ELECTRIC VEHICLES FOR A SMARTER MOBILITY

Energy efficiency, business models and innovative concepts

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Transport

Demand for transport is a derived demand, depending from the demand of other economic sectors. Users «consume» transport services in order to access other goods or services.

Relevant variables: time, space, cost.

Mobility

Mobility can be considered as a functionality/capability. User is the core, accessing services under given «constraints».

Relevant variables: time, space, cost, experience/accessibility → FREEDOM.
Some facts

• **More than 60% of EU citizens live in urban areas, where 85% of GDP is produced.**

• **Because of congestion costs, 1% of UE GDP is lost every year.**

• **Traffic contribution to CO2 production is 40%.**

• **One third of road fatalities happens in urban environment (and victims are mainly walkers or bikers).**

*From EC Green Paper “Towards a new culture for urban mobility” (September 2007)*
Sustainable development approach:

- Use of environmental, cultural and economic resources, minimizing external effects at local and global level;
- Meeting the needs of the present without compromising the ability of future generations to meet their own needs;
- Maintaining attractiveness and competitiveness of the local environment.

Sustainable mobility is a "win-win strategy" because it combines environmental and economic advantages with the stimulus to economic growth and the livability of cities.
Users, how will behave?

I. SUSTAINABLE

Quality of environment

Energy consumption/production

Safety

Global emissions
II. SHARE

Space

Vehicles

Information and knowledge

Travel experiences

Users, how will behave?
Users, how will behave?

III. SMART

SUSTAINABLE

SHARED

Seamless

Flexible

Maximising our value of time

Looking for innovative and added value services
What about cars then?

«The emergence of a new automobile DNA (...) promises a renassaince in vehicles design. It will open up for exploration spaces of design possibilities that have never before seriously considered.

(Mitchell W. J. et. Al, Reinventing the automobile, MIT Press 2010)

The car of the future

Energy efficient *
Eco-friendly *

Driverless
Modular
Specialized
Connected
...

*IBM Automotive Global Study 2020
And in the end, is it still just about making cars?

Automotive sector:
- New products
- New services
- Business models
- Supply chains

Service providers:
- Specific services (e.g. fleet management, car rental, etc.)
- Wider range of (sustainable) mobility services, B2B and B2C

Users:
- CAR OWNERS
- MOBILITY CONSUMERS
“Within a year, I hope, we shall begin the manufacture of an electric automobile. (...) Mr. Edison and I have been working for some years on an electric automobile which would be cheap and practicable. Cars have been built for experimental purposes, and we are satisfied now that the way is clear to success. The problem so far has been to build a storage battery of light weight which would operate for long distances without recharging. Mr. Edison has been experimenting with such a battery for some time.”

... will be possible tomorrow?

Source: M. de Saint-Chéron, Mobilitytech Milan, Oct 19th 2010
E-mobility: which factors are driving the system?

VEICHLES (supply)

HARDWARE INTERACTIONS (networks)

SOCIOECONOMIC BACKGROUND (models)

USERS (demand)

INSTITUTIONAL CONTEXT (rules)
**Batteries:**
Performance 150 km to 300 km.
Duration from 3 years (1000 deep discharge) to 10 (in ten years).
Costs from 700-1000 $/kWh, to 300$-400$.

**OEMs plans:**

<table>
<thead>
<tr>
<th></th>
<th>BEV</th>
<th>PHEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small size</td>
<td>This is the immediate candidate for BEV. Most of early models fall in this category</td>
<td>Vehicle packaging problem and excessive price are obstacles.</td>
</tr>
<tr>
<td>Medium size</td>
<td>Very few model are expected in the short term. This would however emerge later with battery cost decline and increased performance</td>
<td>Priviledge segment, but marketing is unlikely before 2020</td>
</tr>
<tr>
<td>Large size</td>
<td>Large car are usually used for long distance trip. Battery capacity is an obstacle. This would be limited to specific market (e.g. luxurary cars)</td>
<td>Priviledge segment, but marketing is unlikely before 2020</td>
</tr>
</tbody>
</table>

Source: JRC ipts 2010, Nemry F., Brons M., Plug-in Hybrid and Battery Electric vehicles
Scenarios and forecasts

Comparison of scenarios in terms of vehicle sales (EU level)

Source: JRC ipts 2010, Nemry F., Brons M., Plug-in Hybrid and Battery Electric vehicles
## Scenarios and forecasts

