Transition to E-mobility as a system

Dennis Zuev
Hochschule fur Wirtschaft und Umwelt, Geislingen

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.


ARCTIC OCEAN
Greenland
Svalbard (Nor.)
ARCTIC OCEAN
United States
Canada
Iceland
Norway
Sweden
Finland
Russia
United Kingdom
Ireland
Den.
Neth.
Estonia
Latvia
Belarus
Ger.
Pol.
Ukraine
France
Kazakhstan
Mongolia
Rom.
Georgia
Bulgaria
Italy
Spain
Portugal
Greece
Turkey
Azer.
Uzb.
Turkm.
Kyrgyz
Tajikist
China
Japan
S. Korea
United States
ATLANTIC
OCEAN
Morocco
Tunisia
Lebanon
Syria
Iraq
Iran
Afg.
Israel
Jordan
Kuwait
Pakistan
Bhutan
Mexico
Western Sahara
Algeria
Libya
Egypt
Saudi Arabia
U.A.E.
Oman
India
Laos
Taiwan
PACIFIC
PACIFIC
Guatemala
Honduras
Nicaragua
Costa Rica
Panama
Mali
Niger
Chad
Eritrea
Sudan
Yemen
Djibouti
Bangl.
Burma
Thailand
Vietnam
Cambodia
Philippines
OCEAN
Senegal
Guinea
Sierra Leone
Cote d' Ivoire
Ghana
Togo
Nigeria
Cam.
C.A.R.
South Sudan
Ethiopia
Somalia
Sri Lanka
Malaysia
Ven.
Guyana
French Guiana
Suriname
Colombia
Ecuador
OCEAN
Gabon
Rep. of the Congo
Dem. Rep. of Congo
Uganda
Kenya
Tanzania
INDIAN
Indonesia
Papua New Guinea
Solomon Islands
Peru
Brazil
Angola
Zambia
Malawi
Madagascar
OCEAN
Bolivia
Namibia
Zimbabwe
Botswana
Mozambique
Fiji
Paraguay
ATLANTIC
Australia
New Caledonia
Chile
eSwatini
Lesotho
Argentina
Uruguay
OCEAN
South Africa
New Zealand
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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

