Decarbonising Road Freight

Results of expert opinion survey

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The expert survey is part of the ITF Decarbonising Transport initiative's thematic work stream on Road Freight transport, aiming to

- Gather initial evidence on cost-effectiveness, market uptake and barriers to implement different measures
  - Logistics and supply chains
  - Alternative Fuels
  - Vehicle and engine efficiency
  - Intelligent systems and driver training
- Explore how emerging market trends, new entrants and disruptive technologies might shape the sector
- Identify pressing challenges and policy priorities
The survey was sent to experts in government, industry, civil society and academia.

- 108 experts responded
- 80% of respondents European based, 20% are non-European based
- 30% government
- 28% private sector
- 25% research/academia
- 18% international organisations or NGOs

In which area do you work?

- Policy making and analysis: 33.80%
- Environment and sustainability: 29.58%
- Production, data, operations: 14.09%
- Administration and management: 9.86%
- Institutional relations: 4.93%
- Other: 7.75%
Logistics and supply chains
Optimisation of routing, assets and collaboration

Modularised and standardised packaging units

Widening delivery windows

Average score (0-10)

Costs to implement  Effective in CO2 reduction  Operational improvements

Optimisation and collaboration most effective logistics measure reducing emissions (above overall average)

All logistic measures have more impacts on operational improvements than for reducing emissions
<table>
<thead>
<tr>
<th>Optimisation and Collaboration</th>
<th>Modular packaging units</th>
<th>Widening delivery windows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry-level coordination and cooperation</td>
<td>Industry-level coordination and cooperation</td>
<td>Goes against market trends</td>
</tr>
<tr>
<td>Market structure and lack of scale at individual company level</td>
<td>Market structure and competitive pressure</td>
<td>Permits, standards and regulations</td>
</tr>
<tr>
<td>Cultural barriers in the industry</td>
<td>Vehicle design</td>
<td>Cultural barriers in the industry/Lack of government support and incentives</td>
</tr>
</tbody>
</table>

- Industry level coordination and market structure are the major barriers for Optimisation and Modular units.
- Market trends and existing permits/regulations are the key barriers to widening the delivery windows.
If delivery windows are not relaxed it is impossible to increase vehicle capacity utilisation (even when other measures are deployed)?

- **Strongly disagree**
- **Strongly agree**

Beyond the average score a picture of divided opinions
When do you think “The Physical Internet” will be in widespread use?

- By 2020: 0%
- Between 2020 and 2030: 16%
- Between 2030 and 2050: 55%
- After 2050: 12%
- Never: 6%
- I don't know: 12%

- Majority thinks it will be in widespread use by 2050
- Potentially as effective in decreasing CO2 emissions as Optimisation/Collaboration
Alternative Fuels
Different alternative mix for different operation types

- Full-battery electric (2\textsuperscript{nd} Hybrid) for \textit{Urban}
- Hybrid (2\textsuperscript{nd} Gas/Full-battery) for \textit{Regional}
- Biofuels (2\textsuperscript{nd} Electric road) for \textit{Long-haul}
TIMELINE

- Hybrid fastest adoption
- >50% think Full-battery Electric in widespread use by 2030
- Gas and Biofuels, >50% also think they will be in widespread use by 2030, but higher skepticism
- Hydrogen and Electric roads latest adoption and highest skepticism

Alternative Fuels

- Biofuels
- Gas (LNG, CNG)
- Hydrogen fuel cell
- Hybrid
- Full-battery electric
- Electric roads

Legend:
- By 2020
- Between 2020 and 2030
- Between 2030 and 2050
- After 2050
- Never
- I don't know
- **Key overall barrier is “charging and distribution network”**

