McKinsey & Company

China's EV strategy – regulations and control over the battery value chain

WORLD MATERIALS FORUM

World Materials Forum | Nancy, 13. June 2019

Key facts for the battery materials

Cobalt

~140kt	Demand in 2017
~10% p.a.	Demand growth 2010-2017
~70%	Mine supply from DRC (Glencore, Gecamines, Chinese producers)
~65%	Share of China in refined Co production
~30%	Share of Co for Li-ion batteries in total Co demand

Nickel

2.2mt	Primary Nickel demand in 2017
~4%	Demand growth 2010-2017
~55%	Share of class 1 Ni in total Ni mine supply in 2017
~35%	Share of top 5 Ni-mining companies
<5%	Share of Ni for Li-ion batteries in total Ni demand

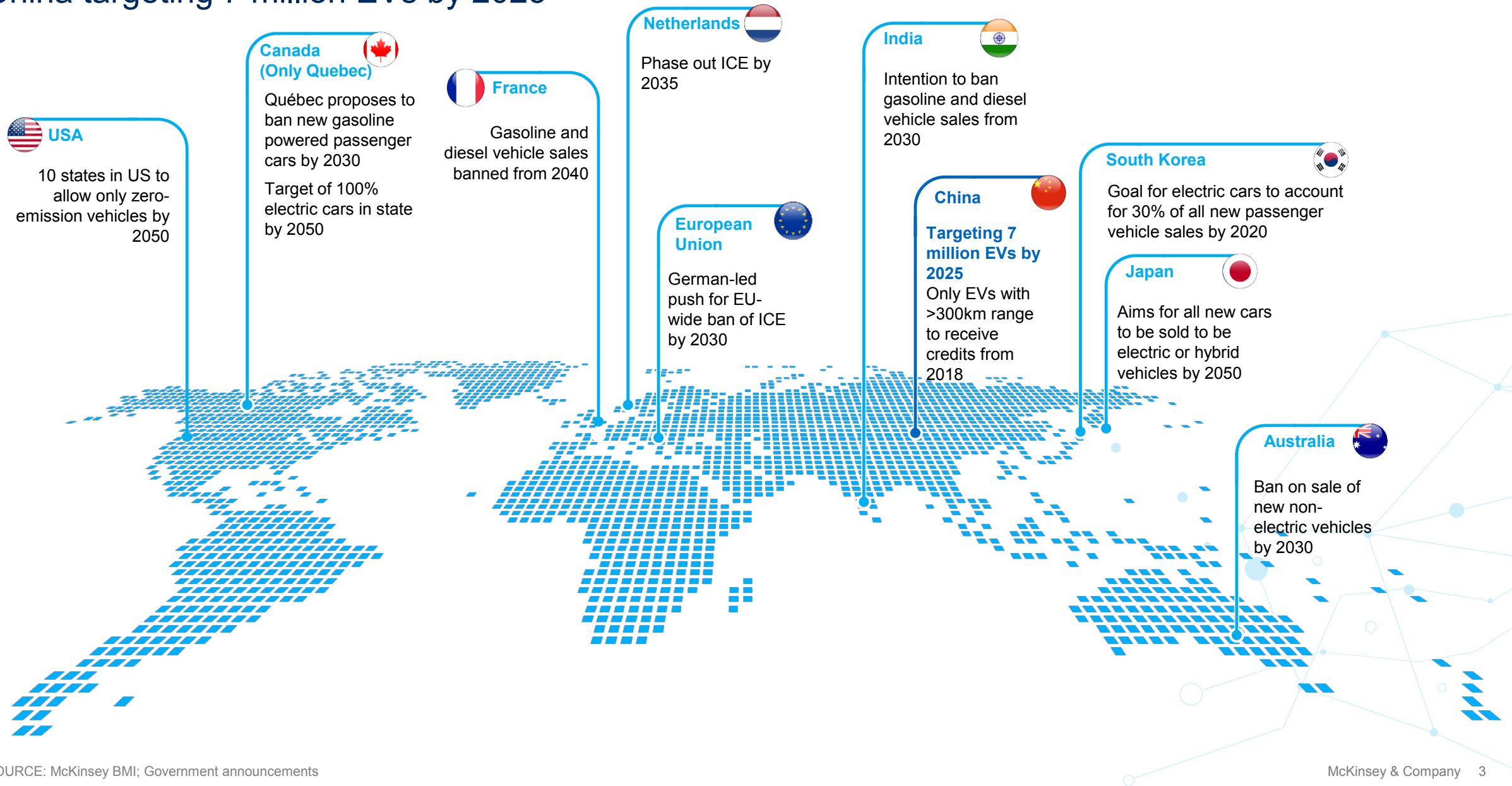
Lithium

~230kt	Demand in 2017
~10% p.a.	Demand growth 2010-2017
>85%	Mine supply from Australia, Chile and Argentina
~55%	Share of top 3 Li-mining companies
~45%	Share of Li for Li-ion batteries in total Li demand

SOURCE: McKinsey

Governments around the world announced regulations that will promote EV demand – China targeting 7 million EVs by 2025

NOT EXHAUSTIVE



SOURCE: McKinsey BMI; Government announcements

China applies an end-to-end approach to promote EVs, securing access to battery raw materials and ensuring China is capturing the value add

