The global lithium-ion battery race and Europe's role in it

Presentation at ITIF, Washington DC, 7 Nov 2018

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Agenda

- **Why is it a race to lithium-ion?**
- What is Europe's position in this race?

Why lithium-ion (as opposed to other storage techs)?

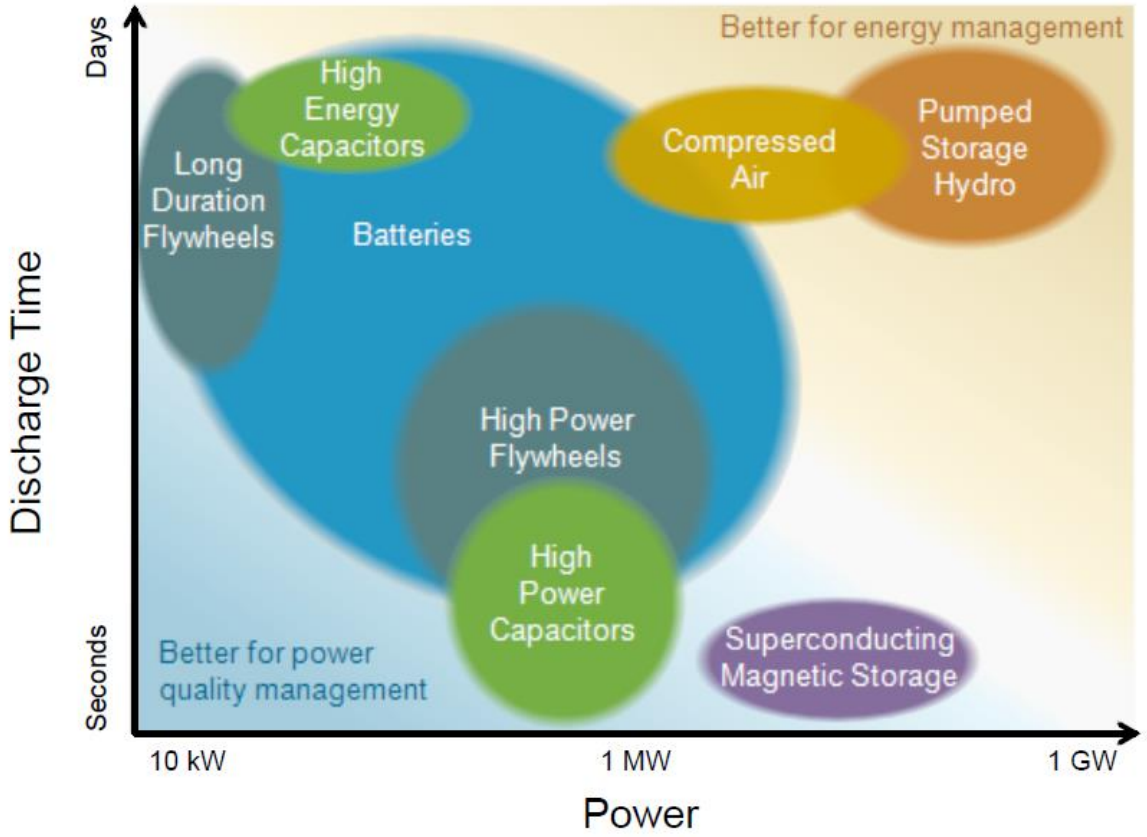
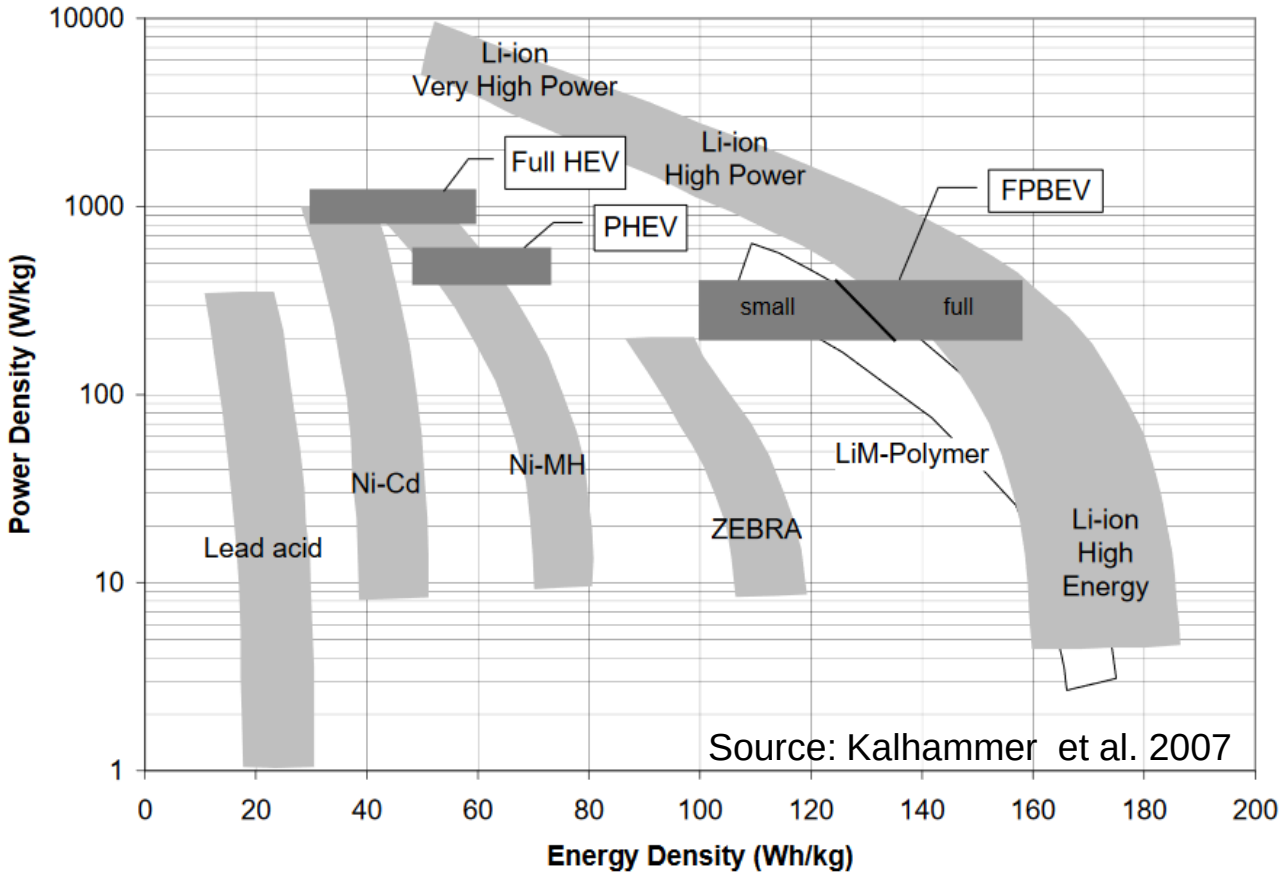