EVs - On Positive Side

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

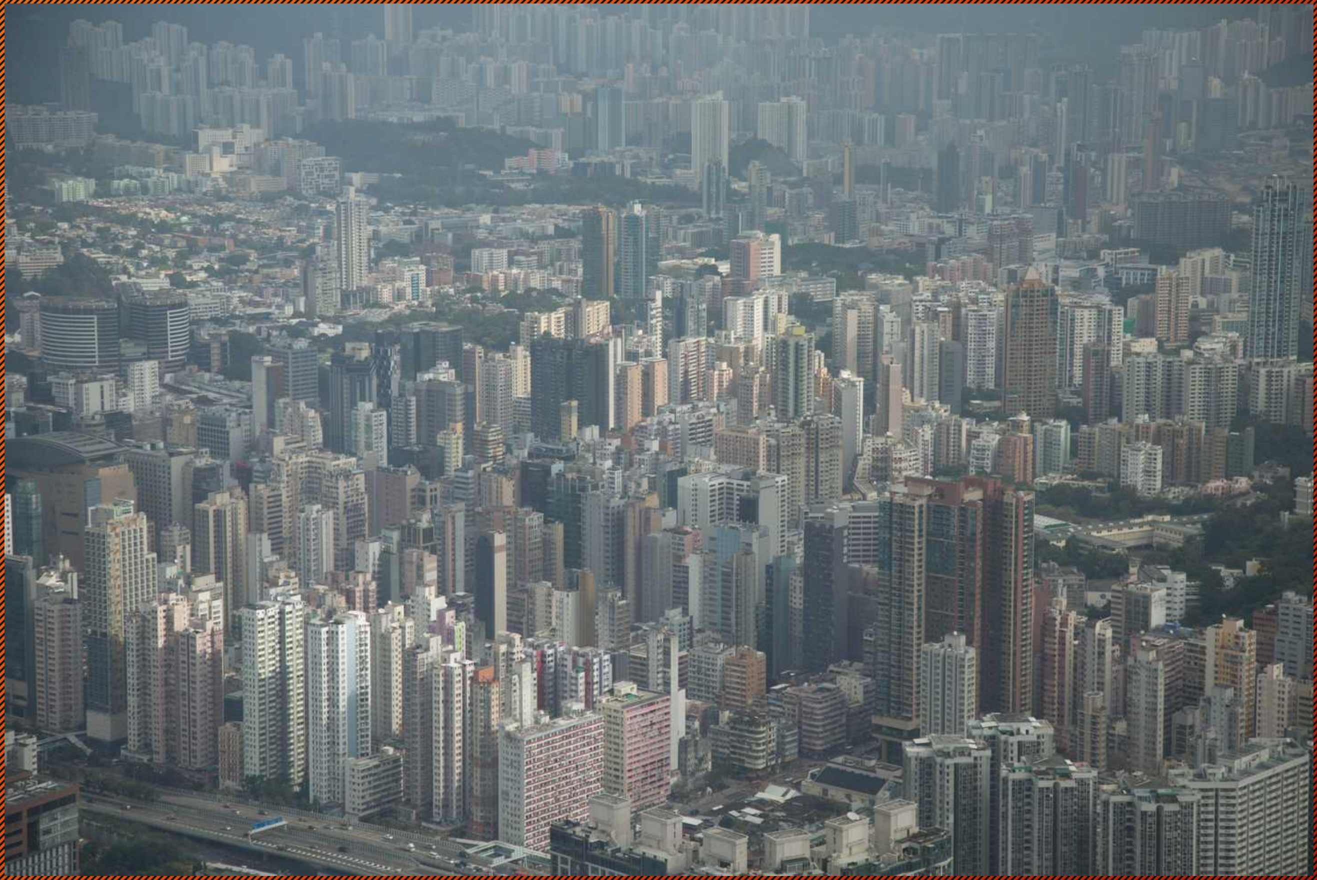
Raw Material Demand

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 unsastainable.
3. Extraction of Lithium requires water in dry lands, exposure to Li: health hazards.
4. Implications: more mining, not necessarily sustainable environmentally and socially

Tesla Battery

- 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)

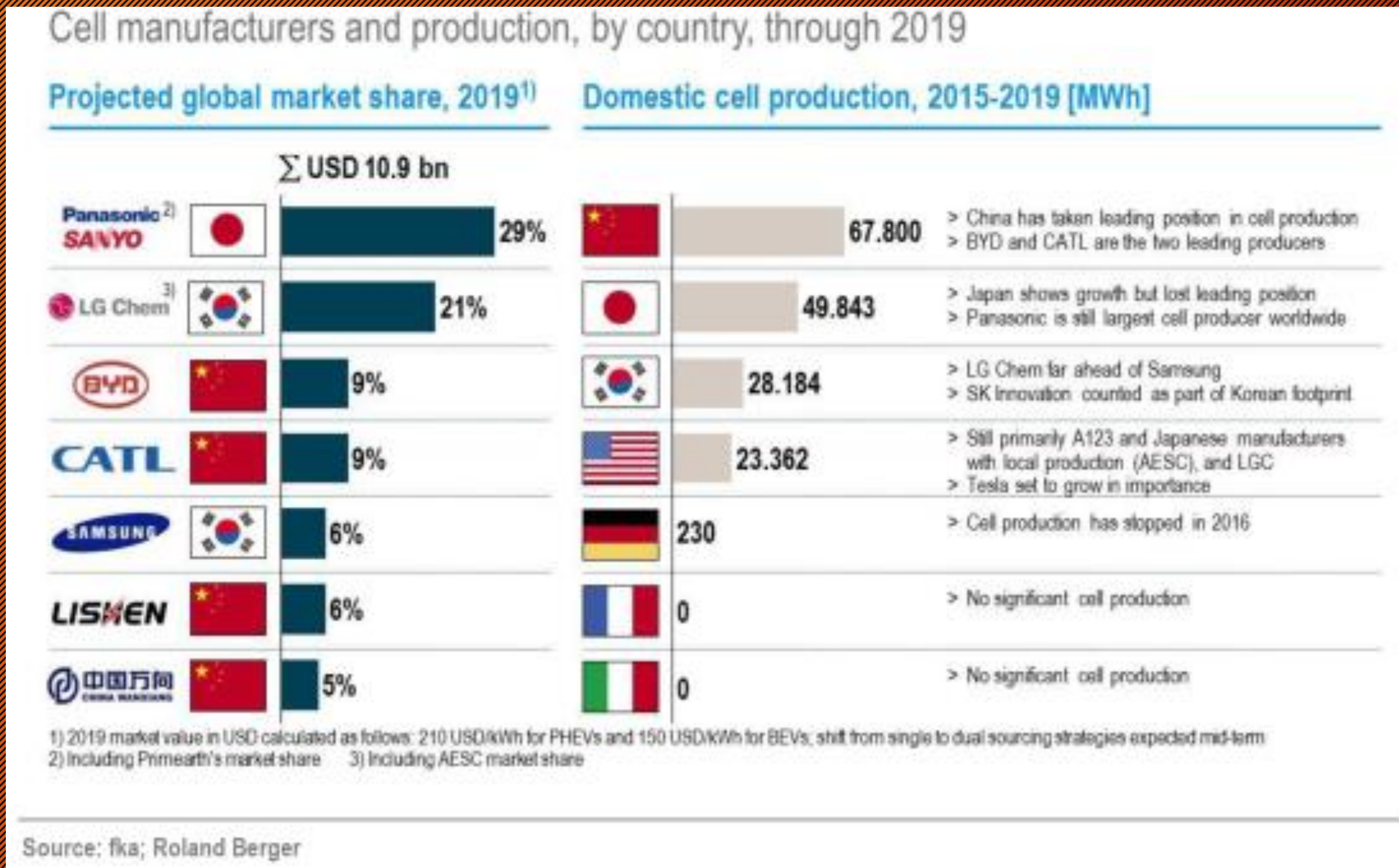
The Case for E-mobility transition - China