61 Chinese brands selling EVs in 2018 in China

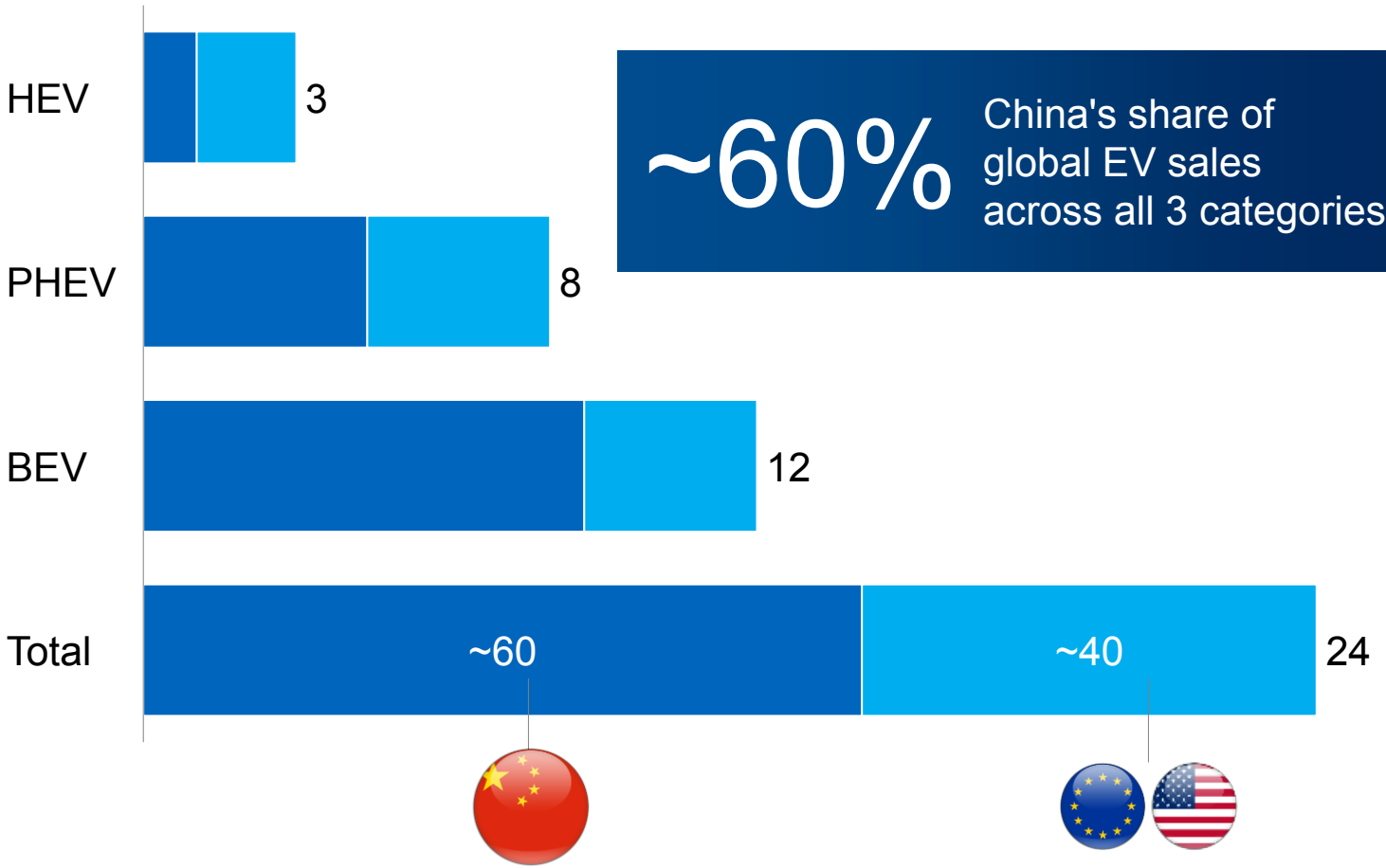
5.5 bn Government subsidies in China for EV in 2017 in USD

~5 m Charging poles by 2020

65% China's share of global refined cobalt production in 2017

>60% China's share of global Li-ion production capacities in 2028

Scenario 2030[1]
New vehicle sales by powertrain type, million units



1 Base case scenario 2030 for US, China, Europe and Rest of World

SOURCE: IHS, Fuji, Bernstein, McKinsey Center for Future Mobility

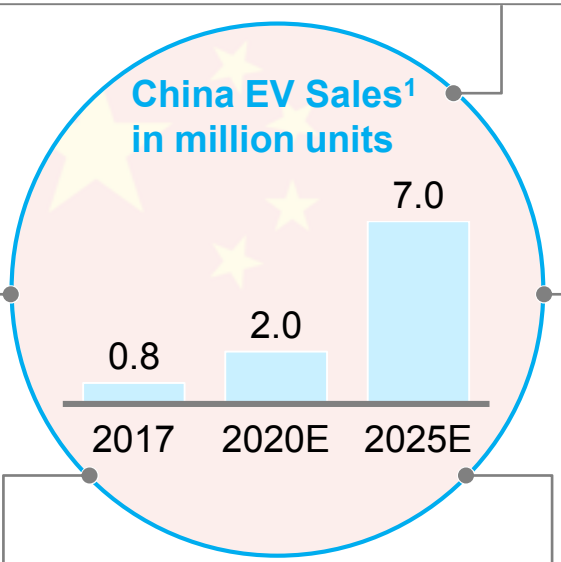
The China EV market is driven by a set of factors – regulation and incentives play a vital role