Figure from U.S. Energy Information Administration, based on Energy Storage Association, Dec 14 2011



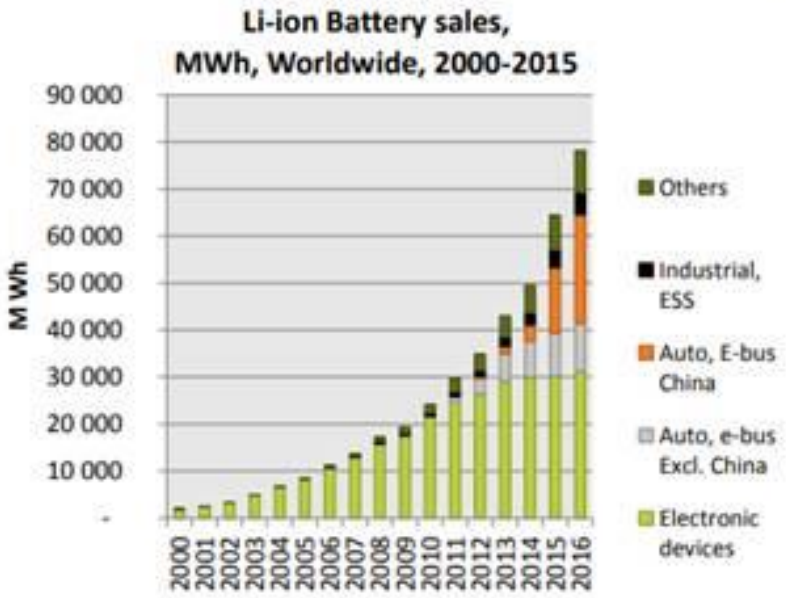
+ high round-trip efficiency
+ low-temperature
+ relatively safe

+ government support (US, Japan, Korea, China)

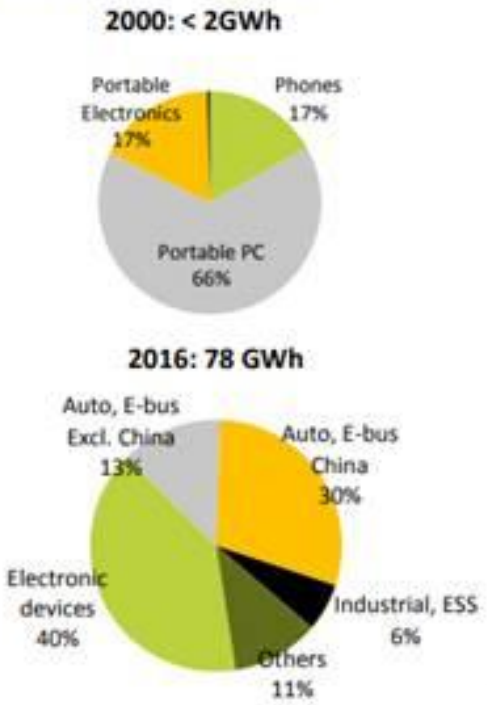
Historic demand for and innovation in lithium-ion batteries

+78 000 MWh - 20 600 M$ (1)
5 675 M small cells

CAGR 2006/2016
+22 % per year in Volume



(1) Cell level
Others: medical devices, power tools, gardening tools, e-bikes...
Source: AVICENNE Energy 2016



