Electric Vehicle – Money Trap or Cash Cow? Is E-Mobility the Business Model of the Future for Traditional Automotive OEMs?

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EV uptake and overall profitability will depend on 3 key levers...

**How many – how fast – how profitable?**

**Product Offering**
- Product features that meet customer requirements (performance, range, etc.)
- Affordability: right balance between vehicle price, range and durability
- High degree of reliability of offered "mobility solution"

**Consumer Confidence**
- Understand consumer motivations
  - Cost/TCO
  - Convenience
- Understand consumer concerns
  - Range
  - Reliability
  - Residual Value
- Promote customer education

**Sustainable OEM Business Case/ Subsidies**
- Compensate for lost downstream revenues (compared to ICE vehicles)
- Strategic ownership of "right" pieces of downstream value chain
- Downstream product portfolio (service, parts, energy, etc.)

1. What products & services to be offered?
2. Who owns the battery?
3. How does a sustainable business case look like?

**Abb. 1:** EV uptake and overall profitability will depend on 3 key levers

**Products & Services**

Consumer demand for EVs will be driven significantly by economic attractiveness and individual product perception

1st Question: What products & services need to be offered?

<table>
<thead>
<tr>
<th>EV drivers from consumer's perspective</th>
<th>Product &amp; Service Offering</th>
</tr>
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<tbody>
<tr>
<td>Tax</td>
<td>Mobility services</td>
</tr>
<tr>
<td>Social pressure</td>
<td>All inclusive leasing</td>
</tr>
<tr>
<td>Legislation</td>
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<tr>
<td>Customer</td>
<td></td>
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<tr>
<td>Fuel price</td>
<td></td>
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<tr>
<td>Fleet guidelines</td>
<td></td>
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<tr>
<td>Environmental sensitivity</td>
<td></td>
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</tbody>
</table>

- Multiple drivers impact consumers' adoption of EVs
  - Fuels Cost
  - Tax
  - Congestion Charges
- Customers will have different motivators:
  - Urban / Rural
  - Lifestyle
  - Economical situation, etc.
- But, high uncertainty regarding EV durability, feasibility and residual value of battery and vehicle

**Abb. 2:** Consumer demand for EVs will be driven significantly by economic attractiveness and individual product perception
Mitsubishi responds to the customer expectations by offering a full service leasing package for a fixed monthly lease

**All-inclusive product bundles**

i-MiEV “Maintenance Lease”

- **EXAMPLE**
  - Full service “no hassle” product package
  - High predictability of service and maintenance costs for customer
  - Clear guidance for customer regarding service & maintenance requirements
  - Short service intervals allow for continuous tracking of vehicle usage and hence learning about customer driving behavior and impact on vehicle/battery
  - Same leasing logic applies to other manufacturers like Peugeot/Citroen

Abb. 3: Mitsubishi responds to the customer expectations by offering a full service leasing package for a fixed monthly lease

**Battery ownership**

Different strategic options related to battery ownership, payment mechanisms and infrastructure are currently being developed

2nd Question: Who owns the battery?

- **“Buy-Model”**
  - Customer “buys” vehicle and battery
  - Customer is fully responsible for battery charging and maintenance
  - Technology and supercession risks, depreciation etc.
  - with customer

- **“Lease-Model”**
  - Customer “buys” vehicle and leases battery
  - Lease includes battery maintenance and charging control
  - Battery risks reside with OEM or mobility company

Battery lease models will drive EV acceptance significantly

- Battery price compensation
- Limitation of residual value risks
- Forcing of customer contact points

Abb. 4: Different strategic options related to battery ownership, payment mechanisms and infrastructure are currently being developed
Given the dominant role of the battery for a viable EV business case the battery life-cycle needs to be maximised.

Reducing consumer risk delivers real benefits for the consumer and value opportunities for the Mobility Company or OEM.

Abb. 5: Given the dominant role of the battery for a viable EV business case the battery life-cycle needs to be maximised.

Abb. 6: Reducing consumer risk delivers real benefits for the consumer and value opportunities for the Mobility Company or OEM.
Abb. 7: Extending battery automotive life, developing “2nd life” uses and finally recycling the product delivers incremental profit opportunities.

Battery ownership
Extending battery automotive life, developing “2nd life” uses and finally recycling the product delivers incremental profit opportunities.

Abb. 8: But: Electricity storage in batteries is currently not economical – Utilities are unlikely to pay for used EV batteries.

E-Storage in batteries not economical

Annual revenue per battery
- Daily battery capacity for energy arbitrage\(^1\): 0.5 kWh
- Efficiency factor: 90%
- Days per year: 365
- A peak vs. off-peak electricity price\(^2\): €1.5/kWh

Annual revenue per battery = € 99

Annual cost per battery
- Cost for required space\(^3\): € 45
- Handling/maintenance costs\(^4\): € 26

Annual cost (€ 71/kWh) = € 65

Additional one-off costs per battery
- Battery price
- Logistics costs (e.g., collection)
- Repackaging and testing costs

Additional one-off costs per battery = € 26

Enough alternative options for energy storage

<table>
<thead>
<tr>
<th>Storage Medium</th>
<th>Capacity</th>
<th>Price (\text{Cents/kWh)}\</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water pump power storage</td>
<td>~6.4 GWh</td>
<td>2</td>
</tr>
<tr>
<td>Air pressure power storage</td>
<td>~0.6 GWh</td>
<td>4</td>
</tr>
<tr>
<td>Sulfuric-acid battery storage</td>
<td>N/A</td>
<td>6</td>
</tr>
</tbody>
</table>

\(^1\) Average peak vs. off-peak electricity price: 0.5 kWh
\(^2\) Battery power output: 4.5 kWh, 24 hours of charging storage, 90% power efficiency, 80% round trip efficiency
\(^3\) Battery price: € 260/kWh
\(^4\) Handling/maintenance costs: € 26/kWh

Source: Ricardo, Aachen, Germany

Abb. 8: But: Electricity storage in batteries is currently not economical – Utilities are unlikely to pay for used EV batteries.
Abb. 9: The EV market will develop in three main stages – each of which requires a dedicated business case for its own.

