EVs and post 2020 CO$_2$ targets for passenger cars

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CO₂ legislation for cars
A step towards meeting long term GHG emission targets
Post 2020 targets
Important for momentum of the transition towards large-scale application of (L)EVs

• 60% reduction of transport CO\textsubscript{2} emissions is expected to require significant share of (L)EVs

• 95 g/km in 2020 feasible without (L)EVs
• 70 g/km is lowest average that can be achieved with ICEVs on the basis of current market division and vehicle models

• What is necessary from the overall perspective of the European CO\textsubscript{2} emission reduction strategy?

• What would help to realize ambitions w.r.t. role of (L)EVs?
  • Target level + definition
Discussion about post 2020 targets For CO₂ regulation of passenger cars

- Target levels
  - informal proposal: 68 – 78 g/km for 2025

- Metric
  - TTW or WTW CO₂ (g/km)
  - TTW or WTW energy (MJ/km)

- Modalities
  - utility parameter: from mass to footprint?
  - shape of target function
  - mileage weighting
  - etc.

For this assessment a TTW-based metric is assumed, similar to current legislation.

Other modalities not relevant for this assessment
How to motivate post-2020 target levels?

Different approaches possible:

- Extrapolation of annual reduction levels that are considered feasible, e.g. 3 or 5% p.a.
- Bottom-up assessment of what is technically feasible in target year at acceptable costs
  - Will be done in the coming year
- Top-down back-casting of the path along which vehicle target should develop in order to reach overall 60% target for 2050
  - Subject of this paper

Composition of new vehicle sales in 2035 must be similar to the overall fleet composition in 2050 required for meeting the target
Top-down back-casting
The path along which vehicle target should develop in order to reach overall 60% target for 2050

• White Paper target of 60% is a sectoral target (IPCC rules)
  • EVs and FCEVs count as zero emission
  • biofuels count as zero emission
    • but have no effect under a TTW CO$_2$ target
  • WTT emissions are attributed to energy sector and agriculture

• Take into account that:
  • passenger cars may have to do more than 60%
  • volume of transport grows between 1990 and 2050
  • share of biofuels will change over time
Back-of-the-envelope calculation

Assumptions

• Average TA CO$_2$ value of fleet in 1990 is 180 g/km

• New cars in 2035 must have same average CO$_2$ emission as entire fleet must reach in 2050
  • linear interpolation between 2020 target and required 2035 value

• TTW targets under 70 g/km can only be reached with a finite share of (L)EVs
  • for simplicity calculation for EVs only
Scenario variants:

- Overall CO₂ reduction target passenger cars: 60%, 70%, 80%
  - Passenger cars may need to do more than 60% to compensate for smaller potential in other subsectors

- Share of biofuels in 2050: 0%, 40%
  - Note: consumption of fuels in 2050 is very low, so high share of biofuels may still not be (much) more than present use

- Mobility growth up to 2050
  - Reference scenario on basis of data from White Paper scenario
  - Scenario variants based on literature
Example calculation

- Average fleet emissions to be reached in 2050 in function of the reduction target and the assumed growth in traffic volume

<table>
<thead>
<tr>
<th>Year</th>
<th>Fleet average CO₂ emissions (IPCC) [g/km]</th>
<th>Volume of pass. car transport [vkm]</th>
<th>Fleet average CO₂ emissions (IPCC) [g/km]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>180</td>
<td>1</td>
<td>180</td>
</tr>
<tr>
<td>change</td>
<td>-60%</td>
<td>+80%</td>
<td>-78%</td>
</tr>
<tr>
<td>2050</td>
<td>72</td>
<td>1.8</td>
<td>40</td>
</tr>
</tbody>
</table>
Example calculation

- Required share of EVs to meet the target for 2050 in the scenario assessed in previous slide, for two different assumed shares of biofuels

<table>
<thead>
<tr>
<th>Fleet average CO$_2$ emission in 2050 (IPCC)</th>
<th>ICEVs TA CO$_2$ (TTW)</th>
<th>Biofuels share</th>
<th>ICEVs IPCC CO$_2$</th>
<th>ICEVs share</th>
<th>EVs share</th>
</tr>
</thead>
<tbody>
<tr>
<td>[g/km]</td>
<td>[g/km]</td>
<td>[%]</td>
<td>[g/km]</td>
<td>[%]</td>
<td>[%]</td>
</tr>
<tr>
<td>40</td>
<td>70</td>
<td>0%</td>
<td>70</td>
<td>57%</td>
<td>43%</td>
</tr>
<tr>
<td>40</td>
<td>70</td>
<td>40%</td>
<td>42</td>
<td>95%</td>
<td>5%</td>
</tr>
</tbody>
</table>
40% biofuels in 2050

Scenario | Fleet average IPCC CO₂ emission [g/km] | reduction of pass. car CO₂ emissions [%] | Pass. car traffic volume growth [%] | Fleet average TTW CO₂ emission [g/km]
---|---|---|---|---
1990 | 2050 - 1990 | 2050 - 1990 | 2050 |
a) 180 | -60% | +80% | 66.7 |
b) 180 | -70% | +80% | 50.0 |
c) 180 | -80% | +80% | 33.3 |