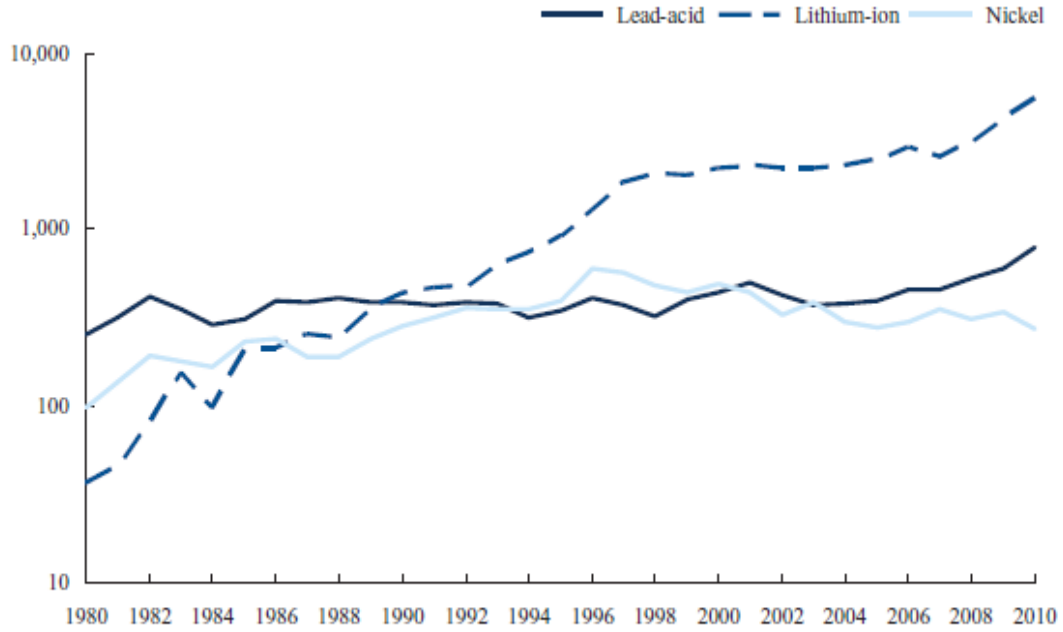
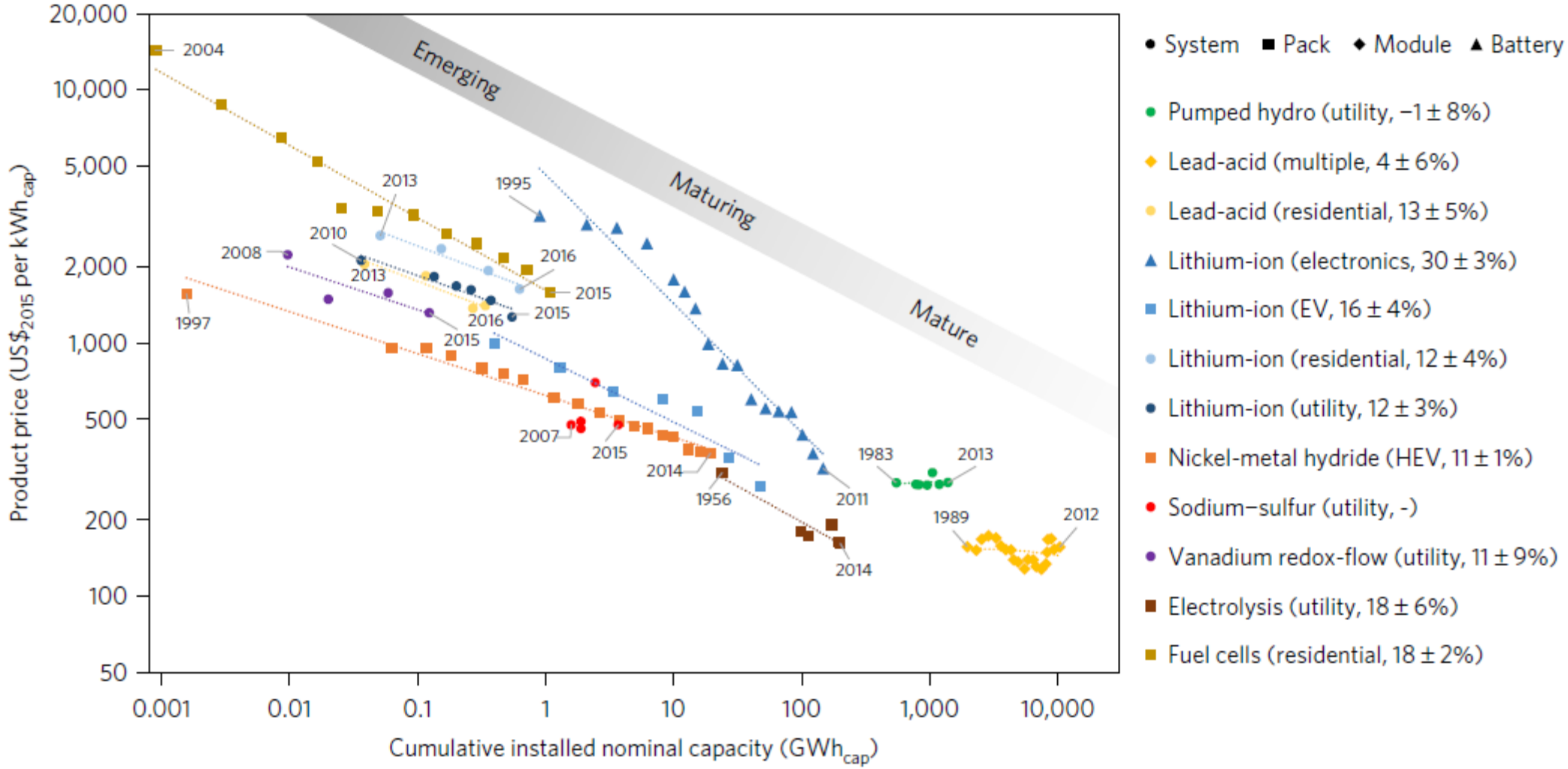


Fig. 2. Development of new patents per year and battery technology (#).

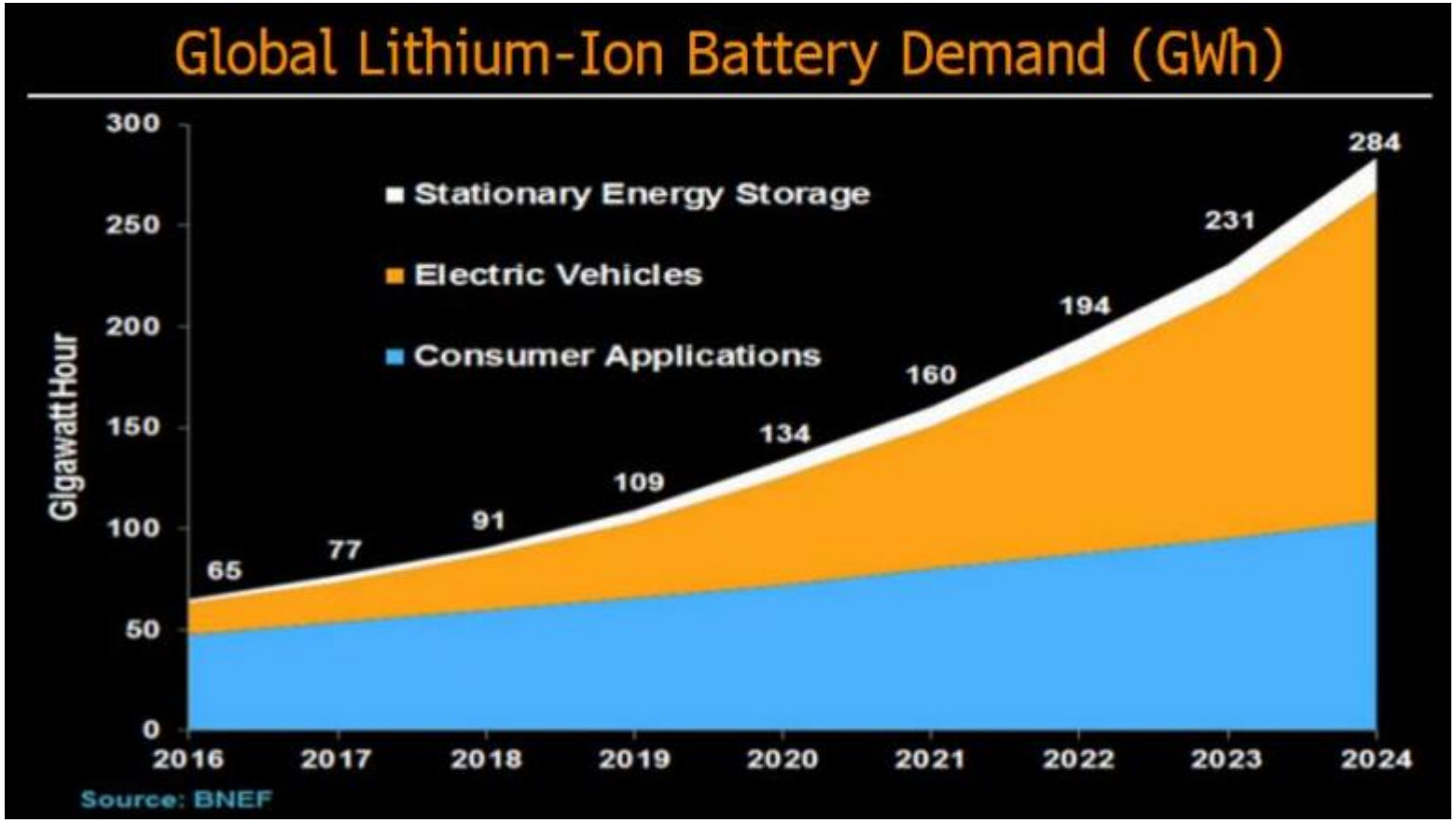
Source: Battke, Schmidt, Stollenwerk, Hoffmann. *Research Policy* (2016)
http://dx.doi.org/10.1016/j.respol.2015.06.014

