The role of Electrical vehicles in Europe
- Outcome from the ERA-Net Project EV-STEP

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Motivation and objective

- What will be the perspective electro-mobility in the transport sector of the EU-28 as a whole and in the countries is one main question at the moment?
- Varied assumptions concerning energy, climate and environmental policy in the EU can have impact on the role of electro-mobility.
- The penetration of electric vehicle concepts can have impacts on the sustainability of both, transport sector and the total energy system.

Analyze with a scenario analysis the role of electro-mobility in the energy system in the EU-28 and there member states.
TIMES PanEU

- Technology oriented bottom-up partial equilibrium model
- 30 region model (EU 28, No, CH, IS)
- Energy system model
  - **SUPPLY:** reserves, resources, exploration and conversion Country specific renewable potential and availability (onshore wind, offshore wind, ocean, geothermal, biomass, biogas, hydro)
  - Electricity: public electricity plants, CHP plants and heating plants
  - Residential and Commercial: End use technologies (space heating, water heating, space cooling and others)
  - Industry: Energy intensive industry (Iron and steel, aluminium copper ammonia and chlorine, cement, glass, lime, pulp and paper), food, other industries, autoproducer and boilers
  - Transport: Different transport modes (cars, buses, motorcycles, trucks, passenger trains, freight trains), aviation and navigation
- Country specific differences for characterisation of new conversion and end-use technologies
- Time horizon 2010 - 2050
- GHG: CO2, CH4, N2O, SF6 /Others pollutants: SO2, NOx, CO, NMVOC, PM2.5, PM10
Schematic representation of the consideration of Vehicle-to-Grid (V2G) energy storage in TIMES PanEU

- Idea: Electric vehicles (BEV, PHEV) serve as energy storage if connected to grid
- Thus, they could provide (peak) electricity if necessary
- Recharging during off-peak times
- However, keep sufficient energy for vehicle trips
- Additional battery cycles decrease battery lifetime!
Development of specific investment cost of batteries

- Bain & Company (2010)
- CSM (2009)
- Deutsche Bank (2009)
- Deutsche Bank (2010)
- DOE (2010)
- Goldman Sachs (2010)
- IEK (2011)
- JC (2010)
- McKinsey (2012)
- USABC (2008)
Overview of the scenarios

<table>
<thead>
<tr>
<th></th>
<th>REF</th>
<th>REF-</th>
<th>EU</th>
<th>EU-</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GHG reduction target</strong></td>
<td>EU-ETS: -21% till 2020 comp. 2005 afterwards -1,74% p.a.</td>
<td>Overall GHG reduction -20% till 2020 and -80% till 2050</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Renewable</strong></td>
<td>Increasing reliance on RES, 60% share in electricity consumption 2050</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Electromobility</strong></td>
<td>national targets</td>
<td>no</td>
<td>national targets</td>
<td>no</td>
</tr>
<tr>
<td><strong>Biofuels</strong></td>
<td>national targets</td>
<td>no</td>
<td>national targets</td>
<td>no</td>
</tr>
</tbody>
</table>

Social economic assumptions:

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population</strong></td>
<td>Mio.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average growth per annum</td>
<td></td>
<td>497</td>
<td>500</td>
<td>499</td>
<td>491</td>
</tr>
<tr>
<td>%</td>
<td></td>
<td>0,01</td>
<td>0,00</td>
<td>-0,2</td>
<td>-0,3</td>
</tr>
<tr>
<td><strong>GDP</strong></td>
<td>10^{12}€_{07}</td>
<td>12,0</td>
<td>15,1</td>
<td>17,9</td>
<td>20,9</td>
</tr>
<tr>
<td>Average growth per annum</td>
<td></td>
<td></td>
<td>1,7</td>
<td>1,7</td>
<td>1,6</td>
</tr>
</tbody>
</table>
## Mobility demand in the EU28

<table>
<thead>
<tr>
<th></th>
<th>EU-28</th>
<th>2005</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Passenger traffic</strong></td>
<td><strong>Bio. Pkm</strong></td>
<td>5.857</td>
<td>6.458</td>
<td>6.796</td>
<td>6.884</td>
<td>6.911</td>
</tr>
<tr>
<td>(without aviation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>car/motorcycles</td>
<td>%</td>
<td>83,6</td>
<td>83,8</td>
<td>84,0</td>
<td>84,2</td>
<td>84,5</td>
</tr>
<tr>
<td>bus</td>
<td>%</td>
<td>8,8</td>
<td>8,4</td>
<td>8,1</td>
<td>7,9</td>
<td>7,7</td>
</tr>
<tr>
<td>train</td>
<td>%</td>
<td>7,6</td>
<td>7,8</td>
<td>7,9</td>
<td>7,9</td>
<td>7,8</td>
</tr>
<tr>
<td><strong>Aviation</strong></td>
<td><strong>PJ</strong></td>
<td>2.066</td>
<td>2.947</td>
<td>3.399</td>
<td>3.634</td>
<td>3.787</td>
</tr>
<tr>
<td><strong>Good transport</strong></td>
<td><strong>Bio. tkm</strong></td>
<td>2.549</td>
<td>3.268</td>
<td>3.762</td>
<td>4.009</td>
<td>4.133</td>
</tr>
<tr>
<td>trucks</td>
<td>%</td>
<td>72,3</td>
<td>74,8</td>
<td>75,1</td>
<td>75,2</td>
<td>75,0</td>
</tr>
<tr>
<td>rail</td>
<td>%</td>
<td>16,7</td>
<td>14,7</td>
<td>14,4</td>
<td>14,5</td>
<td>14,6</td>
</tr>
<tr>
<td>navigation</td>
<td>%</td>
<td>11,0</td>
<td>10,4</td>
<td>10,5</td>
<td>10,3</td>
<td>10,3</td>
</tr>
</tbody>
</table>
Scenario analysis CO₂ Emissions (EU-28)
Net Electricity Supply (EU-28)

Share of renewable electricity generation of total gross electricity consumption

Net electricity supply [TWh]

- Electricity storage (excl. pump storage)
- Electricity Imports Desertec
- Net Imports w/o Desertec
- Others / Waste non-ren.
- Other Renewables
- Biomass / Waste ren.
- Solar
- Wind offshore
- Wind onshore
- Hydro (incl. pump storage)
- Nuclear
- Gas CCS
- Gas w/o CCS
- Oil
- Lignite CCS
- Lignite w/o CCS
- Coal CCS
- Coal w/o CCS
- Share of renewable energies
Final Energy Consumption Electricity (EU-28)

Electricity consumption [PJ]

- Agriculture
- Transport
- Residential
- Industry
- Commercial

2010
2020
2030
2040
2050
Final energy consumption transport by transport mode (EU-28)

- Navigation
- Aviation
- Rail
- Trucks
- Bus

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Final energy consumption transport by energy carrier (EU-28)
Final energy consumption cars by energy carrier (EU-28)
Stock of cars by engine type (EU-28)
Stock of trucks and buses (EU-28)
Conclusion and Outlook

● The penetration of electrical vehicles not only depends on the share of renewables it is influenced mainly by the GHG reduction target.

● Till 2030 the assumed cost reduction for batteries and the GHG reduction targets are too low to bring electro-mobility in the transport sector without subsidies.

● Supporting electro-mobility influence the penetration in the midterm, in the long term it’s the option to decarbonize the transport sector.

● A sensitivity analysis related the battery cost and the share of renewable electricity generation of the gross electricity generation will follow.
Thank you for your attention!

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