Plug-in Hybrids: Is Europe heading for another Dieselgate?

Webinar 24/11/2020
PHEV sales soared to comply with 2020 CO2 targets (50% EV share)

72% of PHEV sales are company cars

Strategy for Volvo, BMW, Daimler, JLR & Ford (even PSA & Renault produce in a compliance push)

Source: EEA car registration data (2019) and T&E analysis of carmakers' compliance for 2020 and 2021 based on car registration data from the first half of 2020 from JATO Dynamics. 2020 total EU sales are assumed to be 25% lower in 2020 (vs. 2019) and 12.5% lower in 2021 (vs. 2019).
What is new about this analysis

1. WLTP-approved PHEV models tested
2. Real-world trip/average CO2 emissions tested, including starting on a fully charged battery
3. Vehicle design vs driver behaviour
The Test Results
Aim of T&E’s 2020 testing project:

1. To measure the real world electric only range, CO2 emissions and fuel consumption of PHEVs on the road in a range of operating modes and driving conditions

2. To check if PHEVs can stay in EV-only (zero emission) operation under a wide range of driving conditions

3. To analyse the impact of these result on EU regulation, particularly compliance with CO2 targets
The PHEVs tested

BMW X5  
Volvo XC60  
Mitsubishi Outlander

All Euro 6d-temp WLTP approved cars
The tests:

**RDE compliant route:** mild/moderate driving style
- **EV-mode test:** full battery, starting in EV-predominant mode
- **ICE-mode test:** empty battery, combustion engine used to power car
- **Charging-mode test:** empty battery, combustion engine used to power car and charge battery
- **Max load test:** maximum payload, full battery, starting in zero emission operation

**Dynamic/Elevation (non-RDE) route:** faster accelerations and greater elevation gain
- **Dynamic/elevation test:** Full battery, starting in EV-predominant mode

**Reverse order (non-RDE) route:** tests the car mainly on motorway driving
- **Reverse-order test:** Full battery, starting in EV-predominant mode
Plug-in hybrids

Electric-only (zero-emission) range

- EV-mode test, EV-only range came close or surpassed official WLTP EV-range
- EV-only range reduced by **2-76%** on all other tests but one
- Dynamic/Elevation test particularly large drop of as much as **76%** as X5 and XC60 could not stay in EV-only operation

PHEV EV-only range is highly dependant on driving style and road conditions- some PHEVs can’t stay in EV-only mode

Source: For type approval values the respective vehicle’s Certificate of Conformity, for test values Emissions Analytics.
CO2 emissions

- Only the X5 managed to come close to its official CO2 value and only on the ‘easiest’ test
- Even when starting with a fully charged battery CO2 emissions are higher than official WLTP values
- X5 CO2 emissions were between 1.3-12 times the official values
- 1.6-3.4 times for the XC60
- 1.9-4.7 times for the Outlander
- Highest emissions of up to 384g/km were measured on the battery charging test

PHEV CO2 emissions on the road are up to 12 times higher than official values

Source: Emissions Analytics
PHEVs are not better than ICE’s when not charged

Bases on official WLTP data the gap is:

- X5 is **22-55g/km** higher than diesel models and middle of the range for comparable petrol (**231-249g/km**)
- For the XC60 there is a gap of **17-41g/km**

When only the ICE is used to power the PHEV CO2 emissions are higher or similar to comparable ICE models
How far can PHEVs drive before exceeding official values?

- CO2 emissions increase rapidly once ICE turns on.
- The X5 can drive an estimated 86km before exceeding official emissions, the XC60 61km and the Outlander 67km.
- A 100km trip on one charge would emit an estimate x2 the official value for the X5, x1.6 for the XC60 and x1.9 for the Outlander.

PHEVs are not suited for long journeys, they are suited for short journeys where the majority of km can be driven electrically.
Charging using the ICE is very inefficient

- Charging the battery using the ICE is between 2-3 times less efficient than charging from the mains.
- Charging the battery emitted and additional 131g/km for the X5, 58g/km for the XC60 and 53g/km for the Outlander.
- This alone exceeded the official WLTP values for the X5 (by 4 times) and Outlander.
- The use of this mode could increase with geo-fencing.

