.a.), mainly due to the large increase of international trips (e.g. to
emerging economies in Asia). Thus, it will become the second most important passenger mode after road transport.

Passenger rail activity is projected to increase by 79% during 2010-2050 (1.5% p.a.) and expand its modal share by 2 percentage points (from 8% in 2010 to 10% in 2050), driven in particular by the completion of the TEN-T core network by 2030 and of the comprehensive network by 2050. High-speed rail sees a significant increase in terms of volume (2.5% p.a. during 2010-2050) and share as a result of the infrastructure build-up and the upgrade of existing railway lines. About 37% of passenger rail traffic, expressed in passenger-kilometres, would be carried by high-speed rail by 2050. Passenger rail competes with both road and air transport. In EU15 a relatively important share of additional demand would be covered by rail (in most cases high-speed rail where investments are foreseen), considering the saturation of passenger car demand. The increase of fossil fuel prices also shifts part of the passenger road traffic to rail. In addition, high-speed rail attracts demand from short-haul air travel.

Freight transport activity showed steady growth between 2005 and 2007, continuing the 1995-2005 trend. However, the economic crisis led to a reduction of activity in the subsequent years resulting in lower levels in 2010 compared to 2005. The projections show an increase in the total freight transport activity by about 57% (1.1% p.a.) between 2010 and 2050. Notably, the strong growth in activity (1.7% p.a.) in the short-term (up to 2015), driven by GDP developments, allows the recovery of freight transport activity to pre-crisis levels. Freight traffic shows strong correlation with GDP growth until 2030. The completion of the TEN-T core network by 2030 and of the comprehensive network by 2050 is expected to provide more adequate transport infrastructure coverage and support a concentration of trans-national traffic and long-distance flows. It is also expected to provide support for logistic functions and improve inter-modal integration (road, rail, and inland navigation), through the innovative information management systems which are part of the network, and reduce the time losses caused by road congestion.

Road freight traffic is projected to increase by about 55% between 2010 and 2050 (1.1% p.a.), but growth is unevenly distributed between the EU15 and EU12. The highest growth in road freight transport activity would take place in the EU12 (72% for 2010-2050, equivalent to 1.4% p.a.) where a strong correlation with GDP growth can be observed. Overall, road freight sees a slight reduction in its modal share, from 71% in 2010 to 70% in 2050. By 2050, rail freight features the highest growth among the freight transport modes (79%, equivalent to 1.5% p.a.) and increases its modal share from almost 16% in 2010 to 18% in 2050. The significant increase in rail freight transport activity is mainly driven by the completion of the TEN-T core and comprehensive network; thus improving the competitiveness of the mode.

Energy demand in transport

Transportation is projected to remain dominated by oil. Historically, final energy demand in the transport sector has grown in line with the transport activity. However, despite the projected upward trends in transport activity beyond 2010, final energy demand stabilizes by 2050 to levels marginally lower than those observed in 2010. The projections show some weak growth in energy demand (0.3%
p.a.) in the short term (up to 2015), mainly driven by the strong recovery in the freight transport activity following the crisis. Beyond 2015 however, energy demand is decoupling from transport activity (Figure 24).

**Figure 24: Trends in transport activity and energy consumption**

The main driver of low final energy demand from transport relative to transport activity is the improvement in fuel efficiency driven by policies, in particular for passenger cars and light commercial vehicles and the uptake of more efficient technologies for other transport means. In particular, in passenger road transport energy efficiency of vehicles improves by 21% in 2020 and 35% in 2030 relative to 2005, leading to a **decline in energy demand in passenger road transport by 2030**. Beyond 2030, energy demand of passenger road transport stabilizes. Efficiency gains, driven by increasing fuel prices and techno-economic developments, evolve at slower pace in lack of more stringent CO2 emissions regulations.
The improvements would be mainly attributed to fuel substitution; in particular switching from diesel to electricity in areas where electrification is an economically viable option and in line with the provisions of specific initiatives by MS.

**Efficiency improvements** also take place in freight transportation, and moderate the effect of the increasing activity (which is growing stronger than for passenger transport) on energy demand. Heavy goods vehicles (HGVs), which throughout the projection period account for more than 80% of energy consumed in freight transport, undergo improvements in specific fuel consumption driven in particular by the increasing fossil fuel prices. Fuel costs represent a considerable part of operational costs of HGVs and their minimization is among the main objectives of HGV manufacturers and fleet operators. Improvements in technology, related among others to vehicle design or vehicle powertrain, aim to reduce vehicle specific fuel consumption. Overall, fuel consumption in road freight transport per Mtkm is projected to decrease by 6% in 2020, 15% in 2030 and 22% in 2050 relative to 2005.

