THE ROLE OF THE EU CAR CO_2 REGULATION TO ACHIEVE LOWER CO_2 EMISSIONS FROM TRANSPORT BY 2030

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Overview

Total CO_2 emissions caused by passenger cars in the EU have increased despite recent specific improvements in their efficiency (Fontaras and Dilara, 2012). Moreover, passenger car transport is expected to further grow over the next decades (European Commission, 2013). The EU recently adopted a CO_2 legislation, setting specific CO_2 emission targets of the average new fleet at 130 g/km for 2015 (EC, 2009) and 95 g/km by the end of 2020 and onwards (EU, 2014a). Furthermore, the European Commission has proposed to reduce the total greenhouse gas (GHG) emissions in the EU by 40% in 2030 over 1990 levels (European Commission, 2014a). In our exploratory study we use an energy system model to analyse, how a specific policy the CO_2 car legislation, can contribute towards this 40% reduction target. While our analysis starts from the basis of the impact assessment that accompanied the proposal of the 40% GHG reduction target (European Commission, 2014b) we study the car sector at a much higher technology detail in the context of the car CO_2 legislation. We discuss in detail the role that electro-mobility could play in order to achieve the EU's objectives on decarbonisation and greater energy independence.

Methods

We use the JRC-EU-TIMES model to study the potential impact of the current and an alternative stricter EU CO_2 car legislation beyond 2020 on transport related CO_2 emissions, on the uptake of electrified vehicles, and on the reduction of fossil oil based fuel use. JRC-EU-TIMES is a linear optimisation bottom-up technology model generated with the TIMES model generator. The JRC-EU-TIMES model represents the EU28 energy system plus Switzerland, Iceland and Norway from 2005 to 2050, where each country is one region. More information on the model, including a detailed description of its inputs, can be found in Simoes et al. (2013). In this study we differentiate 50 car powertrain variants including alternatively fuelled cars, such as CNG cars, LPG cars, battery electric vehicles (BEV), plug-in hybrid electric vehicles (PHEV) for short and long range, and hydrogen fuel cell (HFC) cars. The techno-economic assumptions for these technologies are based on Thiel et al. (2014). Member state specific differences in the vehicle fleet composition in terms of size and average mileage are implicitly considered in the model through the base year (2005) data. For this study we run the model up to 2030 with the following policy scenarios: (i) reference: 40% overall CO_2 reduction by 2030 (versus 1990 levels) for the whole energy system without specific sector targets; (ii) current CO_2 car legislation (95g scenario): CO_2 cap as in reference but excluding the transport sector where a tank to wheel based CO_2 target for the new car fleet of 95 g/km from 2020 and beyond (based on type approval values) is applied; (iii) alternative stricter future CO_2 car legislation (70g scenario): same as current CO_2 car legislation but with a CO_2 target of 70 g/km in 2030 and beyond. We analyse the following model outputs for the three scenarios for the EU for 2020 and 2030, comparing them with 2010 values from Eurostat (Eurostat, 2014) and the European Environment Agency (EEA, 2013): CO_2 emissions caused by transport, car transport needs satisfied by the different powertrain technologies, level of fossil oil based fuel use, and energy system costs. We have performed a sensitivity analysis for 2030 on the basis of the 70g scenario: changing the cost assumptions for the powertrain specific components of the electrified cars, varying it by +/- 10% in 2030 versus the reference case.

Results

Table 1 presents an overview of the most relevant results. The more stringent the scenario for the CO_2 emissions from cars the more reductions are achieved in transport CO_2 emissions and fossil oil based fuel consumption. Based on the CO_2 car target and the cost-effectiveness of the available technologies the model deploys a different portfolio of car powertrains. In all scenarios electrified vehicles (BEV, PHEV, HFC) do not reach significant market shares before 2020. In our model results, HFC do not enter the market before 2030. It needs to be noted that the non-transport related CO_2 emissions are reduced in all scenarios by 34 and 51% respectively in 2020 and 2030 over 1990 levels. The total discounted system costs from 2005-2050 increase in the 95g scenario by 0.2% and in the 70g scenario by 0.3% over the reference scenario.

Table1 – Overview of most relevant results

	Eurostat/ EEA data	Reference scenario		95g scenario		70g scenario	Sensitivity on 70g scenario (+/-10% cost for electrif. cars)
	2010	2020	2030	2020	2030	2030	% change vs 70g scen. in 2030
Transport CO_2 emissions (in % change from 1990 levels)	+27	+9	+4	+7	-3	-10	+0.4 / -0.3
Passenger car transport satisfied by electrified vehicles (in % of total cars pkm)	-	0.1	3.4	0.4	14.4	24.5	-10 / +6
Fossil oil based fuel consumption in the total energy system (in % change from 1990 levels)	-3	-15	-20	-16	-23	-26	+0.2 / -0.1

Conclusions

Our model results reveal that legislating the EU car CO_2 emissions plays an important role to mitigate the CO_2 impact of expected growing transport demand in the EU. While the current legislation, based on our calculations, would lead to a net increase of transport related CO_2 emissions in 2020 and a slight decrease in 2030 versus 1990, a stricter limit in 2030 could effectively reduce these emissions versus 1990 by 10%. Under the condition that significant cost reductions based on a learning rate of 10% are achieved over currently available electrified vehicles, our analysis indicates that the deployment of electrified vehicles is a viable option to attain these CO_2 reductions. Under the most stringent scenario (70g) roughly one quarter of the passenger car transport demand could be satisfied by electrified vehicles in 2030. As a side effect, the CO_2 legislation and deployment of electrified vehicles can have a significant positive impact on energy security aspects as it can reduce the consumption of fossil oil based fuels in the EU, roughly by one quarter in 2030 versus 1990 levels. A more stringent CO_2 target for cars has, according to our calculations, only a small effect on total system costs. In future research we intend to analyse scenarios of the CO_2 car legislation, in which well-to-wheel emissions of BEVs and HFCs are considered in the CO_2 target, hence these vehicles would not be treated as zero emission vehicles under these scenarios. Further methodological improvements within the JRC-EU-TIMES model could enhance the accuracy of this analysis: (i) explicit disaggregation of car segments similar to Thiel et al., 2014, (ii) explicit modelling of the fleet average CO_2 target for light commercial vehicles in accordance to EU, 2014b, (iii) scenarios for CO_2 improvements in heavy duty vehicles.

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