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charging and distribution network</td>
<td>25%</td>
</tr>
<tr>
<td>Lack of strict emission regulations</td>
<td>16%</td>
</tr>
<tr>
<td>Vehicle side technology</td>
<td>14%</td>
</tr>
<tr>
<td>Lack of financial incentives</td>
<td>14%</td>
</tr>
<tr>
<td>Fuel production technology</td>
<td>14%</td>
</tr>
<tr>
<td>High lifecycle &quot;well-to-wheel&quot; emissions of alternatives to combustion engine</td>
<td>9%</td>
</tr>
<tr>
<td>Permits, standards and regulations (e.g. labour laws, regulations)</td>
<td>4%</td>
</tr>
<tr>
<td>Other</td>
<td>4%</td>
</tr>
</tbody>
</table>
For Biofuels key barrier is the difficulty to scale up production, vehicle costs for Hybrids
Vehicle and engine efficiency
Improving efficiency of vehicles (engine, rolling resistance, aerodynamics etc.) is the most effective CO2 reducing measure (not including alternative fuels).

High Capacity Vehicles more impacts on operational improvements than CO2 reduction.
To what extent should high capacity vehicles be deployed for long-haul operations?

- They should and can be applied to most long-haul operations. 38%
- They should be applied for trips along major highways. 13%
- They should be applied only on specific corridors with high demand volumes where there are limited alternatives for other heavy modes (e.g. rail, inland waterways). 35%
- There should not be increases in current truck capacities. 15%

- 85% of the respondents think it should be applied (with more or less restrictions)
- But around half put high restrictions (or completely object)
High Capacity Vehicles

- Regulation and Infrastructure limitations

- Road infrastructure limitations (e.g. bridges, crossings and junctions) and damage increase.

- Limited to certain demand characteristics (e.g. high volumes of bulk commodities)

- Other

Regulation: 42%

Road infrastructure limitations: 42%

Limited to certain demand characteristics: 11%

Other: 5%
Vehicle and engine efficiency

**BARRIERS**

- Initial costs: 27%
- Lack of strict fuel and emission standards: 24%
- Small companies lack scale economies that allow a return on investment: 17%
- Lack of financial incentives from government: 14%
- Separate ownership of trailers and tractors: 9%
- These technologies are already being widely adopted by the industry: 5%
- Other: 4%

**Vehicle technologies**

- Initial costs, lack of strict fuel and emissions standards
Intelligent systems and driver training
Driver training the most effective in decreasing CO2 emissions in this group (above overall average).

Truck platooning on the average, Autonomous Trucks below.
To what extent are driver training and assisted driving currently employed across the industry?

- Average score 4.73, still room to grow

MARKET UPTAKE

Not at all

<table>
<thead>
<tr>
<th>Score</th>
<th>Uptake</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>2</td>
<td>10%</td>
</tr>
<tr>
<td>3</td>
<td>15%</td>
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<tr>
<td>4</td>
<td>20%</td>
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<tr>
<td>5</td>
<td>25%</td>
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<tr>
<td>6</td>
<td>30%</td>
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<tr>
<td>7</td>
<td>35%</td>
</tr>
<tr>
<td>8</td>
<td>40%</td>
</tr>
<tr>
<td>9</td>
<td>45%</td>
</tr>
<tr>
<td>10</td>
<td>50%</td>
</tr>
</tbody>
</table>
>50% think Truck platooning will deliver operational cost decreases of more than 10%

45% think Autonomous trucks will deliver operational cost decreases of more than 25%
>50% stated Truck platooning will be a common practice by 2030

>50% stated Autonomous Trucks will be in general use by 2050
Start with the top of the graph:

- **Security and safety concerns (e.g. vulnerability to "hacking")**
  - 26%

- **Permits, standards and regulations (e.g. labour laws, regulations and insurance)**
  - 20%

- **Required changes to road infrastructure (e.g. highway entrance/exit ramps, reinforce structure, sensors)**
  - 18%

- **Vehicle technology (sensors, equipment and digital tech)**
  - 18%

- **Competitive pressure will limit platooning opportunities between trucks of different companies**
  - 9%