### New car sales shares in 2020 and 2030

<table>
<thead>
<tr>
<th>New car sales</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B1_I1</td>
<td>B1_I2</td>
</tr>
<tr>
<td>Conventional</td>
<td>94,5%</td>
<td>90,2%</td>
</tr>
<tr>
<td>PHEV</td>
<td>5,0%</td>
<td>8,9%</td>
</tr>
<tr>
<td>BEV</td>
<td>0,5%</td>
<td>0,9%</td>
</tr>
</tbody>
</table>

*Source: JRC ipts 2010, Nemry F., Brons M., Plug-in Hybrid and Battery Electric vehicles*
“non-mainstream people, with different connotations ranging from "a computer expert or enthusiast" to "a person heavily interested in a hobby“ (...)”

[wikipedia]
Hardware interactions: impacts on the grid

Average electric power demand with and without electric cars (GW)

Maximum electric power demand with and without electric cars (GW)

Average and maximum impact on the electric power request profile during the winter months. Scenario 3 – Electric fleet share = 5%

Hardware interactions: impacts on the grid

Average and maximum impact on the electric power request profile during the winter months. Scenario 3 – Electric fleet share = 25%

Business models for mobility

a. Product oriented
b. Service oriented
   - Use (e.g. car sharing, fleet management, etc.)
   - Result (transport services)

Approach to classification of business models for electric mobility, based on 3 driver clusters:
   - vehicle + battery
   - infrastructure
   - integration grid + vehicle

Source: Lerch et al. (2010)
Business model drivers: vehicle+battery

Source: Lerch et al. (2010)
## Business model drivers: infrastructure

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Design possibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of power supply</td>
<td>Conductive (wired)</td>
</tr>
<tr>
<td></td>
<td>Inductive (wireless)</td>
</tr>
<tr>
<td></td>
<td>Battery exchange</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Private</td>
</tr>
<tr>
<td></td>
<td>Semi-public (e.g. at employer)</td>
</tr>
<tr>
<td>Power connection</td>
<td>1-phase (Level 1)</td>
</tr>
<tr>
<td></td>
<td>3-phase (Level 2)</td>
</tr>
<tr>
<td></td>
<td>High voltage AC (Level 3)</td>
</tr>
<tr>
<td></td>
<td>High voltage DC (Level 3)</td>
</tr>
<tr>
<td>Power type</td>
<td>Unidirectional</td>
</tr>
<tr>
<td>Communication connection</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Unidirectional</td>
</tr>
<tr>
<td></td>
<td>Bidirectional</td>
</tr>
<tr>
<td></td>
<td>Real-time</td>
</tr>
<tr>
<td>Operator of power supply</td>
<td>Private</td>
</tr>
<tr>
<td></td>
<td>State</td>
</tr>
<tr>
<td></td>
<td>Energy utility</td>
</tr>
<tr>
<td></td>
<td>Independent provider</td>
</tr>
<tr>
<td>Type of billing</td>
<td>No fee</td>
</tr>
<tr>
<td></td>
<td>Pay per use</td>
</tr>
<tr>
<td></td>
<td>Fixed rate</td>
</tr>
</tbody>
</table>

*Source: Lerch et al. (2010)*
# Business model drivers: infrastructure+vehicle

## Systems Services

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Design possibility</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of systems service</td>
<td>No services offered</td>
<td>Load shifting</td>
</tr>
<tr>
<td>Number of participants</td>
<td>One participant</td>
<td>More than one participant</td>
</tr>
<tr>
<td>Level of Grid Integration</td>
<td>Local/stand-alone grid</td>
<td>Balancing group</td>
</tr>
<tr>
<td>Control</td>
<td>Uncontrolled</td>
<td>Indirect control</td>
</tr>
<tr>
<td>Type of power input</td>
<td>Public grid</td>
<td>Local generation</td>
</tr>
<tr>
<td>Provider</td>
<td>Private</td>
<td>Energy utility</td>
</tr>
<tr>
<td>Billing/compensation</td>
<td>No fee</td>
<td>Independent provider</td>
</tr>
</tbody>
</table>

Source: Lerch et al. (2010)
"If we don’t start imagining this future, and then start trying to help shape this future, we’re going to be left behind, because this future is going to happen with or without us"

Bill Ford jr, 2013

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