Lithium-ion batteries have experienced massive cost reductions and will see more in the future

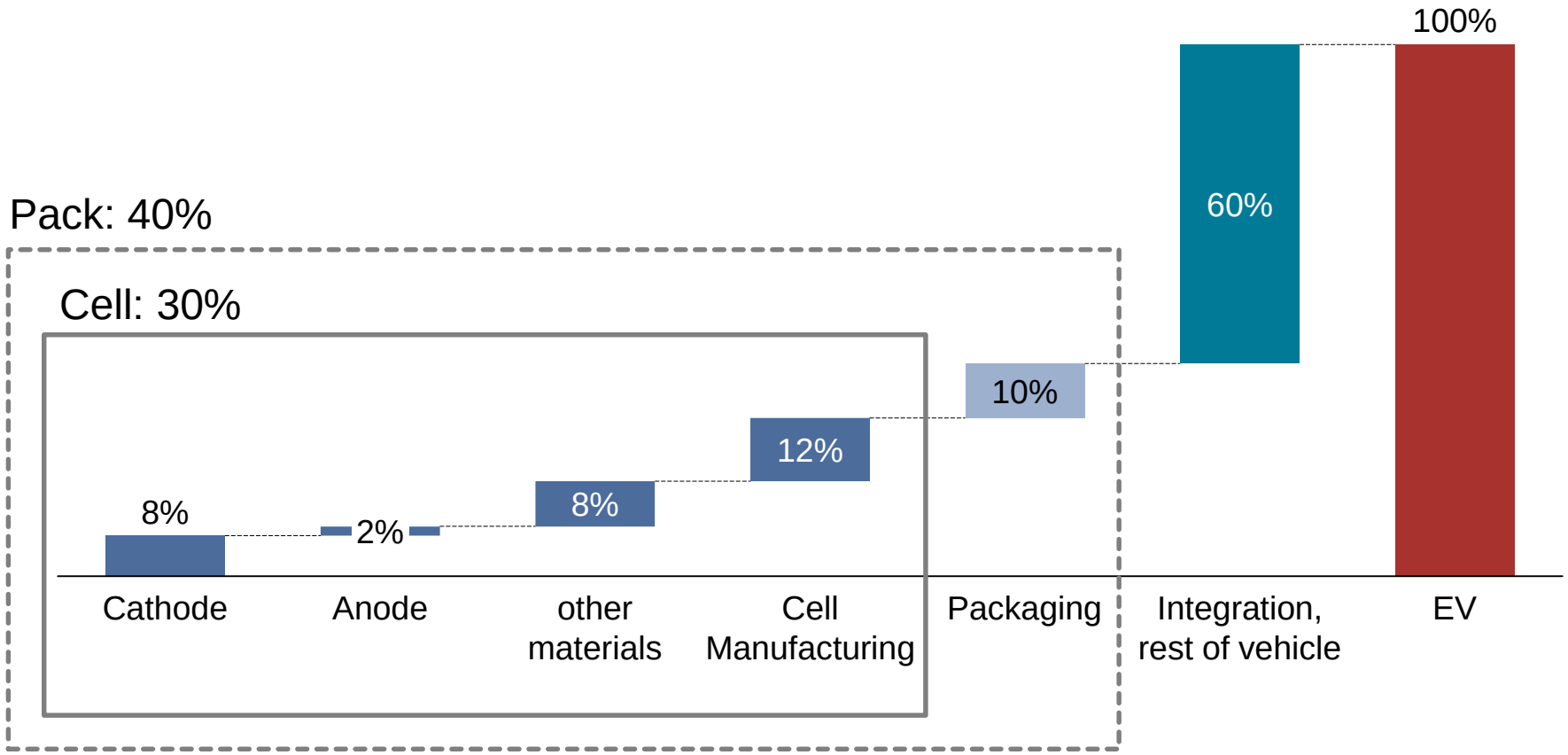


Source: O. Schmidt et al. (2017), Nature Energy http://dx.doi.org/10.1038/nenergy.2017.110

Future demand for Lithium-ion batteries will come from three main markets



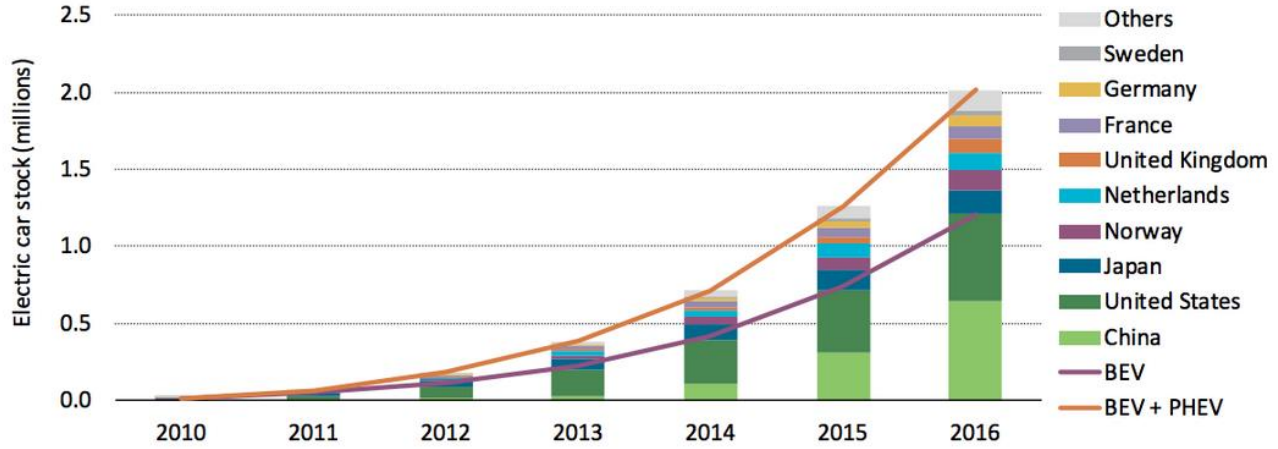
Rough cost composition of an EV and its battery pack (as of 2017)