Charging the battery during driving using the combustion engine is incredibly inefficient and causes a huge increase in CO2.
PHEVs drive much less electric km’s than regulations assumes

Real world utility factors (based on German usage) compared to NEDC

More realistic utility factors for the three PHEVs tested

<table>
<thead>
<tr>
<th></th>
<th>K5</th>
<th>XC60</th>
<th>Outlander</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEDC electric range (km)</td>
<td>94</td>
<td>42</td>
<td>54</td>
</tr>
<tr>
<td>Assumed NEDC UF (%)</td>
<td>79</td>
<td>63</td>
<td>68</td>
</tr>
<tr>
<td>UF private (%)</td>
<td>69</td>
<td>41</td>
<td>49</td>
</tr>
<tr>
<td>Gap Private UF vs. NEDC UF (%)</td>
<td>-13</td>
<td>-35</td>
<td>-28</td>
</tr>
<tr>
<td>UF Company (%)</td>
<td>30</td>
<td>15</td>
<td>19</td>
</tr>
<tr>
<td>Gap Company UF vs NEDC UF (%)</td>
<td>-62</td>
<td>-76</td>
<td>-72</td>
</tr>
</tbody>
</table>

Source: T&E

NEDC overestimates the share of electric kilometers driven by the three PHEVs by between 12-72%(based on German data)
This means that real world CO2 emissions and fuel consumption are greatly underestimated.

CO2 emissions:

- When used privately, PHEV NEDC CO2 emissions are ~ 50% higher than official NEDC values.
- When used as a company car, 2.2-3 times higher.

PHEV CO2 emissions are much higher in the real world than official values.
Bigger picture
If UF seen in Germany are used:

- BMW’s fleet-wide CO2 should be 8-11g/km higher
- Volvo’s - 8-14g/km higher

Driving in EV mode of 60-70% required to comply with the CO2 target

When real-world utility factors used - highly unlikely that BMW or Volvo would comply with CO2 targets
Over EUR 1bln spent on subsidising PHEVs in 2020

<table>
<thead>
<tr>
<th>Country</th>
<th>Purchase subsidy Jan-Sep 2020 (EUR)</th>
<th>Reduced benefit in kind tax 2020 (EUR)</th>
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</thead>
<tbody>
<tr>
<td>France</td>
<td>38,278,000</td>
<td>7,262,640</td>
</tr>
<tr>
<td>Germany</td>
<td>348,310,500</td>
<td>208,353,600</td>
</tr>
<tr>
<td>Italy</td>
<td>27,999,500</td>
<td>N.A</td>
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<tr>
<td>Spain</td>
<td>21,494,700</td>
<td>N.A</td>
</tr>
<tr>
<td>UK</td>
<td>N.A</td>
<td>339,068,984</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>436,082,700</strong></td>
<td><strong>554,685,224</strong></td>
</tr>
</tbody>
</table>

Source: Schmidt Automotive Research
Is it all driver’s fault?

- Power from electric motor is less than half (43%) that of engine

>> not designed to be driven in ZE mode

- Fast charging extremely rare

>> 7h to charge X5 fully

- Engine’s CO2 can be worse than conventional equivalents

>> inefficient engine propelling a very heavy car
Key Policy recommendations

1. **End purchase subsidies** for private or company car PHEVs

2. Only PHEVs with an **electric range of >80km, sufficient power** to drive electric in all conditions & with **fast charging** should be eligible for any CO2-related tax benefits

3. Use data from on-board fuel consumption meters to set **manufacturer specific utility factors** for CO2 emission ratings and CO2 compliance

4. **Remove 0.7 multiplier** from the Zero and Low Emission Vehicle (ZLEV) credits from 2025 and **stop all credits for PHEVs** by 2030

5. **Improve the WLTP test procedure**: include the use of auxiliaries, update the electric range definition & remove corrections
Thank you for listening!

Questions?