THE ROLE OF THE EU CAR CO₂ REGULATION TO ACHIEVE LOWER CO₂ EMISSIONS FROM TRANSPORT BY 2030

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Overview
Total CO₂ 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 CO₂ legislation, setting specific CO₂ 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 CO₂ 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 CO₂ 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 CO₂ car legislation beyond 2020 on transport related CO₂ 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 CO₂ reduction by 2030 (versus 1990 levels) for the whole energy system without specific sector targets; (ii) current CO₂ car legislation (95g scenario): CO₂ cap as in reference but excluding the transport sector where a tank to wheel based CO₂ 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 CO₂ car legislation (70g scenario): same as current CO₂ car legislation but with a CO₂ 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): CO₂ 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 CO₂ emissions from cars the more reductions are achieved in transport CO₂ emissions and fossil oil based fuel consumption. Based on the CO₂ 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\textsubscript{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

<table>
<thead>
<tr>
<th></th>
<th>Eurostat/EEA data</th>
<th>Reference scenario</th>
<th>95g scenario</th>
<th>70g scenario</th>
<th>Sensitivity on 70g scenario (+/-10% cost for electrif. cars)</th>
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</thead>
<tbody>
<tr>
<td>Transport CO\textsubscript{2} emissions (in % change from 1990 levels)</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>2010</td>
<td>+27</td>
<td>+9</td>
<td>+4</td>
<td>+7</td>
<td>-3</td>
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<tr>
<td>2020</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+10</td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+0.4 / -0.3</td>
</tr>
<tr>
<td>Passenger car transport satisfied by electrified vehicles (in % of total cars pkm)</td>
<td>-</td>
<td>0.1</td>
<td>3.4</td>
<td>0.4</td>
<td>14.4</td>
</tr>
<tr>
<td>Fossil oil based fuel consumption in the total energy system (in % change from 1990 levels)</td>
<td>-3</td>
<td>-15</td>
<td>-20</td>
<td>-16</td>
<td>-23</td>
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<td>-26</td>
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### Conclusions

Our model results reveal that legislating the EU car CO\textsubscript{2} emissions plays an important role to mitigate the CO\textsubscript{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\textsubscript{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\textsubscript{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\textsubscript{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\textsubscript{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\textsubscript{2} car legislation, in which well-to-wheel emissions of BEVs and HFCs are considered in the CO\textsubscript{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\textsubscript{2} target for light commercial vehicles in accordance to EU, 2014b, (iii) scenarios for CO\textsubscript{2} improvements in heavy duty vehicles.

### References