Source: EPG/ETH Zurich, based on 2017 market numbers

The market for BEVs (past and outlook)

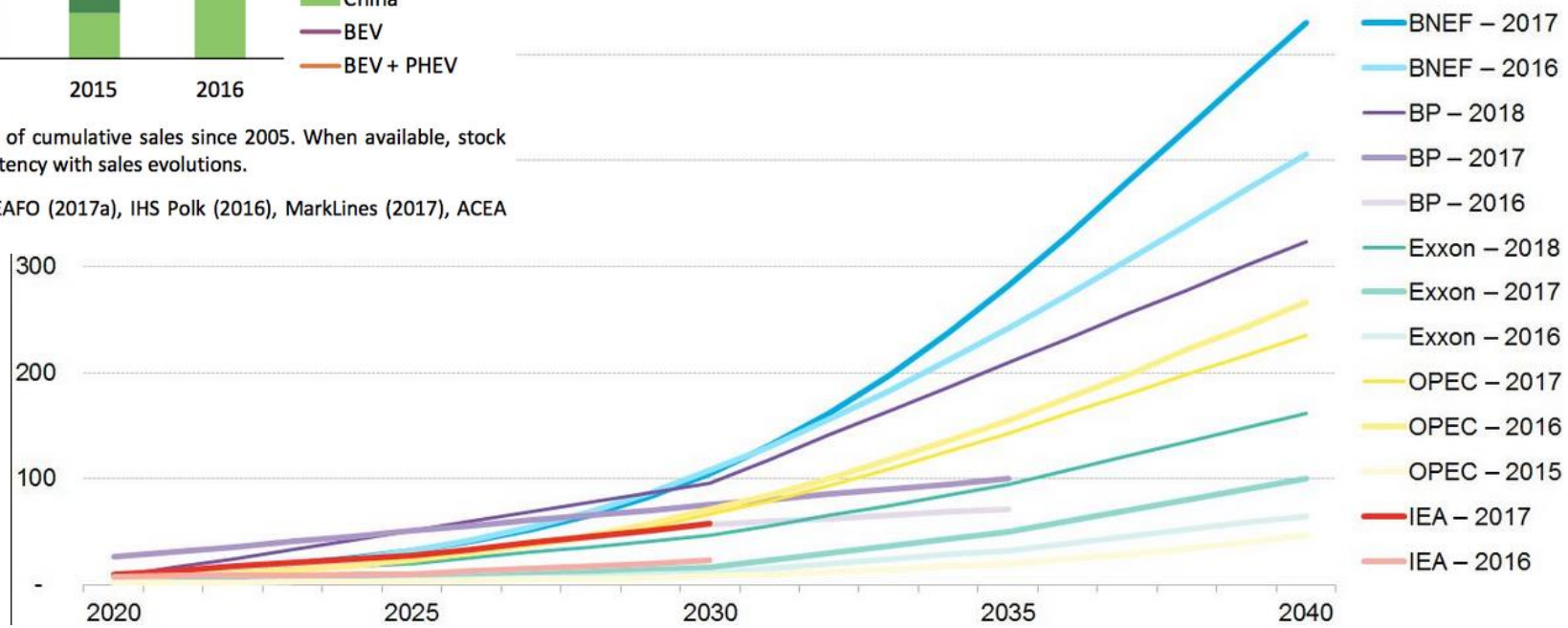
Figure 1 • Evolution of the global electric car stock, 2010-16



Notes: The electric car stock shown here is primarily estimated on the basis of cumulative sales since 2005. When available, stock numbers from official national statistics have been used, provided good consistency with sales evolutions.

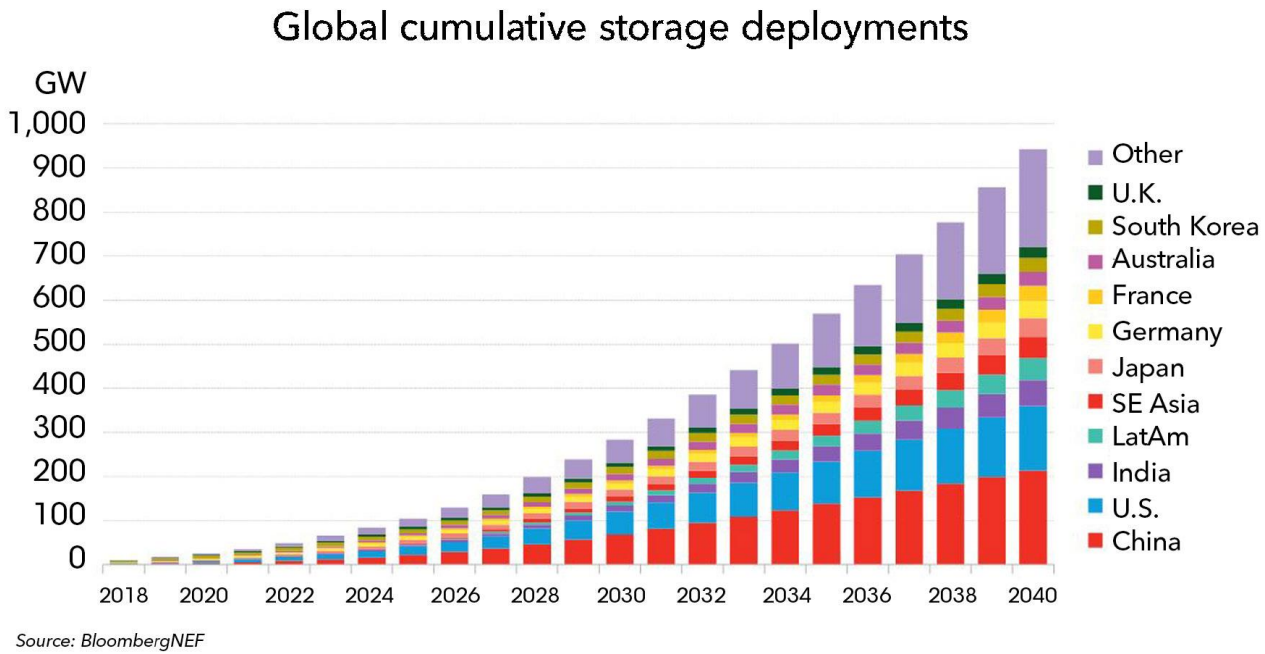
Sources: IEA analysis based on EVI country submissions, complemented by EAFO (2017a), IHS Polk (2016), MarkLines (2017), ACEA (2017a, 2017b) and EEA (2017).

