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materials for a better life

WORLD MATERIALS FORUM

On the road towards clean mobility

5th World Materials Forum
Nancy, June 12th – 14th 2019

Dr An Steegen (an.steegen@umicore.com) – Umicore Chief Technology Officer

Who we are

A global materials technology and recycling group

CATALYSIS

One of three global leaders in emission control catalysts for light-duty and heavy-duty vehicles and for all fuel types

ENERGY & SURFACE TECHNOLOGIES

A leading supplier of key materials for rechargeable batteries used in electrified transportation and portable electronics

RECYCLING

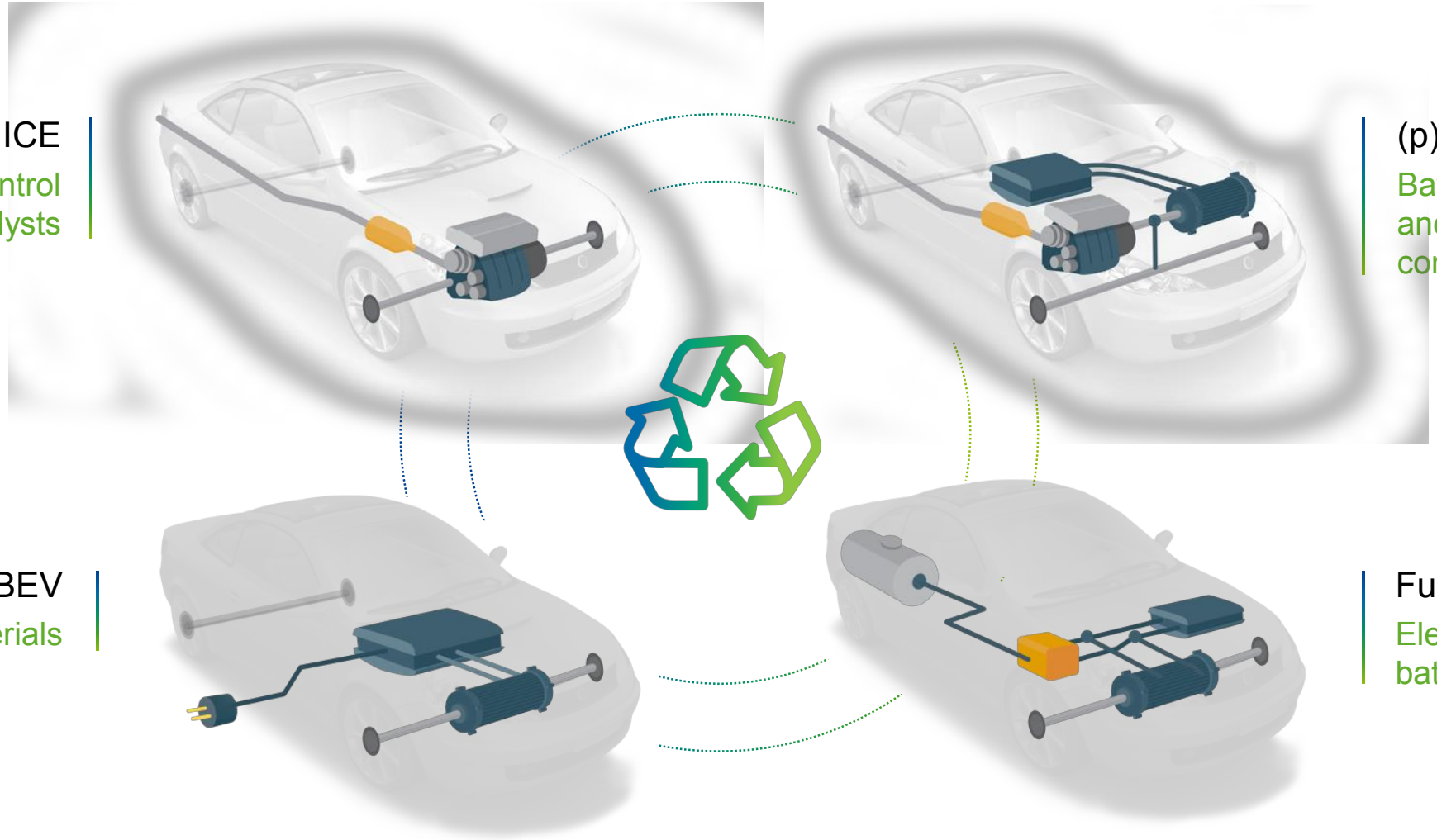
The world's leading recycler of complex waste streams containing precious and other valuable metals