- **Cultural barriers, resistance from general public**
  - 8%

- **Other**
  - 2%

**Truck platooning**

- Security and safety, Regulation
Autonomous trucks

- Security and safety, Regulation
Emerging Trends
Emerging Trends

- E-commerce is the least effective CO2 reduction measure/trend,
- Crowdshipping is second worst overall
- Collection points slightly above overall average
E-COMMERCE MOST RELEVANT IMPACTS

- Increased service requirements that constrain efforts to optimise operations and decrease available capacity use (19%)
- Increased economies of scale will allow for more efficient operations and higher vehicle capacity utilisation (16%)
- Increased market control by E-commerce giants will reduce prices for carriers and the trucking industry (15%)
- Facilitates collaboration, freight matching and asset sharing (12%)
- Less ability of independent trucking companies to renew their equipment and competitive pressure that can lead to increased empty runs and lower load... (12%)
- Facilitates the adoption of new standards and technologies (11%)
- Other (9%)
- No significant impacts (7%)
EXOGENOUS FACTORS

- **Reshoring**
  - No consensus on demand
  - Decreased distances

- **3D printing**
  - Not significant on demand
  - Not significant or decreased distance

- **Shifts in trade routes**
  - Increased demand
  - No consensus on distance
MOST LIKELY TRENDS AND LOGISTIC MEASURES
BY 2030

- **E-commerce** is the most likely trend (78%)
- Optimisation is also likely for >50% (67%)
- **Reshoring** is the least likely, 3D printing second to last (4%)

- Easily accessible, all day long, collection points for deliveries in cities (49%)
- Collaboration and asset sharing (43%)
- Modularised, standardised packaging units (39%)
- Digital freight matching (39%)
- Shifts in trade routes (29%)
- "Physical Internet" (27%)
- Widened delivery windows (25%)
- Crowdshipping (25%)
- 3D printing (22%)
- Reshoring (12%)
- Other (4%)
Pressing challenges, policy priorities and who will lead transformation?
Different pressing challenges by level of economic development

- **High-income countries**:
  - Shocks from new entrants and disruptive technologies
  - Inadequate regulation and legal framework
  - Lack of qualified workforce
  - Safety and security issues
  - Profitability and financial viability
  - Increase productivity and resource use efficiency
  - Lack of adequate infrastructure
  - Environmental impacts and energy consumption

- **Middle-income countries**:
  - Shocks from new entrants and disruptive technologies
  - Inadequate regulation and legal framework
  - Lack of qualified workforce
  - Safety and security issues
  - Profitability and financial viability
  - Increase productivity and resource use efficiency
  - Lack of adequate infrastructure
  - Environmental impacts and energy consumption

- **Low-income countries**:
  - Shocks from new entrants and disruptive technologies
  - Inadequate regulation and legal framework
  - Lack of qualified workforce
  - Safety and security issues
  - Profitability and financial viability
  - Increase productivity and resource use efficiency
  - Lack of adequate infrastructure
  - Environmental impacts and energy consumption
## PRESSING CHALLENGES

<table>
<thead>
<tr>
<th>Low-income</th>
<th>Middle-income</th>
<th>High-income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of adequate infrastructure</td>
<td>Environmental impacts and energy consumption</td>
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</tr>
<tr>
<td>Inadequate regulation and legal framework</td>
<td>Safety and security issues</td>
<td>Shocks from new entrants and disruptive technologies</td>
</tr>
<tr>
<td>Safety and security issues</td>
<td>Increase productivity and resource use efficiency</td>
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</tr>
</tbody>
</table>

- Environmental issues are the most pressing challenges in middle- and high-income countries, lack of infrastructure in low-income countries.
- Shocks from new entrants and disruptive technologies are an important challenge in High-income countries, Safety and security in middle income and inadequate regulation in low income.
Policy priorities for each country group vary

- **High-income countries**
  - Total or partial bans on certain vehicle types (e.g. prevent diesel trucks from making deliveries in city centre)
  - Fuel efficiency and emissions standards for vehicles
  - Pricing mechanisms (e.g. fuel tax, distance based)
  - Financial incentives
  - Reform regulation and legal framework for the sector (e.g. labour laws, permits, insurance related issues)
  - Promote standardisation of vehicles, equipment, procedures and digital networks
  - Improve infrastructure supply