Electric vehicle sales (millions)



Source: BNEF

Also stationary storage market is expected to grow massively, where it can create value in many applications

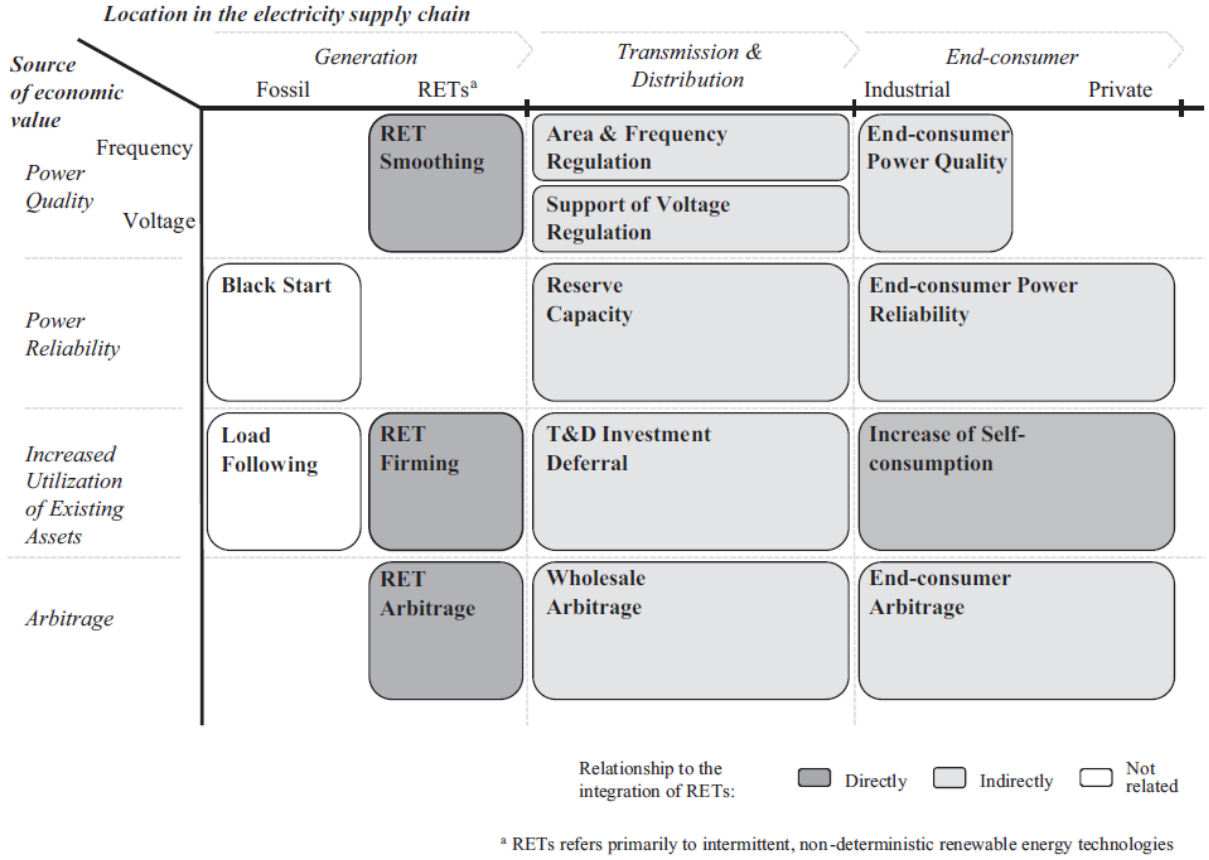


Source: BloombergNEF

BNEF: stationary storage (without PHS) is a USD 1.2 trillion market till 2040

Source: BNEF 2018, https://about.bnef.com/blog/energy-storage-1-2-trillion-investment-opportunit§y-2040/?sf94588529=1

Stationary storage applications along electricity supply chain and by type of value creation