1 Regulation and incentives

- EV supporting policy **shifting from monetary incentives to none-monetary incentives** e.g. the NEV (New Electrical Vehicle) &CAFC (Corporate Average Fuel Consumption) dual-credit scheme
- China government may **continue to favor local players** in different ways

2 Powertrain incl. battery development

- Battery cost continues to drop, driving **Total Cost of Ownership** of EV competitive for daily-use
- **EV powertrain** evolves to bring better performance and passenger comfort



3 Consumer interest

- **Consumer awareness** of EV is rising across population
- **Shared mobility users** are becoming early-adopters with large fleet orders

4 Competition

- The fast-growing market is attracting **new entrants** from diverse types of backgrounds
- **100+ EV models will become available in China in the next several years**, launched by both local and international OEMs

5 Charging infrastructures

- **EV charging infrastructure has been developing fast** with support from China government
- Investments are coming from diverse backgrounds, and the **operators are already consolidating** with an ecosystem gradually emerging

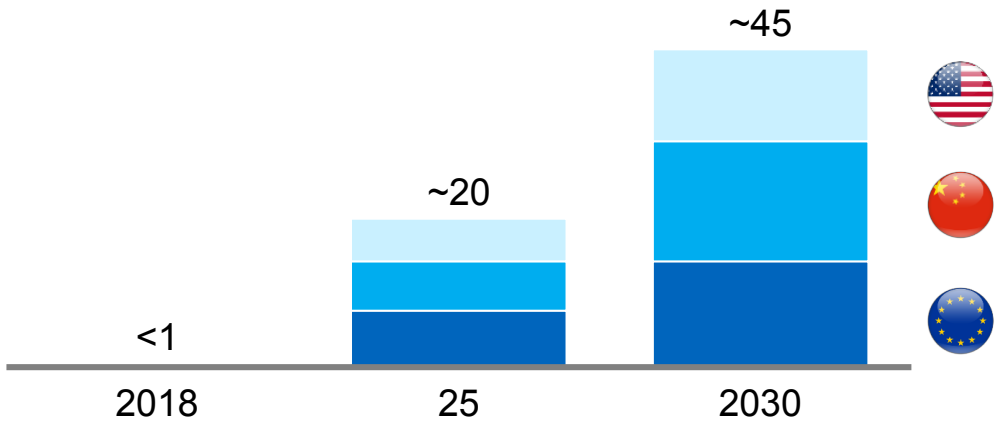
1 Current and government targets; CVs+PVs

SOURCE: McKinsey Sustainable Mobility Initiative

The industry may need to invest up to USD 50bn in the US, China and Europe through 2030 to meet the need for chargers