The obligation to meet CO2 standards for LDVs is reflected in the change of the transport fuel mix. Emissions performance standards for vehicles together with favourable taxation of diesel by some Member States result in wide scale substitution of petrol with diesel in conventional passenger cars, and favour the introduction of diesel hybrid vehicles. Consumption of petrol declines considerably until 2030 and stabilizes from thereon to 2050, as no more stringent requirements for fuel-efficiency are introduced. Consumption of diesel increases by 2015 and stabilizes in the period 2015 to 2050, becoming the dominant fuel in passenger cars and continuing to be the primary fuel for heavy duty vehicles (HGVs, buses and coaches). Heavy duty vehicles have little potential to switch to alternative fuels such as LNG as this would require significant investments in infrastructure build-up across the EU, which is not assumed to be the case in the Reference 2013 scenario.

**Biofuels** in general, make significant inroads in transport by 2020, driven by the legally binding target of 10% renewable energy in the transport sector (RES-T target). In parallel with the shift towards diesel...
vehicles, the share of biodiesel consumption increases, also driven by its uptake in road freight transport. Beyond 2020, with no further tightening of the RES-T target, biofuels maintain their share as a result of improved economics of the biofuel supply side and the increasing fossil fuel prices.

Electricity consumption in transport sees a steady increase as a result of rail electrification and the penetration of alternative electric powertrains in road transport. Electrically chargeable vehicles (EVs), in particular in the segment of passenger cars and LCVs, emerge around 2020 as a result of EU and national policies as well as incentive schemes aiming to boost their penetration. Plug-in hybrids (PHEVs) hold the largest share among EVs due to their ability to use both power-trains alternatively (internal combustion engine or electric motor) and they would represent two thirds of EVs in 2050. Some improvements in battery costs are assumed to occur allowing for a decrease in capital costs together with slow increase in infrastructure availability. The penetration of electric vehicles occurs mainly in niche markets, in urban areas for urban commuting and municipal fleets, due to limited range of vehicles, which is assumed to persist. By 2050 the share of electric vehicles in the total stock of cars reaches approximately 8% (Figure 28).

Finally, other energy forms such as LPG and natural gas maintain a rather small share in the final energy demand of the transport sector. Passenger cars running on LPG and CNG see a moderate increase especially stemming from countries with re-fuelling infrastructure already in place; in Member States where such infrastructure is currently not in place the uptake of CNG and LPG vehicles on a commercial basis is limited in the Reference 2013 scenario.
**CO2 emissions in transport**

In transport, **CO2 emissions** (excluding international maritime) **go down by 8% between 2010 and 2050.** CO2 emissions decrease until 2035 and slightly increase thereafter primarily driven by CO2 emissions growth in freight road transport and aviation. Fuel efficiency gains driven by CO2 standards for LDVs as well as the increasing fossil fuel prices result in significant emission reductions relative to current trends. Decreases in carbon intensity of energy consumption are less pronounced as the projections do not show a significant shift towards alternative fuels. A shift to alternative fuels, including electricity, is mainly projected in the longer run for the passenger cars segment and in rail.

The main drivers of declining emissions are policies on CO2 emissions from LDVs. These bring about a considerable **decrease in emissions from passenger cars and light commercial vehicles**, with the **highest reduction** taking place in the **period 2010-20**. Beyond 2035, CO2 emissions from passenger road transport stabilize with no further tightening of CO2 standards assumed. CO2 emissions from passenger rail are decreasing as a result of switching from diesel to electricity and the shift from conventional passenger rail to high-speed rail.

Regarding **freight transport**, **CO2 emissions steadily grow** throughout the projection period. The **main contributor** to CO2 emissions growth is **road freight**, where the increased activity surpasses improvements in specific fuel consumption, especially for HGVs. CO2 emissions from other modes (rail and inland navigation) hold a small share in total freight emissions.

In conclusion, while CO2 emissions in other areas decrease, emissions in the field of transport increase compared to 1990 and despite that they decrease between 2010 and 2050, it is at much slower pace due to the relatively high marginal abatement costs in this sector. In the long term, as power generation becomes almost completely carbon-free, **the transport sector becomes the largest source of CO2 emissions.**

The full text of the Reference Scenario can be found at:  