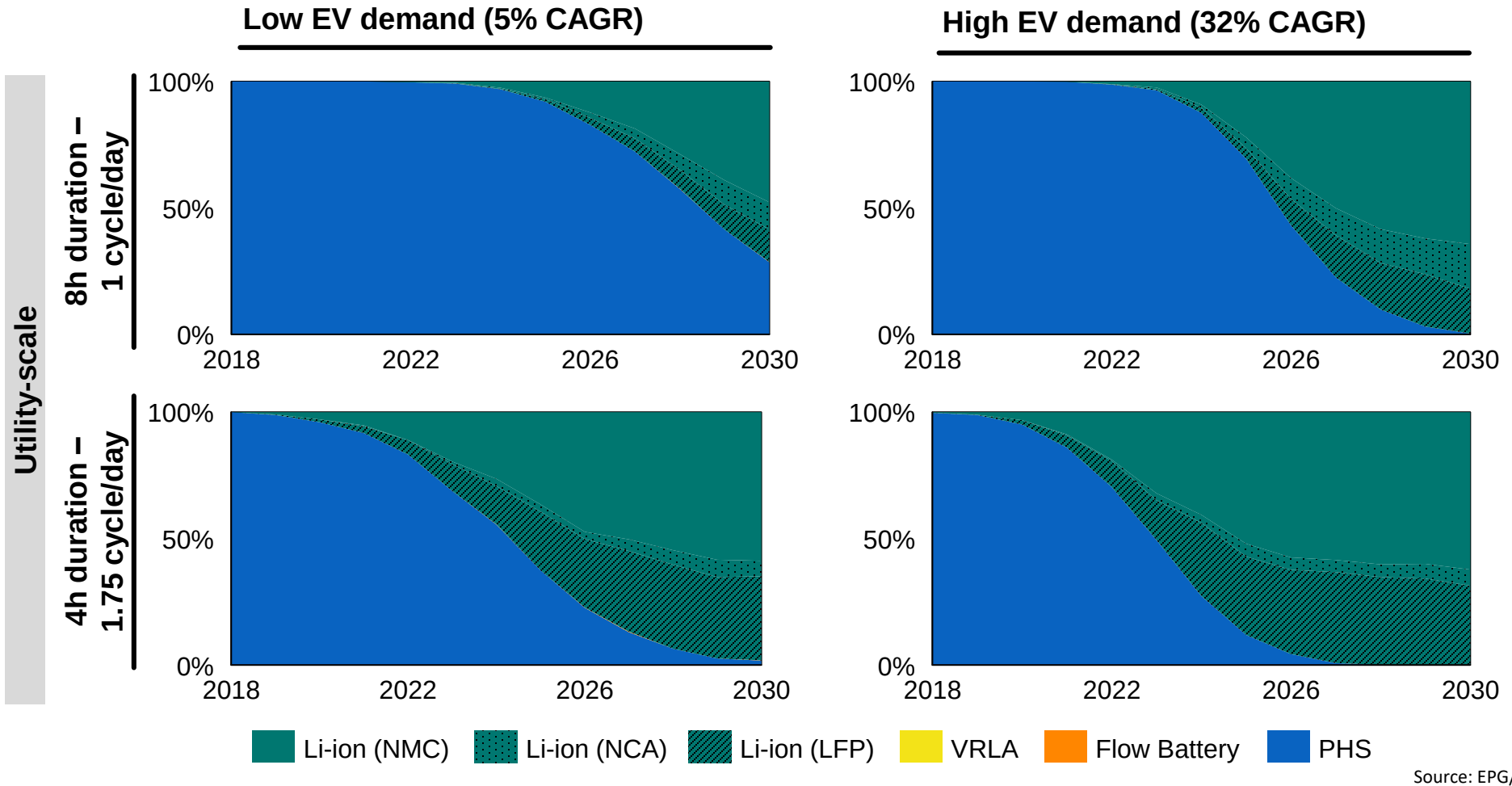
Source: Battke & Schmidt, Applied Energy (2015)
http://dx.doi.org/10.1016/j.apenergy.2015.06.010

Lithium-ion batteries “eat into” stationary storage market

Technology market shares

Preliminary results – do not cite or distribute

[Newly-built electricity storage projects]



Source: EPG/ETH Zurich

Agenda

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- **What is Europe's position in this race?**

POLICY FORUM

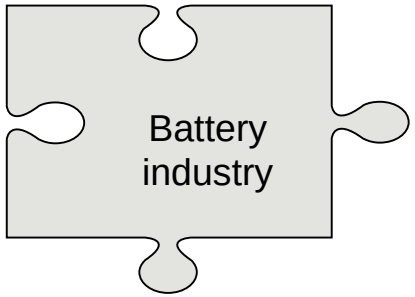
INDUSTRIAL POLICY

A "technology-smart" battery policy strategy for Europe

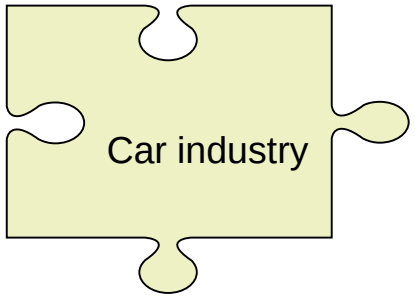
Batteries' inherent characteristics should inform policies

By **Martin Beuse[1], Tobias S. Schmidt[1], Vanessa Wood[2]**

Europe's current position: pieces of the puzzle do not (yet) match



- Market share in cell manufacturing <1% (mostly very small cells)
- Rel. strong upstream activity (material, manuf. equipment); several packaging plants; quite successful storage integrators (stationary)
- Plans for "Gigafactories" in DE (CATL, Tesla/Panasonic), PL (LG Chem), HU (SK Innovation, Samsung); and more announcements (Northvolt)



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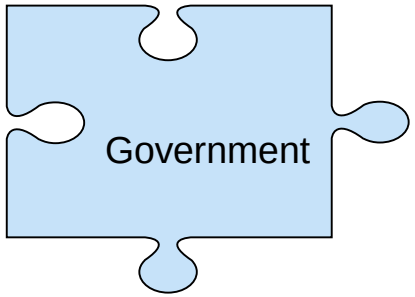

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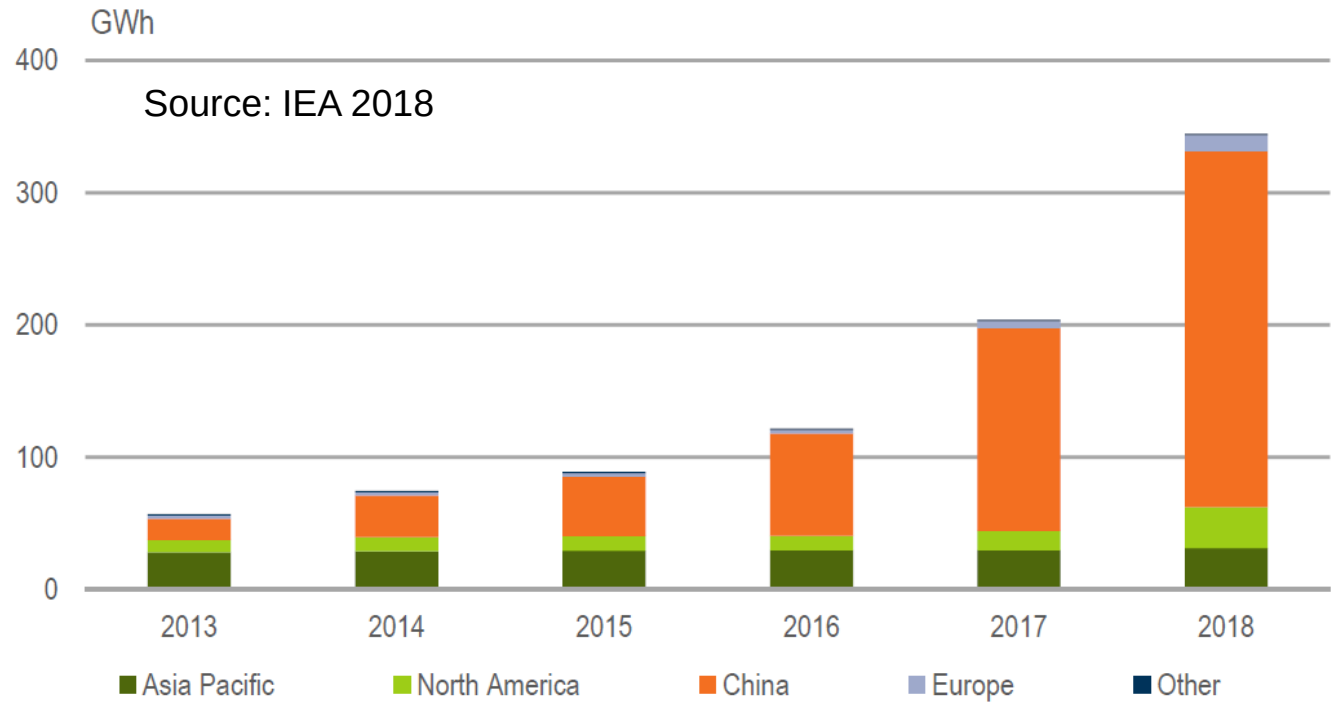