Abb. 10: Consumer focus needs to be shifted towards TCO, rather than initial vehicle price, due to the high battery cost and low residual values.
### Market activation – Price/TCO

#### TCO calculation (15,000km, 36 months)

<table>
<thead>
<tr>
<th></th>
<th>ICE</th>
<th>EV</th>
<th>EV (battery lease)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel</td>
<td>14,000</td>
<td>10,000</td>
<td></td>
</tr>
<tr>
<td>Fixed cost</td>
<td>5,000</td>
<td>5,000</td>
<td>5,000</td>
</tr>
<tr>
<td>SMR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deprec. Vehicle</td>
<td>3,000</td>
<td>2,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Battery depreciation</td>
<td>-20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery lease</td>
<td></td>
<td>500,-</td>
<td>420,-</td>
</tr>
<tr>
<td>Monthly cost [EUR]</td>
<td>3,350,-</td>
<td>5,000,-</td>
<td>4,200,-</td>
</tr>
</tbody>
</table>

1) Diesel compact car
2) EV (battery lease) = battery lease for EUR 110/month
3) Battery EUR 11,000
4) SMR Service, Maintenance & Repair

### Assumptions and Findings
- Vehicle sales price for ICE and EV (without battery) on city car level
- Battery price EUR 500/kWh in 2012
- Depreciation for 3-year period:
  - 50% vehicle depreciation
  - 60% battery depreciation
- Battery leasing fee: EUR 110/month (15,000 km p.a.)

- EV TCO premium of almost 30% compared to ICE
- Significant subsidy required to meet ISO TCO
- But: Early adopters are willing to spend EV-premium price, offering the chance for skimming strategy

### Abb. 11: Higher price/TCO acceptance of early EV adopters offers opportunities during market activation phase

### Even with an aggressive battery margin, the dealer lifetime value of the EV is significantly lower than for an ICE

#### Market activation – Dealer revenue potential

#### Comparison dealer vehicle lifetime value – EV vs. ICE

<table>
<thead>
<tr>
<th></th>
<th>ICE</th>
<th>EV</th>
</tr>
</thead>
<tbody>
<tr>
<td>New vehicle margin</td>
<td>6,000</td>
<td>4,000</td>
</tr>
<tr>
<td>Battery margin</td>
<td>4,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Used vehicle margin</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Parts &amp; service margin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Comments
- Comparison based on average passenger vehicle sales price in Germany
- Even with a aggressive battery margin, the overall EV dealer margin will be significant lower than today
- Only additional revenue source may be the battery
- Lower service and maintenance cost
  ≈ J. € 2,500 over 5 years
- Pushing EV vehicle sales requires additional incentives on dealer level

### Abb. 12: Even with an aggressive battery margin, the dealer lifetime value of the EV is significantly lower than for an ICE
The EV value chain is emerging: new players entering the game with key role of public authorities, but rules of the game not defined yet

### Electric Vehicle Value Chain

<table>
<thead>
<tr>
<th>R&amp;D &amp; Manufacturing</th>
<th>Sales &amp; Marketing</th>
<th>After-sales</th>
<th>Energy Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery</td>
<td>Vehicle</td>
<td>Finance &amp; Insurance</td>
<td>EV maintenance</td>
</tr>
<tr>
<td>Profit potential</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

**Vehicle OEMs**
- Sanyo
- NEC
- BetterFlux

**Battery producers**
- Sanyo
- NEC
- BetterFlux

**Mobility service provider**
- Sanyo
- NEC
- BetterFlux

**Utilities**
- Sanyo
- NEC
- BetterFlux

**Public authorities**
- Sanyo
- NEC
- BetterFlux

*In summary – Attractiveness of EV business depends heavily on speed of market ramp up and incidence of technology breakthrough*

<table>
<thead>
<tr>
<th>Key take aways</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adapt &quot;traditional&quot; model to mobility not ownership</td>
<td>• EV product offering must proactively address customers requirements and fears regarding product feasibility, durability and residual value</td>
</tr>
<tr>
<td>Battery lease models will drive EV acceptance significantly</td>
<td>• Specific sales/lease offers for EVs and batteries will become common for EVs</td>
</tr>
<tr>
<td>Consumer focus needs to be shifted towards TCO</td>
<td>• Especially in the early market phases manufacturers need to bear associated battery risks</td>
</tr>
<tr>
<td>Money trap or cash cow?</td>
<td>• EVs may require a change in the traditional purchase model for vehicles, offering an opportunity for a longer term OEM/customer relationship</td>
</tr>
<tr>
<td></td>
<td>• Higher price acceptance during market activation phase will allow OEM to sell EVs on a cost plus base</td>
</tr>
<tr>
<td></td>
<td>• But: Mid- and long term profitability requires substantial technology breakthrough and fast market ramp up</td>
</tr>
</tbody>
</table>

Abb. 13: The EV value chain is emerging: new players entering the game with key role of public authorities, but rules of the game not defined yet

Abb. 14: In summary – Attractiveness of EV business depends heavily on speed of market ramp up and incidence of technology breakthrough
Abb. 15:  Contact details