OVERVIEW OF STRATEGIES FOR REDUCING CO₂ EMISSIONS DURING THE USE PHASE OF PASSENGER CARS

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Introduction

Fossil fuels are the main energy source for transportation. The expected increase in transportation demand – mainly on developing countries – represent an issue for sustainable transport in the future.

Passenger cars, which represent almost 70% of the passenger travel (p.km/year) in OECD countries, have an important role in the reduction of CO₂ emissions produced during their whole life cycle – CO₂ is a greenhouse gas that contributes to the climate change phenomena.

The main source of CO₂ emissions during the lifecycle of a passenger car is the tank-to-wheels or use phase:

- Production: 77% WTT (energy production)
- TTW (use): 14%
- End-of-life: <1%

Life cycle CO₂ emissions (GWP – %kgCO₂eq) – Diesel car [1]

Aim of the paper: review the strategies developed for reducing CO₂ emissions of passenger cars during their use phase, considering the vehicle technologies, driver behavior modifications and vehicle environment.

Methodology

Review based on scientific journals and reports (Springer, Elsevier, SAE and IEA, OECD).

Considering measures applied to reduce CO₂ emissions during the use phase coming from each element of the DVE system:

- **Driver:** Driver behavior and decisions
- **Vehicle:** Aerodynamics, Weight, Rolling resistance Sources of energy Powertrain characteristics
- **Environment:** Road and traffic conditions

Driver-Vehicle-Environment System and components

Results

The following strategies were reviewed, according to the elements of DVE system they address:

<table>
<thead>
<tr>
<th>Driver</th>
<th>Changes on driver behavior: eco-driving Up to 20% e.r.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle</td>
<td>ICE Powertrain improvements Ex. Downsizing Up to 15% e.r.*</td>
</tr>
<tr>
<td>Environment</td>
<td>Road design and characteristics (slope, sinuosity)</td>
</tr>
</tbody>
</table>

- Materials choice and road conditions
- Life cycle analysis impacts of roads (use phase)

The interactions between measures are not extensively explored in literature. An example already considered is the vehicle-infrastructure communication and hybrid vehicles [2].

Proposition of a framework

Considering the strategies reviewed, we proposed a framework to evaluate and compare these strategies for reducing emissions during the use phase:

- **Target Domain:** Driver / Vehicle / Environment / Interactions
- **Difficulty:** Customers acceptance Policy Measures Technical / feasibility constraints
- **Efficiency:** Emissions reduction (gCO₂/km) Extent (new fleet / whole fleet)
- **Combination with other strategies:** Possible / Not possible Positive / Neutral / Negative effects

Proposed framework for strategy analysis

Conclusions

This review of strategies for reducing emissions during the use phase of passenger cars allowed us to propose some criteria for classifying and comparing these strategies. Further work should deeper evaluate the gains obtained and combinations effects.

References

1. Leduc, G., Mongelli, I. et al. (2010), "How can our cars become less polluting? an assessment of the environmental improvement potential of cars" Transport Policy, 17, 409 – 419.

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