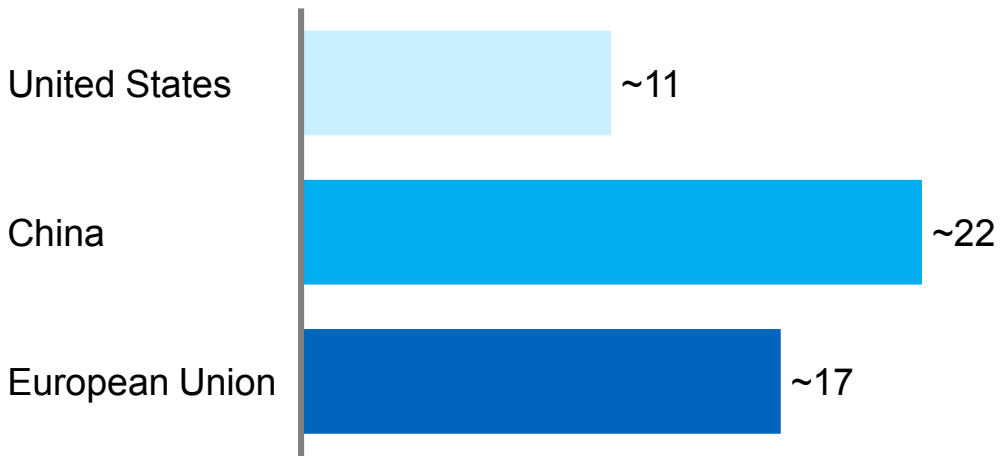
Estimated number of chargers

Millions

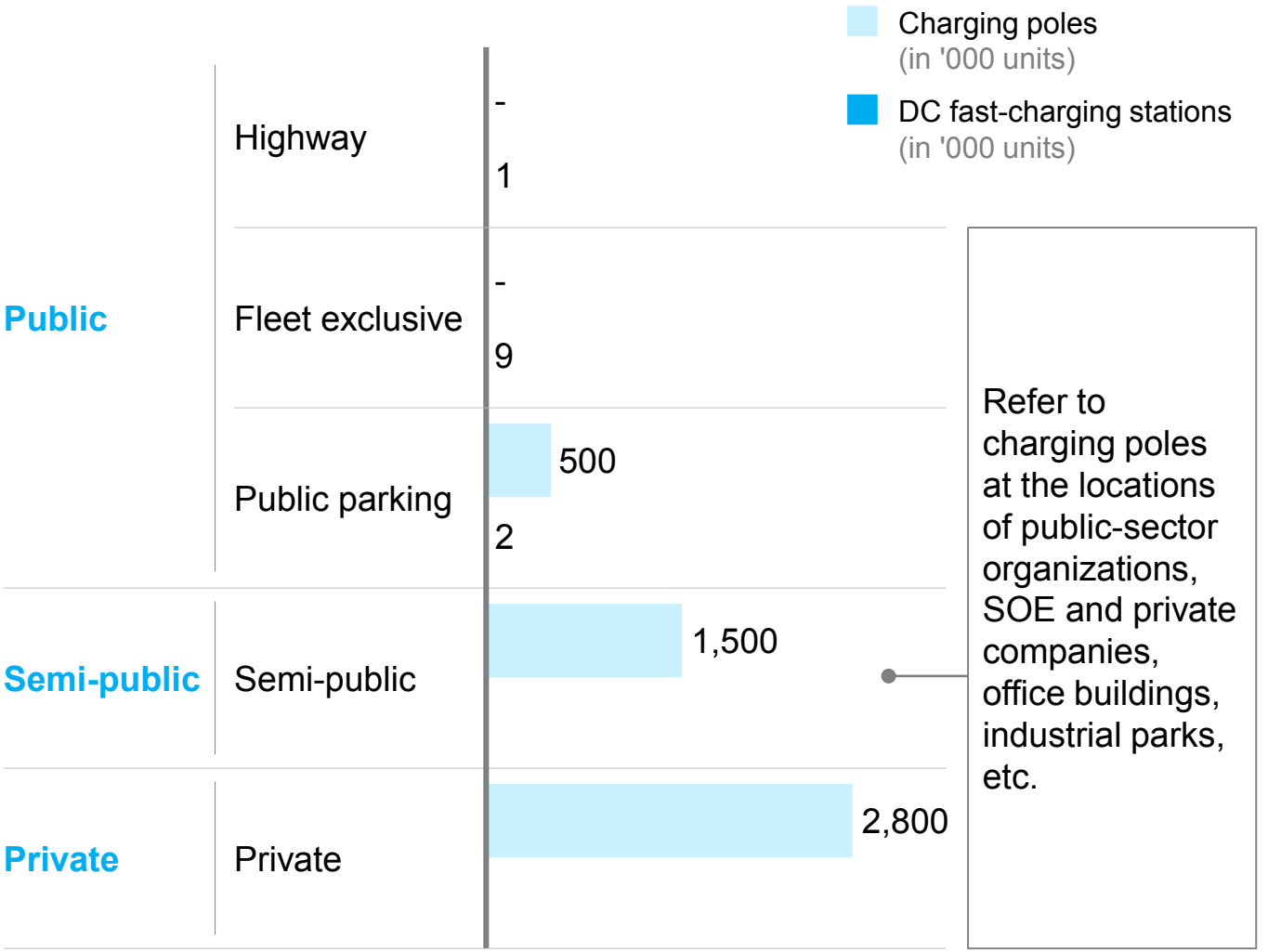


Estimated capital investment

USD billions

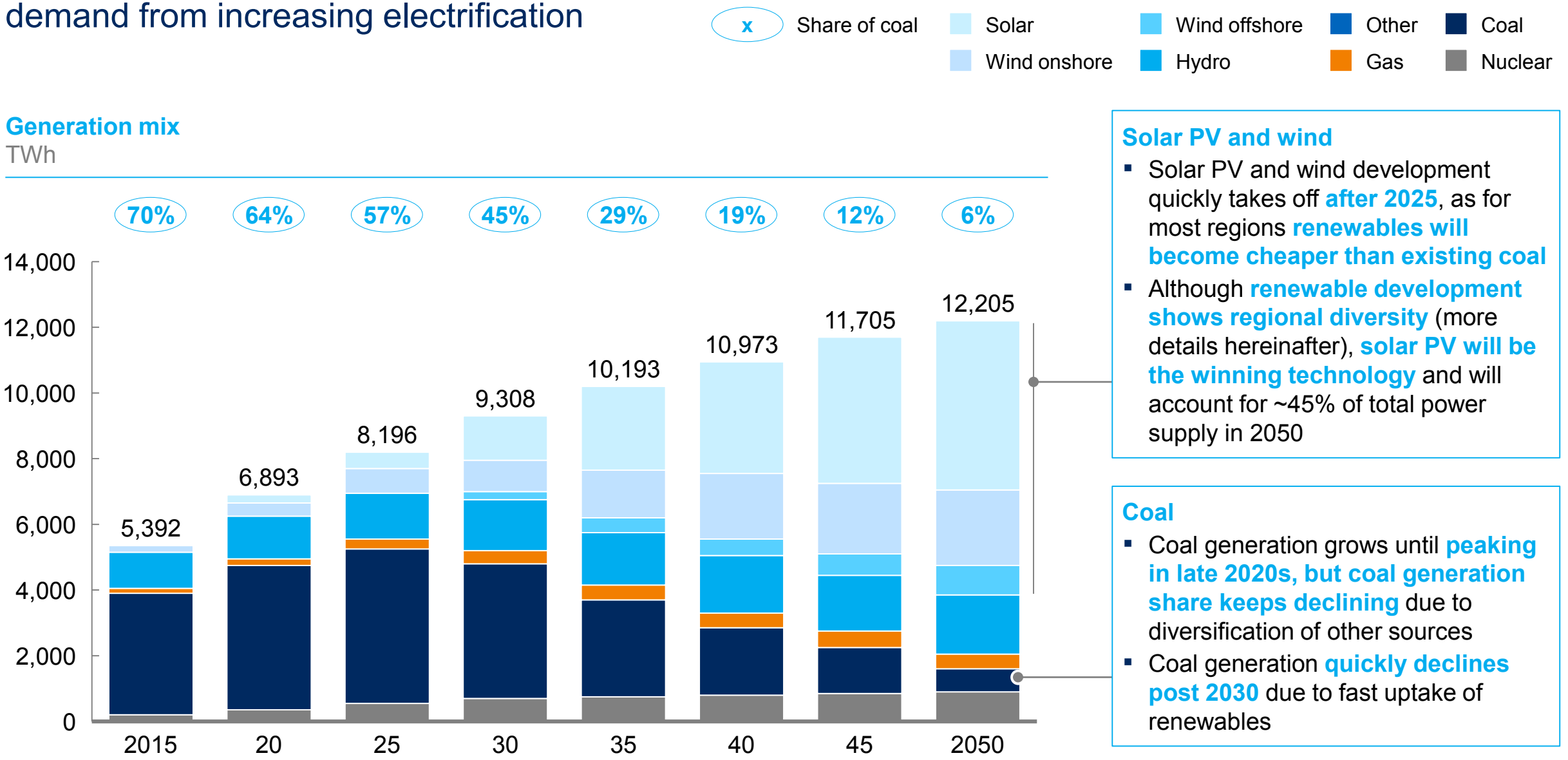


Chinas National Energy Administration targeting 4.8 mn charging poles in China by 2020 starting from a base of ~300k in 2018



SOURCE: Bloomberg, MEA, MITT, McKinsey

China builds up sufficient new and green power generation capacity to meet the energy demand from increasing electrification



Solar PV and wind

- Solar PV and wind development quickly takes off **after 2025**, as for most regions **renewables will become cheaper than existing coal**
- Although **renewable development shows regional diversity** (more details hereinafter), **solar PV will be the winning technology** and will account for ~45% of total power supply in 2050

Coal

- Coal generation grows until **peaking in late 2020s, but coal generation share keeps declining** due to diversification of other sources
- Coal generation **quickly declines post 2030** due to fast uptake of renewables

1 Other includes oil and coal co-fired with biomass as well as biomass, waste and geothermal; 2 Coal includes lignite, if applicable

SOURCE: McKinsey Energy Insights' Global Power Model

China built strong positions in battery materials mining, refining and conversion to secure access to raw materials for the strongly growing demand for Li-ion batteries