=> thus far attempts have failed (renaL) or are faring, buy-in from car industry only picking up now (it seems)

Source: Beuse, Schmidt, Wood, *Science* (2018)

Three questions need to be asked (and answered)

1) Is a battery cell a commodity-like component, to simply source on the market?

Our opinion:

- Core component (strong influence on vehicle design)
- Strategic component (better cell makes a better EV)
- Complex component, requiring tacit knowledge to design
- Market power might not be as clear as with other car component suppliers

2) Is it possible to leapfrog?

Our opinion:

- Hard if not impossible, as next generation requires a lot of tacit knowledge in design and production
- Gaining tacit knowledge requires experience with design, production and use of the technology
- Complex industry value chains involved, with strong need for interaction

3) How to catch up?

Our opinion:

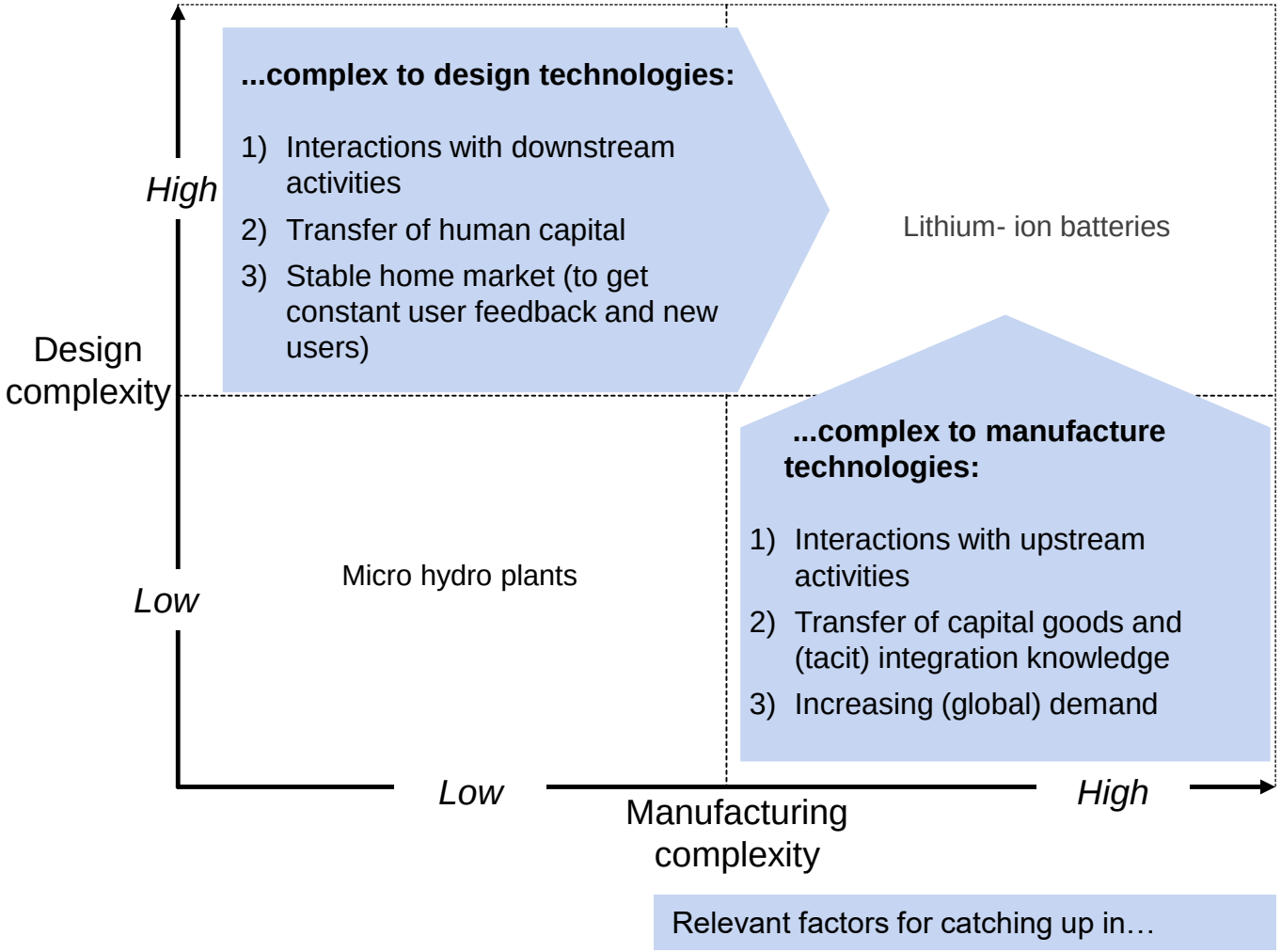
- Generally it is possible to catch up (see Korea/China from Japan)
- Waiting only widens gap
- Airbus is not a good role model
- We recommend a “technology-smart” policy

Source: Beuse, Schmidt, Wood, *Science* (2018)

Our research aims to understand technology differences. Policy should be "technology-smart" in order to be cost effective

What are elements of a "technology-smart" catching up strategy?

1. Make production in Europe and partnerships with European firms attractive
2. Create a large and predictable home market (EV targets; more stringent caps of fleet emission standards)
3. Only if enough learning and catching-up has taken place, create incentive for a "European cell"



Sources: Beuse, Schmidt, Wood, *Science* (2018); Schmidt & Huenteler, Global Env. Change (2016); Malhotra, Schmidt, Huenteler; AAAS conference (2017)

Thanks for your attention!

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