Technology pathways and policies for electric mobility in Europe and Asia

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Electric car take-off started slowly ...

- end of 2014: 665,000 passenger EV worldwide
- 0.08% of all passenger cars globally

... but is likely to accelerate quickly:

- Growth of sales very fast
- Large offer of technologically mature EV
- Technological progress reg. batteries cost and density
- Stricter regulations
Policies

Why? Enormous uncertainty stemming from

- **technology** risks: Time to solve battery problems (low energy density, high cost ..)? How fast will competing technologies (fuel-cells, methane) develop? in comparison with battery-electric vehicles? And to what extent do carmakers succeed in improving the efficiency of ICE

- **market** risks: How fast will battery prices go down, how will oil prices develop ..

- **policy** risks: How strictly will governments regulate, will there be a carbon price, will fossil energy be taxed, will there be incentives for EV purchase ...
Policies

Carmakers pursue diversified strategies

Light-vehicle sales by technology type, units m

Source: International Energy Agency

Source: Economist
Key questions

- What are the right policies?
- How are technologies developing (differently) across the globe?
What can policymakers do?

- **Concerted action** to overcome coordination failure
- **R&D** to accelerate technology development
- Encourage city and fleet **trials**
- Subsidies (e.g. EV purchase)
- Public procurement
- **Predictable policy roadmaps related to emission standards**, fuel taxes, subsidies
- Esp. regulatory standards drive technology choice. Example: Admissible fleet emissions in the EU
Policies

Global market shares by powertrain technology

Percent of units produced

BELOW 10

BELOW 100

ICE (optimized)

BEV

FCEV

HEV

REEV

2010 15 20 25 30 35 40 45 2050

Sequencing:

- Decarbonise electricity generation first
- Electrify end-uses (cars) later when energy mix is „clean“

If not, total emissions (well-to-wheel) may actually increase!
**“Well-to-wheel” CO₂ emissions (g/km) of ICE and electric vehicles assuming different energy mixes**

<table>
<thead>
<tr>
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<th>Total well-to-wheel</th>
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<tbody>
<tr>
<td>Conventional ICE car</td>
<td>145-215</td>
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<tr>
<td>EV EU-27 mix 2010 (27% nuclear, 20% renewable, 53% fossil)</td>
<td>85-105</td>
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<tr>
<td>EV French mix (75% nuclear, 20% renewable, 5% fossil)</td>
<td>20-25</td>
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<tr>
<td>EV 100% renewable (50% photovoltaic, 50% wind)</td>
<td>8</td>
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Source: ERTRAC (2010).
Technologies tend to evolve gradually along certain pathways that reflect specific country conditions / policies.

... especially when markets are not yet mature and deployment depends on (national) politics and incentives.

We compared France and Germany, China and India.
Different initial conditions:

- Expanding home markets in China and India, contraction in Europe
- Sophisticated consumers mainly in Europe, emerging consuming middle classes in China India, demand simpler goods but economies of scale
- More established innovation systems & more related variety in Europe
- Strategies for technology adoption differ. In emerging Asia huge role for FDI, M&A, return migration, tapping into OECD-IS
- Financial power in China > India, and Germany > France
- Concepts of Industrial and Innovation Policy more state-led in China and France than Germany and India ...
- Lower labour costs in Asia
- Energy security valued higher in Asia than carbon emissions ...
Electric mobility France

Specific conditions relevant to EV technology development

- French carmakers with competitive edge in *small functional* cars
- Dependence on Southern European market => crisis
- Cheap nuclear energy makes pure BEV attractive
- Innovation leader in certain diesel technologies
- Long tradition of (military-led) battery technology
- Tradition of state-led industrial policy favours strong incentives for electric mobility: purchase subsidy, public procurement, charging infrastructure
Electric mobility France

Emerging technological specialisation

- Early mover in BEV
- Focus on small, affordable cars
- Diesel hybrid technology as an area of specialisation
- Specific national battery technology developments
Electric mobility Germany

Specific conditions relevant to EV technology development

- Strong car industry specialised in luxury cars. High emissions, lobbying against EU regulations. Germans pay twice as much for new cars as French
- Strong export orientation
- Customers value hi-tech
- New generation open to new mobility concepts
- Strong automotive innovation system
- Energiewende: Electric mobility clearly linked to renewables
- Battery research abandoned in the 1970s
- Industrial policy focused on R&D, innovation clusters, city trials
Electric mobility Germany

Emerging technological specialisation

- hi-tech / high cost solutions, friction-free combination of electric + combustion engine, break energy recuperation, high demands on power electronics.
- Battery Management Systems a brand-differentiating factor => no battery swapping
- Fancy e-cars for high-end techno-friendly consumers. First hybrids Porsche Panamera, Mercedes S class …
- Late market entry, but via modular production concepts rapid catching up => economies of scale with many drive technologies
- Smart grid solutions to cope with renewables ??
- Young urban consumers => new mobility concepts ??
Electric mobility China

Specific conditions relevant to EV technology development

- Huge market growth with first-time consumers in low-end market
- Own innovation capabilities still incipient
- Massive subsidies for new drive technologies
- Main reasons: leapfrogging und urban pollution control: EV “allowed” to drive on fossil fuel energy mix
- Segmented market: SOE, Chinese private, Joint Ventures
- Massive pressure on international investors to share technologies
- Regulation discouraging “frugal” innovations
Electric mobility China

Emerging technological specialisation

- Huge market for two- & three-wheelers with lead acid batteries
- Regional development of low speed, low-voltage, low-range vehicles
- Range-extended EV with simple additional motorbike engine
- Strong in public fleets, buses
- Battery-swapping tested
- Remote battery monitoring systems to substitute for absence of integrated BMS
- EV built on ICE-car platforms
- Strong market position in battery cell manufacturing … leading to wider competitive edge in batteries?
In sum:

- Lot of variation in policy and technology development

Why is this important?

- More experimentation
- More adaptation to local requirements
- More country ownership if there is national technology development and new competitive advantages
Thank you for your attention!