Cobalt

~23% of mined Cobalt production

~65% of refined Cobalt production

~60% of Cobalt sulphate processing capacity for battery grade material

Nickel

13% of mined Nickel production

5% of refined class 1 Nickel production

39% of Nickel sulphate capacity

80% of nickel investments in Indonesia

Lithium

25% of mined Lithium production[1]

~80% of Lithium hard rock conversion capacity

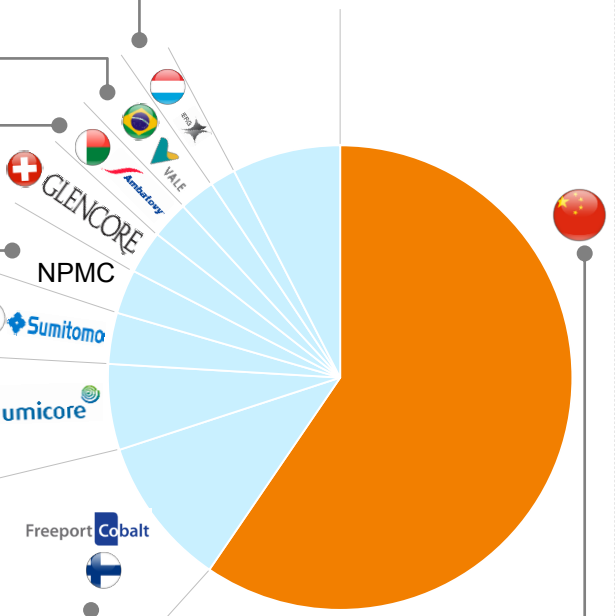
1 Excluding share of SQM

SOURCE: McKinsey

As a consequence roughly 60% of Cobalt refining and conversion capacity to Cobalt sulphate sits in China and another 10% in Finland

2017 estimated cobalt refined production by owner, 100% = 117kt, refined-equivalent

- Metals & intermediates as by-product from Zambian copper smelting activities
- Smelting/refining activities in Canada (Long Harbour & INCO) and Europe (Clydach)
- Sherrit International (Madagascar operations)
- Sudbury (INO) nickel and copper smelting & refining activities in Canada
- International Cobalt Corp. (Canada)
- Niihama Nickel Refinery in Japan (Co metal)
- Refining & recycling, based in China (GEM) & Belgium
- Kokkola Refinery in Finland



Main refiners: Zhejiang Huayou Cobalt, Jinchuan Group, Nanjing Hanrui Cobalt, …

Cobalt sulphate processing capacity estimates, 2017[1], 100% = 50-80kt, Co equivalent

