IEA Experts’ Dialogue on Materials Trends in Transport

The potential for material substitution and new vehicles designs in trucks and buses

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Key aims and findings in our study

Study: "Light weighting as a means of improving Heavy Duty Vehicles’ energy efficiency and overall $CO_2$ emissions".

The objective of the work was to provide a comprehensive survey and analysis of the potential contribution of HDV light-weighting to improving future fuel consumption and reducing GHG emissions in the EU.
Weights trends in HDVs

• *Articulated and rigid trucks*
  
  • Over the past 20 years, the average weight for tractors (of articulated trucks) appears to have increased to a small degree mainly due to the increasing stringency of Euro emission standards, increased safety requirements and increased comfort demand (e.g. through greater use of soundproofing materials).
  
  • The transition from Euro V to Euro VI has increased weight by a similar extent as in artic tractors so the proportionate impact on payload is usually greater.
Weights trends in HDVs

• **Buses and coaches**
  • According to coach manufacturers, coaches had become around 500-600 kg heavier over the past 20 years. Weight increases due to additional comfort, safety and environmental equipment were in part compensated through lighter body parts.
  • City buses have also increased in weight
Information on materials

Steels
• Conventional mild steel tends to be the dominant material in the manufacture of HDVs and their components

Aluminium
• Aluminium is used for some bodies and chassis on weight-sensitive operations

Plastics and fabrics reinforced materials
• There is an emerging trend for non-structural parts on HDVs to be made of plastics (oil sumps, side deflectors, steps, FUP, storage boxes etc)
## Breakdown of Vehicle Composition by Material Type

<table>
<thead>
<tr>
<th>Material</th>
<th>Van (5t GVW)</th>
<th>Rigid Truck (12t GVW)</th>
<th>Midibus (12t GVW)</th>
<th>Coach (19t GVW)</th>
<th>Artic Truck (Curtainsider) (40t GVW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>232</td>
<td>517</td>
<td>449</td>
<td>1,273</td>
<td>1,543</td>
</tr>
<tr>
<td>Steel</td>
<td>1,011</td>
<td>3,198</td>
<td>1,999</td>
<td>5,667</td>
<td>8,750</td>
</tr>
<tr>
<td>HS Steel</td>
<td>268</td>
<td>268</td>
<td>117</td>
<td>476</td>
<td>465</td>
</tr>
<tr>
<td>Aluminium</td>
<td>141</td>
<td>55</td>
<td>2,940</td>
<td>2,544</td>
<td>519</td>
</tr>
<tr>
<td>Copper</td>
<td>23</td>
<td>20</td>
<td>20</td>
<td>34</td>
<td>70</td>
</tr>
<tr>
<td>Plastics</td>
<td>249</td>
<td>214</td>
<td>1,200</td>
<td>1,174</td>
<td>815</td>
</tr>
<tr>
<td>Rubber</td>
<td>69</td>
<td>350</td>
<td>211</td>
<td>388</td>
<td>844</td>
</tr>
<tr>
<td>Glass</td>
<td>14</td>
<td>41</td>
<td>367</td>
<td>300</td>
<td>43</td>
</tr>
<tr>
<td>Water</td>
<td>15</td>
<td>0</td>
<td>36</td>
<td>120</td>
<td>60</td>
</tr>
<tr>
<td>Lead</td>
<td>16</td>
<td>25</td>
<td>90</td>
<td>156</td>
<td>156</td>
</tr>
<tr>
<td>GFRP</td>
<td>0</td>
<td>1,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>263</td>
<td>512</td>
<td>621</td>
<td>1,269</td>
<td>1,285</td>
</tr>
<tr>
<td>Payload</td>
<td>2,700</td>
<td>5,800</td>
<td>3,950</td>
<td>5,600</td>
<td>25,450</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,300</td>
<td>6,200</td>
<td>8,050</td>
<td>13,400</td>
<td>14,550</td>
</tr>
</tbody>
</table>
Breakdown of vehicle composition by material type

**Kerb Weight:**
- 2,300 kg
- 6,200 kg
- 8,050 kg
- 13,400 kg
- 14,550 kg

**Vehicle Types:**
- Van (5t GVW)
- Rigid Truck (12t GVW)
- Midibus (12t GVW)
- Coach (19t GVW)
- Artic Truck (Curtainsider) (40t GVW)