Unique position

in clean mobility materials

ICE

Emission control catalysts



(p)HEV

Battery materials and emission control catalysts

BEV

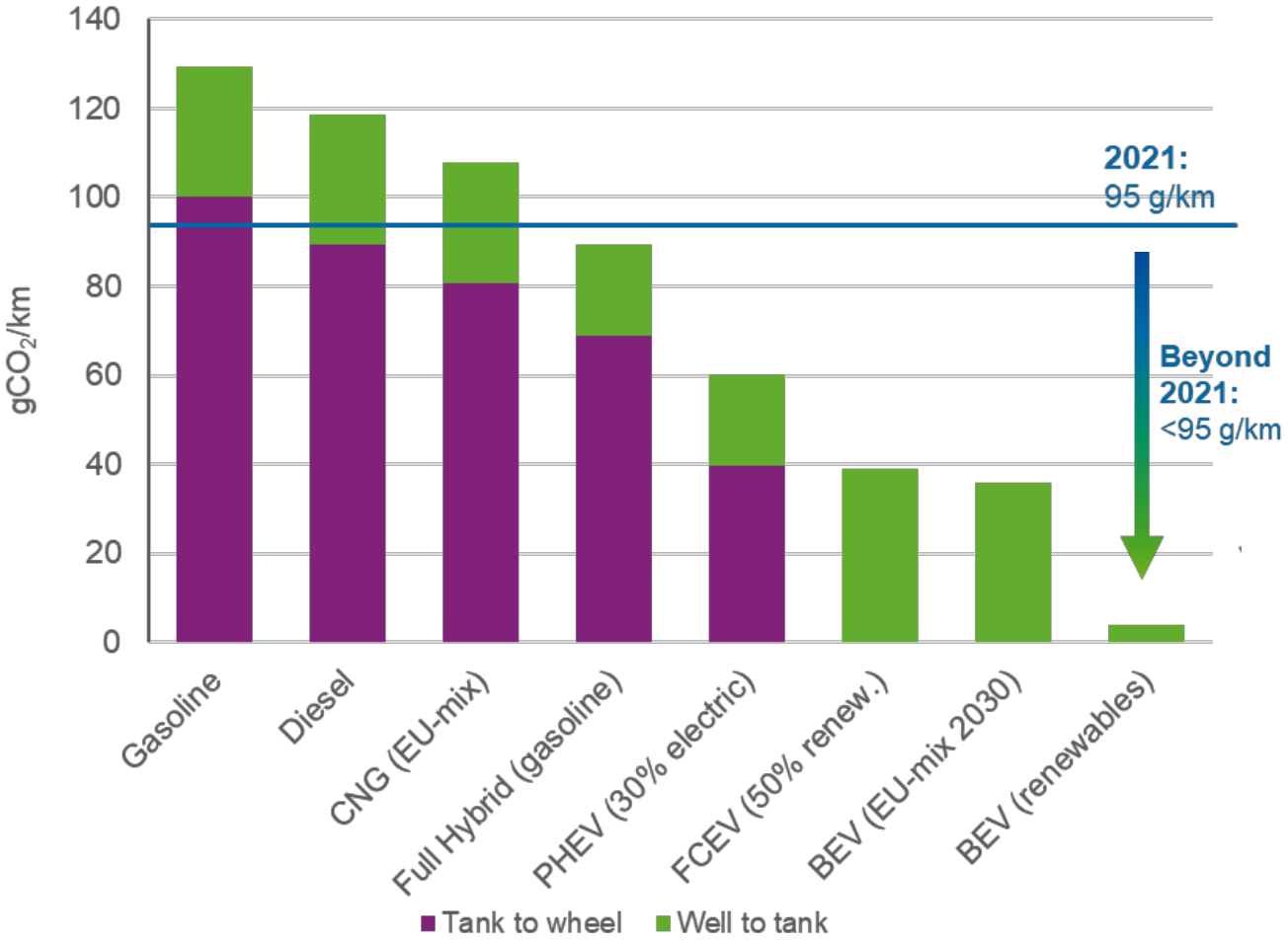
Battery materials

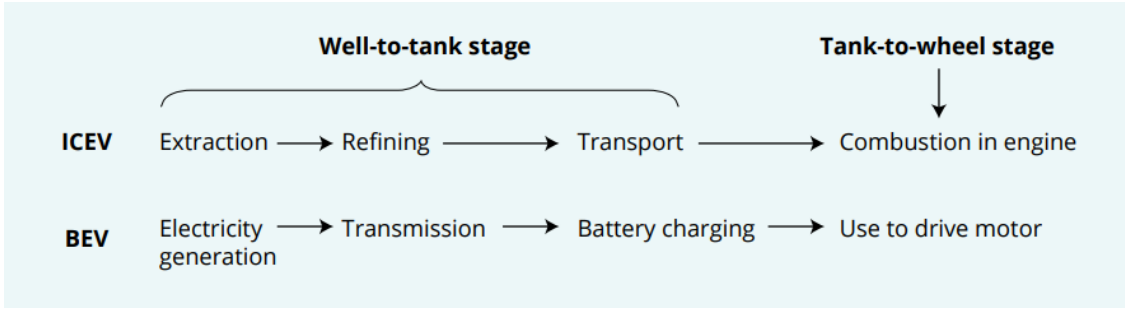
Fuel cells

Electro-catalyst and battery materials

On the road towards clean mobility

Well to wheel considerations favor BEV*



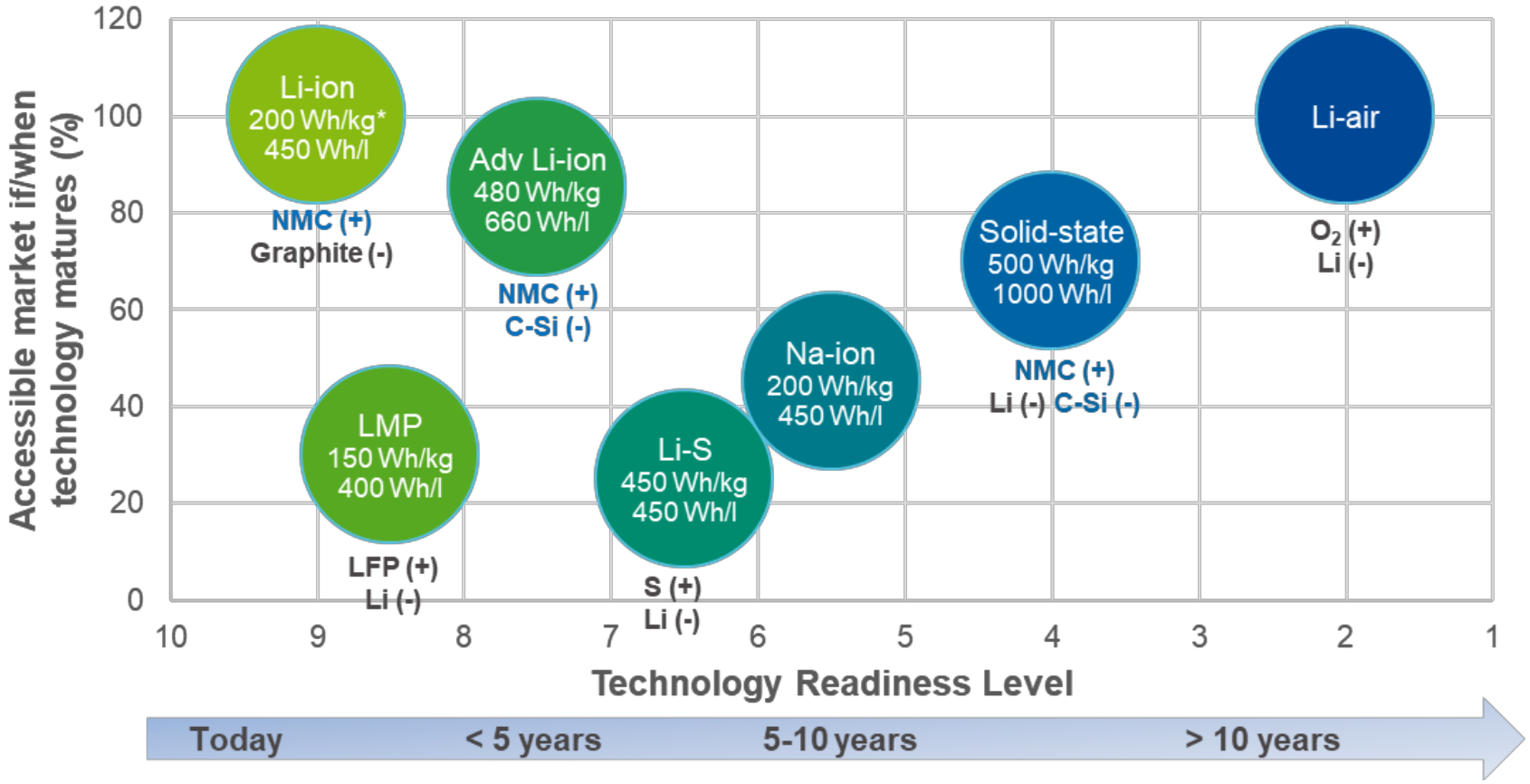


… but it is an evolution and not a revolution

… during which we need a multi-facetted approach to clean mobility