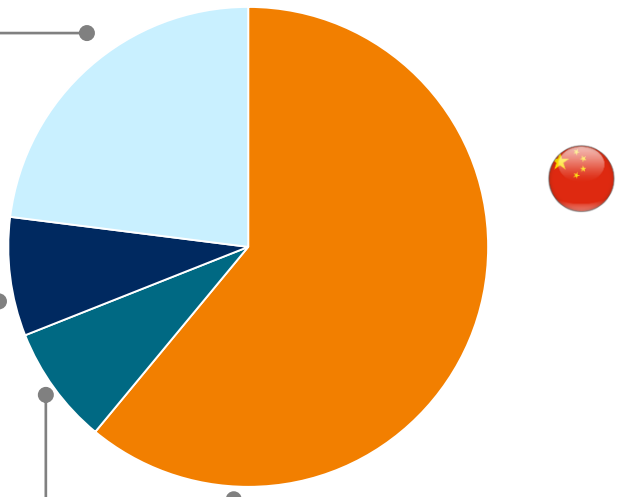
Other players including:
- Nornickel in Finland
- Mechema Toda in Taiwan
- Kansai Catalyst, Nihon Kagaku Sangyo, Hayashi Pure Chemical, Junsei Kagaku, in Japan
- Fortune Minerals in Canada
- Formation Metals, Shepherd Chemicals in USA
- INCASA in Brazil

Umicore with plant in Olen, Belgium

umicore

Freeport Cobalt with plant in Kokkola, Finland

Freeport Cobalt



华友钴业 HUAYOU COBALT JINCHUAN金川

Huayou, Jinchuan and other Chinese players, including GEM, Jiana Energy, Jiangsu, Jiangxi Lithium, Jiayuan, Jilin Jien, Nantong Xinwei, ALT (Dalian), Ganzhou Tengyuan, Huayi Chem

1 Excludes GEM - Umicore in China, which is under Umicore

SOURCE: MineSpans by McKinsey (April 2018), Cobalt Development Institute

1 Includes cobalt sulphate for all applications, including batteries; numbers will not sum to page 69 – page 69 shows total trade flows, while this page shows cobalt sulphate capacity only

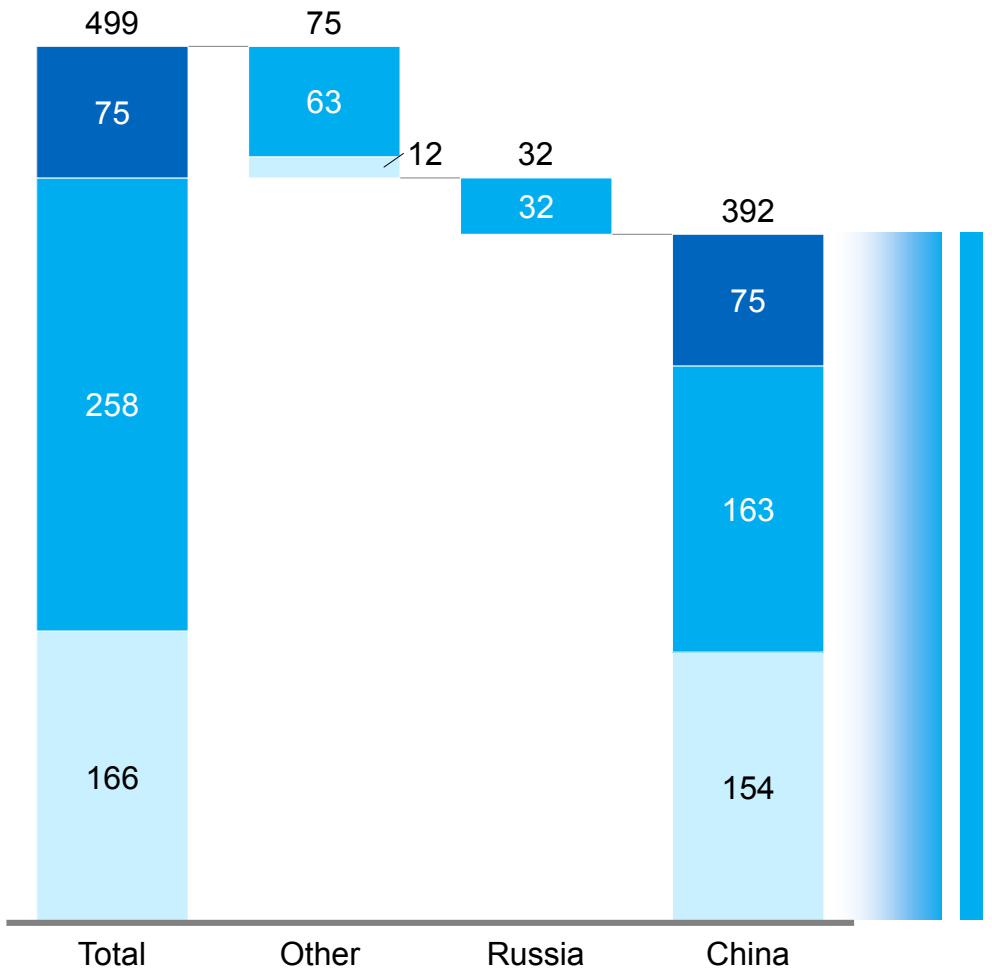
SOURCE: Press search, company websites, expert interviews

Chinese investors will own nearly 80% of all nickel projects in Indonesia, with ~20% of it (~75 kt) to be battery-suitable

Ni class
FeNi (class 2)
NPI (class 2)