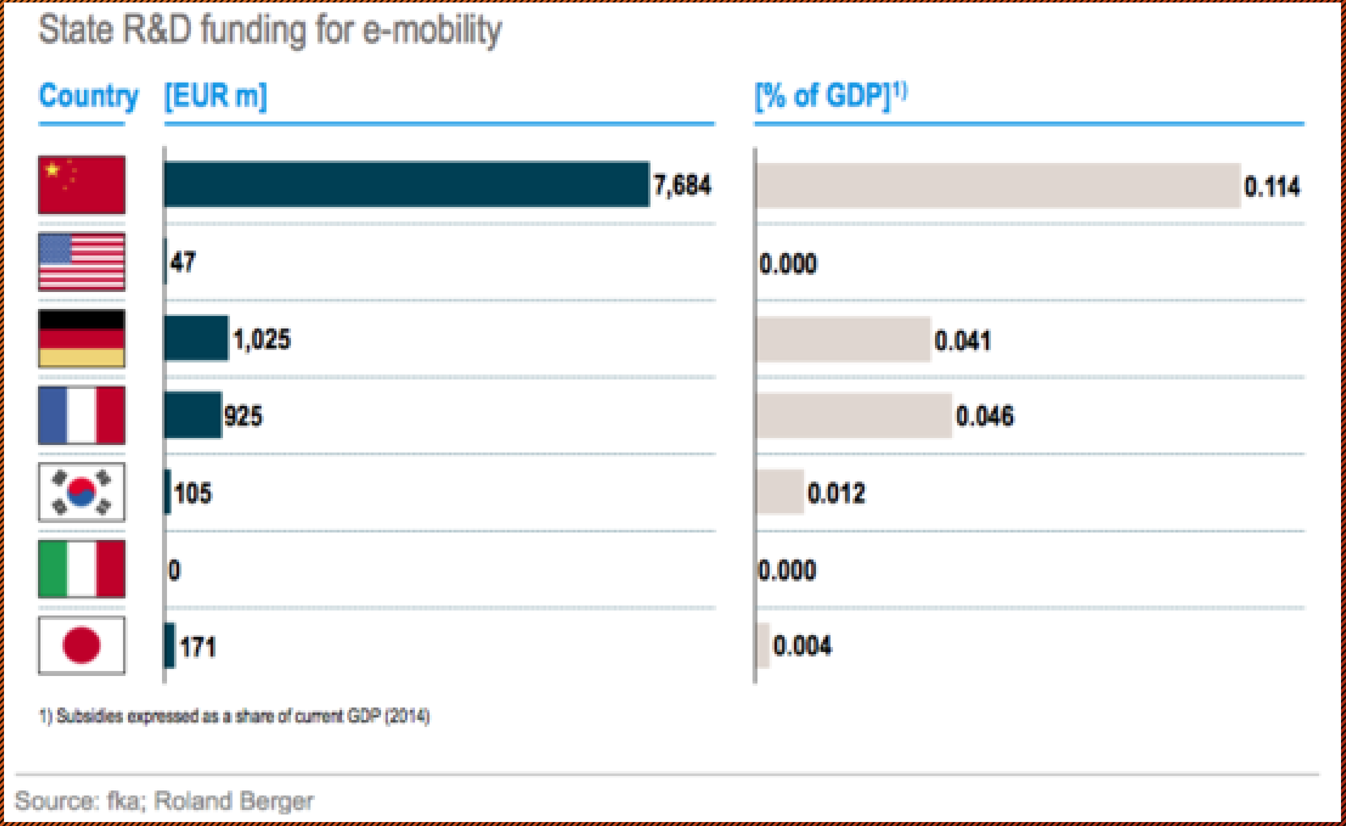
China as the case of global significance