40% biofuels in 2050

Scenario | EVs share [%] | TA CO₂ target (TTW) [g/km]
---|---|---|---|---
2050 | 2025 | 2030 | 2035 |
[a) 5% | 86 | 76 | 67 |
b) 29% | 80 | 65 | 50 |
c) 52% | 74 | 54 | 33 |

- Combination of 60% target and 40% biofuels share leads to negligible required EV share in 2050
**No biofuels for ICEVs**

### No biofuels in 2050

- **Scenario a)** fleet volume +80%, fleet emission -60% (2050 wrt 1990)
- **Scenario b)** fleet volume +80%, fleet emission -70% (2050 wrt 1990)
- **Scenario c)** fleet volume +80%, fleet emission -80% (2050 wrt 1990)

#### 0% biofuels in 2050

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Fleet average IPCC CO(_2) emission 1990</th>
<th>reduction of pass. car CO(_2) emissions 2050 - 1990</th>
<th>Pass. car traffic volume growth 2050 - 1990</th>
<th>Fleet average TTW CO(_2) emission 2050</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>1990</td>
<td>2050 - 1990</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>a)</td>
<td>180</td>
<td>-60%</td>
<td>+80%</td>
<td>40</td>
</tr>
<tr>
<td>b)</td>
<td>180</td>
<td>-70%</td>
<td>+80%</td>
<td>30</td>
</tr>
<tr>
<td>c)</td>
<td>180</td>
<td>-80%</td>
<td>+80%</td>
<td>20</td>
</tr>
</tbody>
</table>

### 0% biofuels in 2050

<table>
<thead>
<tr>
<th>Scenario</th>
<th>EVs share 2050</th>
<th>TA CO(_2) target (TTW) 2050</th>
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<tbody>
<tr>
<td></td>
<td>%</td>
<td>g/km</td>
</tr>
<tr>
<td>a)</td>
<td>43%</td>
<td>77</td>
</tr>
<tr>
<td>b)</td>
<td>57%</td>
<td>73</td>
</tr>
<tr>
<td>c)</td>
<td>71%</td>
<td>70</td>
</tr>
</tbody>
</table>

- Without biofuels a large EV share is needed to meet 2050 target
Scenario variation: volume

- Various scenarios from literature
  - incl. a “peak car” scenario

- Sensitivity assessed under assumption that passenger cars need to reduce 80% in 2050 relative to 1990
Scenario variation: volume

0% biofuels in 2050

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<td>[g/km]</td>
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<td>[g/km]</td>
</tr>
<tr>
<td>1990</td>
<td>180</td>
<td>-80%</td>
<td>0%</td>
<td>36</td>
</tr>
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<td>d)</td>
<td></td>
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<tr>
<td>2050 - 1990</td>
<td>-80%</td>
<td>+10%</td>
<td>33</td>
<td>g)</td>
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<tr>
<td>e)</td>
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<td></td>
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<tr>
<td>2050</td>
<td>180</td>
<td>-80%</td>
<td>+50%</td>
<td>24</td>
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<td>f)</td>
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<tr>
<td>2050</td>
<td>180</td>
<td>-80%</td>
<td>+100%</td>
<td>18</td>
</tr>
<tr>
<td>g)</td>
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0% biofuels in 2050

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<tbody>
<tr>
<td></td>
<td>[%]</td>
<td>[g/km]</td>
</tr>
<tr>
<td>2050</td>
<td>49%</td>
<td>75</td>
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<td>d)</td>
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<tr>
<td>2025</td>
<td>53%</td>
<td>74</td>
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<td>e)</td>
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<tr>
<td>2035</td>
<td>74%</td>
<td>69</td>
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<tr>
<td>g)</td>
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- Even with 40% biofuels the “peak car” scenario would still require 14% EVs to achieve 80% reduction
Conclusions

• EVs and other LEVs such as PHEVs and FCEVs can be expected to play a prominent role in achieving the long term CO₂ reduction goal for transport
  • 0% biofuels: LEV share of 40 to 70% necessary in 2050 to reduce the direct emissions of passenger car fleet by 60 to 80% compared to 1990
  • 40% biofuels: 60% reduction in 2050 feasible with a limited share of LEVs and a 2030 target of 70 g/km

• Required intermediate target levels strongly depend on:
  • assumed growth in vehicle kilometres between 1990 and 2050
  • extent to which >60% reduction in passenger cars is necessary

• 60% target for transport sector does not automatically put sufficient pressure on the system to reach other goals of White Paper wrt phasing out of conventional vehicles in cities
  • E.g. “Halve the use of ‘conventionally-fuelled’ cars in urban transport by 2030; phase them out in cities by 2050”
Conclusions

• Proper choice of post-2020 targets under the CO₂ regulation for passenger cars can be a powerful instrument to:
  • motivate manufacturers to continue their efforts in marketing and further development of (L)EVs in the coming decade
  • pull EVs through the “valley of death”
  • support the transition towards longer term sustainable mobility system

• A 2025 CO₂ target of at most 70 g/km, and a significantly lower target for 2030 should be announced as early as possible