BASE CASE

Indonesia nickel projects breakdown by investor origin, Figures in kt Ni



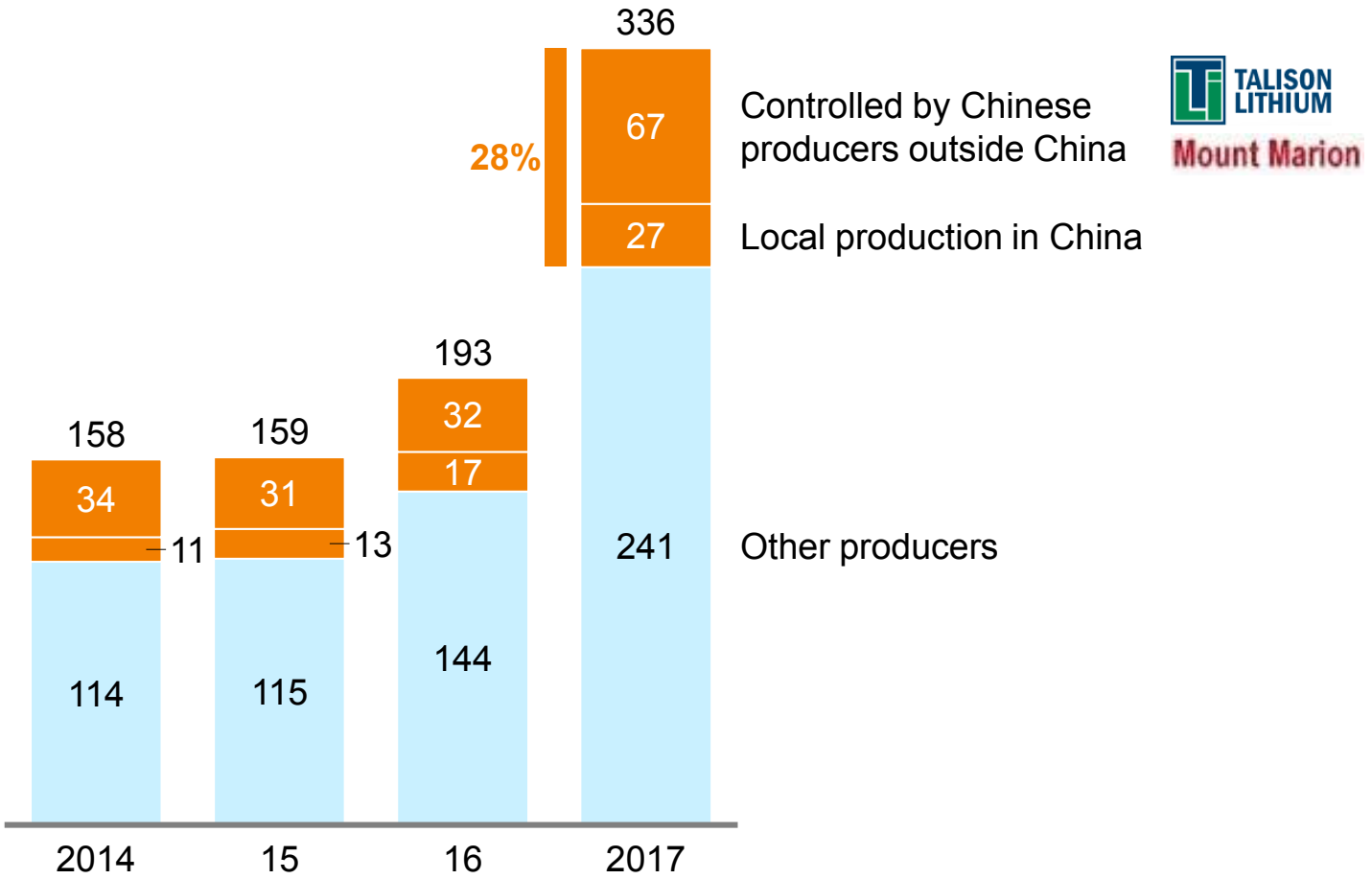
Project	Capacity (kt)
Wanxiang	91
IMIP (Phase III & IV)	75
Ceria Nugraha	63
Fajar Bhakti	52
Bintang (and expansion)	26
Artabumi	23
Central Omega (Phase II)	18
Huadi	12
Titan Mineral	12
First Pacific (Expansion)	8
Macika (Expansion)	4
Modern Cahaya (Expansion)	4
Kinlin	2
Macika	2

Securing access to Nickel for stainless steel equally important

SOURCE: Ministry of Energy and Mineral Resources, Indonesia Processing & Refining Association, press search, MineSpans, team analyses

Chinese producers control about 28% of global lithium mine production, the majority of it outside of China

Lithium mine production, kt LCE, %



China has gained supply independence from Western players through strategic ownership of foreign mines such as