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



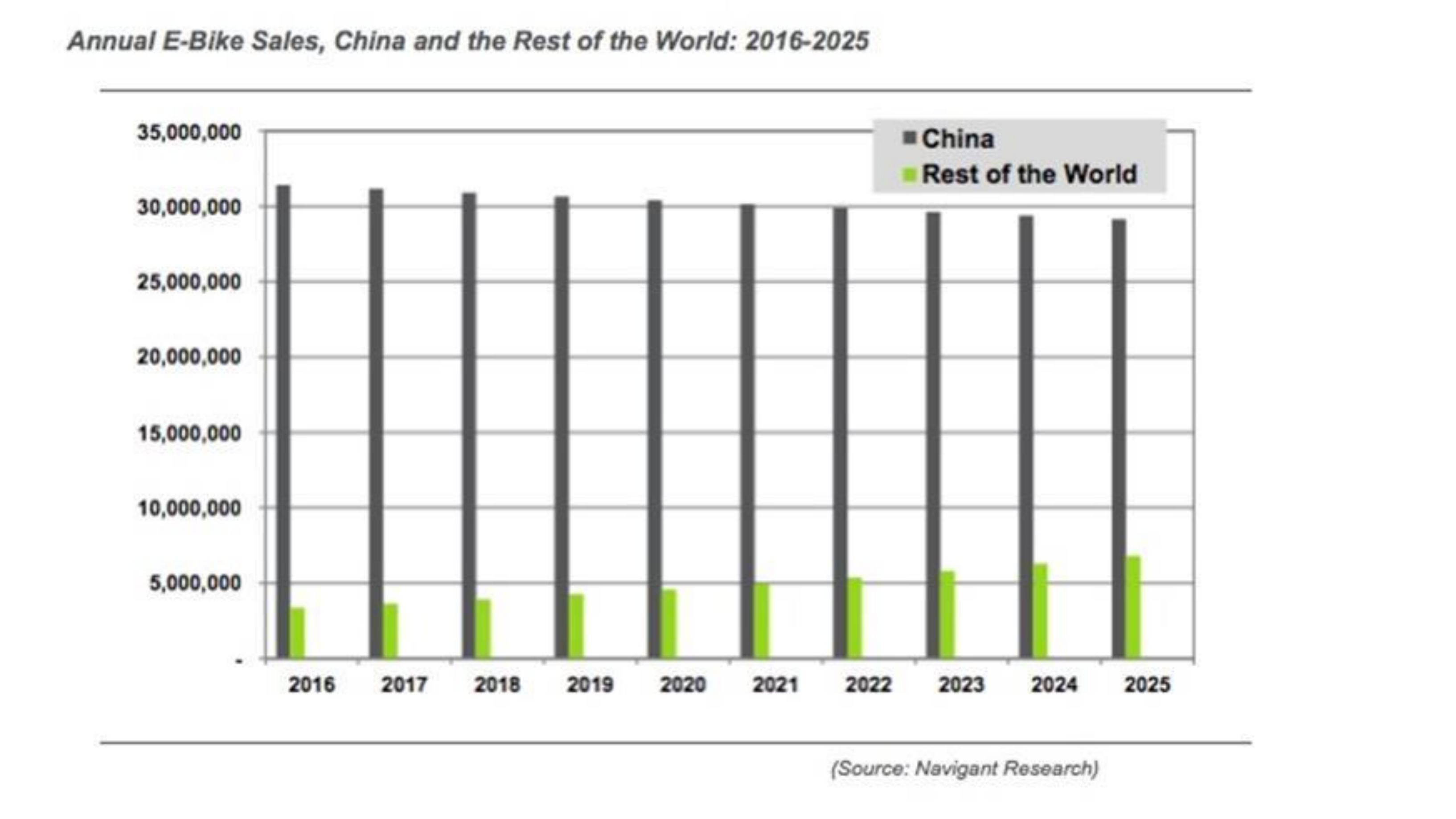
R&D funding


State R&D funding for e-mobility
Country
[EUR m]
[% of GDP][1)]
7,684
0.114
47
0.000
1,025
0.041
925
0.046
105
0.012
0
0.000
171
0.004
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



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