**Materials:**
- Other
- GFRP
- Lead
- Water
- Glass
- Rubber
- Plastics
- Copper
- Aluminium
- HS Steel
- Steel
- Iron

**Weight Distribution:**
- Van (5t GVW): 232 kg, 517 kg, 449 kg, 1,273 kg, 1,543 kg
- Rigid Truck (12t GVW): 263 kg, 512 kg, 621 kg, 1,269 kg, 1,285 kg
- Midibus (12t GVW): 268 kg, 350 kg, 214 kg, 1,999 kg, 5,667 kg
- Coach (19t GVW): 268 kg, 350 kg, 211 kg, 1,200 kg, 8,750 kg
- Artic Truck (Curtainsider) (40t GVW): 232 kg, 517 kg, 449 kg, 1,273 kg, 1,543 kg

**Weight:**
- Van (5t GVW): 2,300 kg
- Rigid Truck (12t GVW): 6,200 kg
- Midibus (12t GVW): 8,050 kg
- Coach (19t GVW): 13,400 kg
- Artic Truck (Curtainsider) (40t GVW): 14,550 kg
# Impacts of alternative powertrains and future technologies on weight

<table>
<thead>
<tr>
<th>Technology</th>
<th>Heavy Van (5 t GVW)</th>
<th>Rigid Truck (12 t GVW)</th>
<th>Midibus (12 t GVW)</th>
<th>Coach (19 t GVW)</th>
<th>Artic Truck (Box) (40 t GVW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline kerb weight</td>
<td>2,305 kg</td>
<td>6,349 kg</td>
<td>7,962 kg</td>
<td>13,560 kg</td>
<td>15,057 kg</td>
</tr>
<tr>
<td>Additional weight of technologies</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Stop-start system</td>
<td>0 kg</td>
<td>20 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid electric*</td>
<td>50 kg</td>
<td>100 kg</td>
<td>100 kg</td>
<td>150 kg</td>
<td>100 kg</td>
</tr>
<tr>
<td>Flywheel hybrid</td>
<td>150 kg</td>
<td>200 kg</td>
<td>200 kg</td>
<td>300 kg</td>
<td>200 kg</td>
</tr>
<tr>
<td>Dedicated gas or dual-fuel (gas/diesel) vehicle**</td>
<td>50 kg</td>
<td>150 kg</td>
<td>200 kg</td>
<td>300 kg</td>
<td>1,000 kg</td>
</tr>
<tr>
<td>Plug-in hybrid electric vehicle</td>
<td>150 kg</td>
<td>250 kg</td>
<td>250 kg</td>
<td>400 kg</td>
<td></td>
</tr>
<tr>
<td>Fully (battery) electric vehicle***</td>
<td>250 kg</td>
<td>400 kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euro VI - additional aftertreatment</td>
<td>40 kg</td>
<td>90 kg</td>
<td>50 kg</td>
<td>100 kg</td>
<td>50 kg</td>
</tr>
</tbody>
</table>

*The numbers in the table represent the indicative additional weight added to the vehicle for each technology. The 'Low' and 'High' columns indicate the range of additional weight for each technology across different vehicle types.*

**The 'Dedicated gas or dual-fuel (gas/diesel) vehicle' technology includes both natural gas and dual-fuel options, with the additional weight varying depending on the specific type of fuel.**

***The 'Fully (battery) electric vehicle' and 'Plug-in hybrid electric vehicle' technologies include both battery electric and plug-in hybrid options, with the additional weight varying depending on the battery size and efficiency.**
Expected trends and drivers for future engineering material prices (1)

**Steel:**
High volume production processes well established and unlikely to undergo considerable change. Steel material technologies likely to see evolution (Nano steel)

**Aluminium:**
Recycled aluminium production is likely to be the most significant technological growth area. Evolution of material grades and processes expected
Expected trends and drivers for future engineering material prices (2)

**Plastics:**
Growth in plastics using natural fibres and new production methods

**Carbon fibre:**
Rapid development of new manufacturing processes, aimed at reducing the expensive polyacrylonitrile (PAN) element should result in material price reductions over 10-15 years. New manufacture and process developments reducing tact time, enabling higher volume production and improved economies of scale
Where can I find this study?


Thank you for your attention!