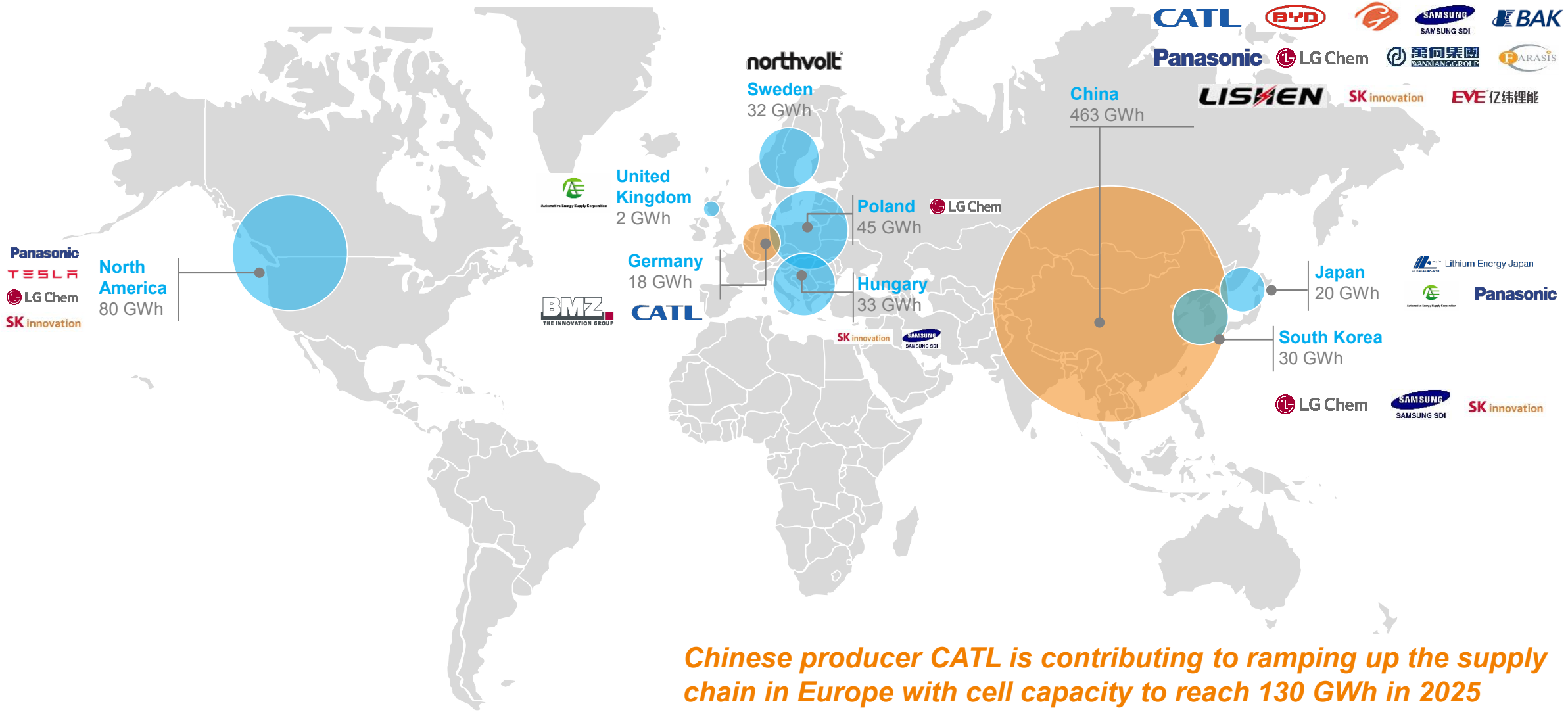
- **Tianqi controls 51% of Talison Lithium (Greenbushes, Australia)**
- **Jiangxi Ganfeng controls 43% of Mt Marion lithium project (Australia)**

Tiangqi is currently in the process of acquiring a 23.77% stake in SQM (Chile, SQM Li- and Li-derivatives sales volume ~45 mt)

1 Assuming 51:49 split between Tianqi and Albemarle for Greenbushes(since 2014) and 43% ownership of Mt Marion for Jiangxi Ganfeng Lithium Co

SOURCE: MineSpans by McKinsey

Globally, Li-ion battery cell manufacturing capacity is expected to reach ~726 GWh by 2025, ~64% of it located in China



Chinese producer CATL is contributing to ramping up the supply chain in Europe with cell capacity to reach 130 GWh in 2025

Notes: Benchmark estimates; not all data disclosed by companies; 2 GWh production capacity for rest of world

SOURCE: Visual Capitalist; Benchmark Mineral Intelligence; press search

Europe, the US as well as Japan and South Korea are taking steps towards securing access to critical raw materials and building a sustainable and competitive battery value chain

European Union

2017 – Launch of the European Battery Alliance (EBA)

- Create a competitive value chain with sustainable battery cells at its core
- Capture a battery market of up to €250 billion a year from 2025 onwards
- Prevent a technological dependence on competitors
- Invest EUR 200m in battery research

2018 – Strategic Action Plan for Batteries

- Secure raw material access
- Support sustainable battery cell manufacturing at scale
- Strengthen industrial leadership and a highly skilled workforce
- Ensure consistency with EU regulation

Europe, the US as well as Japan and South Korea are taking steps towards securing access to critical raw materials and building a sustainable and competitive battery value chain

USA

- The president signed an executive order 13817 **"A Federal Strategy To Ensure Secure and Reliable Supplies of Critical Minerals"**
- Final list of **35 mineral commodities deemed critical** which includes critical battery materials cobalt and lithium
- **Federal strategy report to the president including**
  - A strategy to reduce the Nation's reliance on critical minerals
  - An assessment of recycling and reprocessing technologies, and technological alternatives
  - Options for accessing and developing critical minerals
  - Recommendations to streamline permitting and review processes

Europe, the US as well as Japan and South Korea are taking steps towards securing access to critical raw materials and building a sustainable and competitive battery value chain

Japan and South Korea

Japan: New Strategic Energy Plan, as basis for energy policy towards 2030/50 (state-driven)

- Explore «cobalt-rich ocean crusts»
- Secure stable supply of necessary mineral resources, e.g., strengthen resources diplomacy with Africa
- Promote recycling technologies

South Korea: Strategic actions driven by the industry with limited government support

- Securing raw materials long-term via joint ventures, partnerships and long-term off-take agreements
- Investments in production and conversion capacities locally and abroad