- **Middle-income countries**

- **Low-income countries**

Average score
<table>
<thead>
<tr>
<th>Low-income</th>
<th>Middle-income</th>
<th>High-income</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Improve infrastructure supply</td>
<td>Fuel efficiency and emissions standards for vehicles</td>
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</tr>
<tr>
<td><strong>2</strong> Reform regulation and legal framework for the sector</td>
<td>Pricing mechanisms</td>
<td>Pricing mechanisms</td>
</tr>
<tr>
<td><strong>3</strong> Fuel efficiency and emissions standards for vehicles</td>
<td>Reform regulation and legal framework for the sector</td>
<td>Total or partial bans on certain vehicle types</td>
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- Fuel efficiency and emissions standards for vehicles a top priority for all countries
- Pricing mechanisms on high- and middle income countries, total or partial bans on high-income countries
- Improving infrastructure is the number one priority for low income countries
WHO WILL LEAD TRANSFORMATION?

- **Government and regulators**: 29%
- **New entrants (e.g. mega E-commerce retailers and/or digital platform developers)**: 21%
- **Retailers/Shippers (e.g. Walmart, Nestlé...)**: 16%
- **Logistic suppliers (e.g. DHL, UPS)**: 15%
- **Vehicle manufactures (e.g. Renault-Nissan-Mitsubishi Alliance, Volvo...)**: 13%
- **Energy companies (e.g. BP, Exxon Mobil, Aramco...)**: 4%
- **Other**: 2%

- **Government and regulators almost 30%**
- **Private sector combined 70%**

- New entrants will lead on the private side
Summary of results
<table>
<thead>
<tr>
<th>Vehicle technologies</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver training and assisted driving</td>
<td>5</td>
</tr>
<tr>
<td>Optimisation of routing, assets and collaboration</td>
<td>5</td>
</tr>
<tr>
<td>High Capacity Vehicles</td>
<td>5</td>
</tr>
<tr>
<td>Physical internet</td>
<td>5</td>
</tr>
<tr>
<td>Collection points</td>
<td>5</td>
</tr>
<tr>
<td>Truck Platooning</td>
<td>5</td>
</tr>
<tr>
<td>Digital freight matching</td>
<td>5</td>
</tr>
<tr>
<td>Widening delivery windows</td>
<td>5</td>
</tr>
<tr>
<td>Autonomous Trucks</td>
<td>5</td>
</tr>
<tr>
<td>Modularised and standardised packaging units</td>
<td>4</td>
</tr>
<tr>
<td>Crowdshipping</td>
<td>3</td>
</tr>
<tr>
<td>E-commerce</td>
<td>1</td>
</tr>
</tbody>
</table>

**Summary of results**

**Effective in CO2 reduction?**

- Improving vehicle efficiency (vehicle technologies) is the most effective of these alternatives

- E-commerce the worst
Summary of results

- **Logistics** - Optimisation and collaboration is the measure that gathers more consensus.

- **Alternative Fuels** – Solution for Urban and Regional. Mixed results for the Long-haul. Charging and supply network is a key barrier.

- **Vehicle efficiency** – High cost-effectiveness of CO2 emissions reduction. Initial costs and lack of strict standards are barriers.

- **Intelligent systems and driver training** – Driver training is cost-effective and has room to grow. Truck platooning and Autonomous trucks benefits will reduce cost. In wide use by 2030-2050.

- **Emerging trends** – E-commerce is to gain speed, which will not help decarbonise the sector. Re-shoring and 3D printing not likely.

- **Challenges and Policy** – Environmental impacts a challenge in High and Middle income countries. Safety and security important in Middle and Low income countries. Shocks with new entrants in High income. Fuel efficiency standards a policy priority (H/M), legal framework (M/L). Infrastructure the most important for Low income group.
Thank you

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