Transition to E-mobility as a system

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System Transition

- 24% of GHG emissions from transport.
- Mobility (transportation) is identified as key field for sustainability transition to limit climate change and resource depletion.
- Transition to a new system of mobility is thus necessary.
- Currently, e-mobility is suggested as one of the key solutions or systems to which transition should be made.
Transition to e-mobility system

- Can the changes be governed? Who are the powerful actors? Who are the winners and losers?
- Realistically: will transition to e-mobility help decarbonize our high-carbon lifestyles?
- Where will it work better and for whom?
- We will have a look at four diverse contexts and travel around the world to grasp the complexity of mobility transitions.
E-Mobility as a system

- **System elements**
- Manufactured object and accompanying industries. (car industry - key stakeholder)
- Item of consumption and use
- Interconnected systems: planning, energy provision, traffic, service
- Culture of e-mobility (digital, gadgetism, data)
- Resource-use
1. EVs- 1% of global annual vehicle sales (McKinsey, 2016), 0.2% on the roads (3mln.)
2. By 2035 - 20% (35% in Europe)
3. Car-sharing schemes are increasingly using EVs.
4. Good news for automotive industry: 30% of car-buyers will consider buying an EV.
5. Battery prices are falling
Three surprising resource implications

1. Demand for natural gas will rise to produce more electricity.
2. Land squeeze to install supporting infrastructure (charging points).
3. Ores and metals
Raw Material Demand

1. Cobalt market will have the highest fragility. 55% of all global Co goes to the cause.
2. Flake graphite prices will rise, most mining in China is environmentally unsustaintable.
3. Extraction of Lithium requires water in dry lands, exposure to Li: health hazards.
4. Implications: more mining, not necessarily sustainable environmentally and socially
• Different Cathode Types. Not just Lithium. Li-ion power battery cathode powder LiNiCoAlO2.
• Tesla battery uses 7,000 cells for its half a tone pack, amount of Li used for 10,000 cell phones
• Supply chain is highly spread out: Lithium Brine comes from Chile or Argentina, graphite from China, Cobalt from DPR Congo.
• Domestic Supply Chain is not feasible (no Co, no graphite).
• Conflict mineral - Co (mining controlled by militias)
The Case for E-mobility transition - China
China as the case of global significance

1. Unprecedented government support
2. EV car-sharing (Didi Platform for 12 manufacturers)
3. High rate of LSEV (low speed electric vehicles), affordable for the mass consumer
4. E-mobility and shared mobility hype
5. Leading in Cell production and R&D funding
6. Leading in urban electrification of bus and taxi fleet (Shenzhen), 200mln. E-bikes.
Cell manufacturing

Projected global market share, 2019

- **Panasonic** (SANYO): 29%
- **LG Chem**: 21%
- **BYD**: 9%
- **CATL**: 9%
- **Samsung**: 6%
- **LISHEN**: 6%
- **China Wantong**: 5%

### Domestic cell production, 2015-2019 [MWh]

- **China**: 67,800 MWh
- **Japan**: 49,843 MWh
- **South Korea**: 28,184 MWh
- **US**: 23,362 MWh
- **Germany**: 230 MWh
- **France**: 0 MWh
- **Italy**: 0 MWh

1) 2019 market value in USD calculated as follows: 210 USD/kWh for PHEVs and 150 USD/kWh for BEVs; shift from single to dual sourcing strategies expected in mid-term
2) Including Primearth’s market share
3) Including AESC market share

Source: fka; Roland Berger
R&D funding

State R&D funding for e-mobility

<table>
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<tr>
<th>Country</th>
<th>[EUR m]</th>
<th>[% of GDP]</th>
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<tr>
<td>Japan</td>
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</tbody>
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1) Subsidies expressed as a share of current GDP (2014)

Source: fka; Roland Berger
Electric two-wheeler

- The e-mobility winner in China: industries, livelihoods, urban growth, commuting, youth mobility, trade.
- Fast speed of urbanization and urban sprawl - demand for affordable and individualized mobility
- Growth of e-commerce and demand for cargo-mobility (3.6mln. packages per day in SZ)
- E-bike sales to increase in the rest of the world and to slow down in China.
- Production of e-bikes in China with different Li-Ion batteries is increasing, Lead-Acid are on decline.
E-bikes and e-scooters

Annual E-Bike Sales, China and the Rest of the World: 2016-2025

(Source: Navigant Research)
E-buses

1. 385,000 e-buses globally (99% in China)
2. Shenzhen - 100% e-bus fleet (16,359)
3. Reducing global diesel fuel demand by several hundred thousand barrels a year (500 bbl a day)
4. China is leading, main exporter to California and London.
5. The entire bus fleet in London will reduce U.K. diesel consumption by about 0.7% (BNEF, 2017)
Futures

• Increase in air traffic -> decarbonizing air traffic - (biofuels, less trips)
• E-waste generated by e-mobility, no facilities
• ”Clean” economies (Norway, Switzerland and Iceland) biggest global producers of e-waste (28 kg. per capita, 2014).
• Different resources depletion, public space.
System transitions on social-level

• Not only *technical* transitions - instead social practices change. It is easy to limit individual car-use, but even easier with “livability” urban planning
• Individual and household practices need to change. Easy to not waste food, which is transported from SA or Ecuador.
• Stop demonizing ICE cars and idealizing EVs - the key problem is the scale, resource and land use, as well as individual practices. Sharing public goods.
• Efforts to decarbonize individual lifestyles and household waste generation.
• Educational campaigns at school (environment and health)
• Transitions on institutional, technological level