* BEV stands for battery electric vehicles

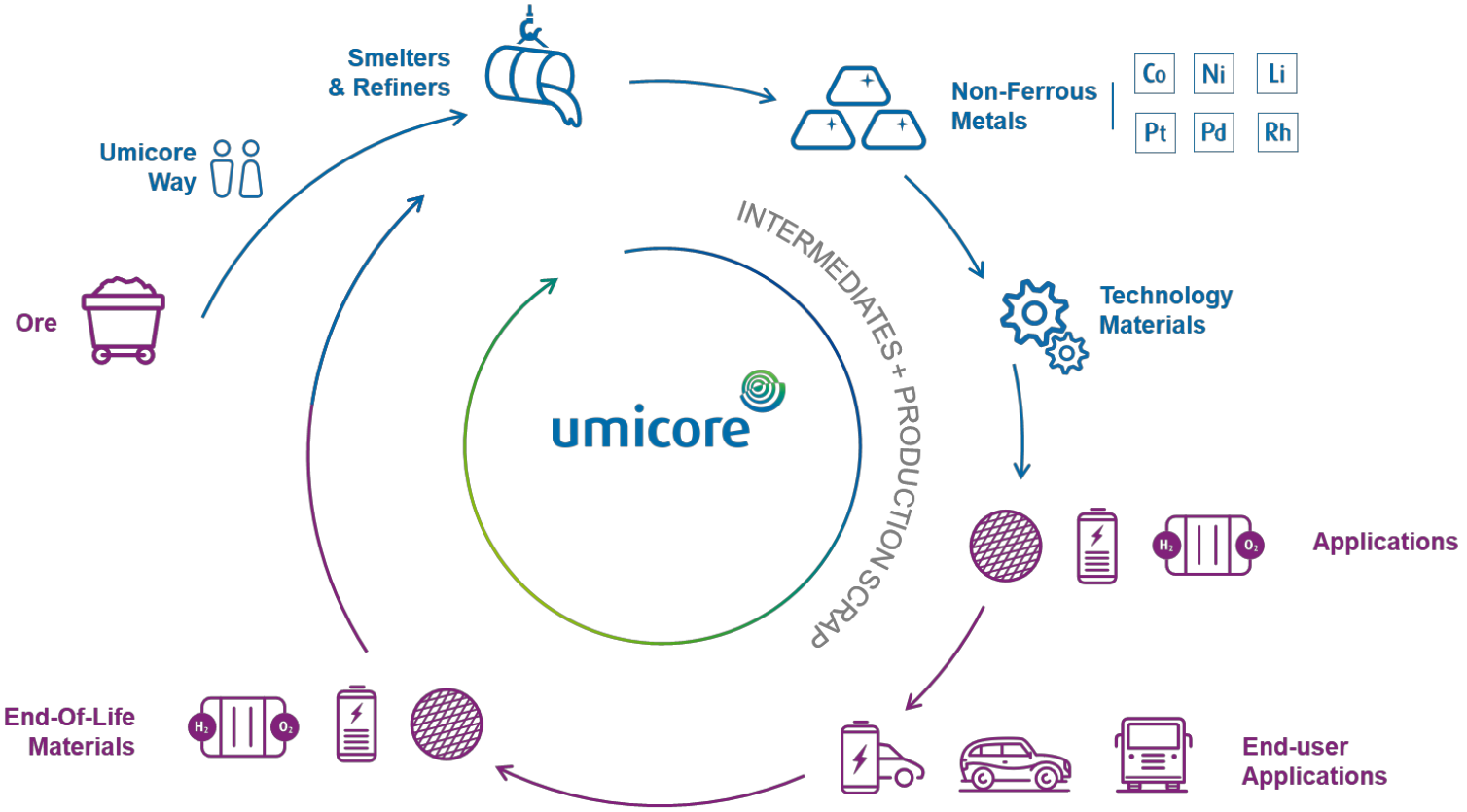
Use smarter
Increasing Energy density of batteries



High Energy Density

- Composition
- Surface properties
- Smart voltage use
- Packing density

Use less
Recycling is the sustainable option
Mass electrification will require clean, dense and integrated supply chains



BMW Group, Northvolt and Umicore join forces to develop sustainable life cycle loop for batteries

Munich/Stockholm/Brussels

The BMW Group, Northvolt and Umicore have formed a joint technology consortium in order to work closely together on the continued development of a complete and sustainable value chain for battery cells for electrified vehicles in Europe. The project is seeking to press ahead with the sustainable industrialisation of battery cells in Europe and the associated acquisition of skills, from cell chemistry and development through to

Recycling is key to cover the needs in critical battery metals for EVs

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Market acceleration

150GWh ca. 500GWh

Cathode materials

300 Kmt ca. 850Kmt

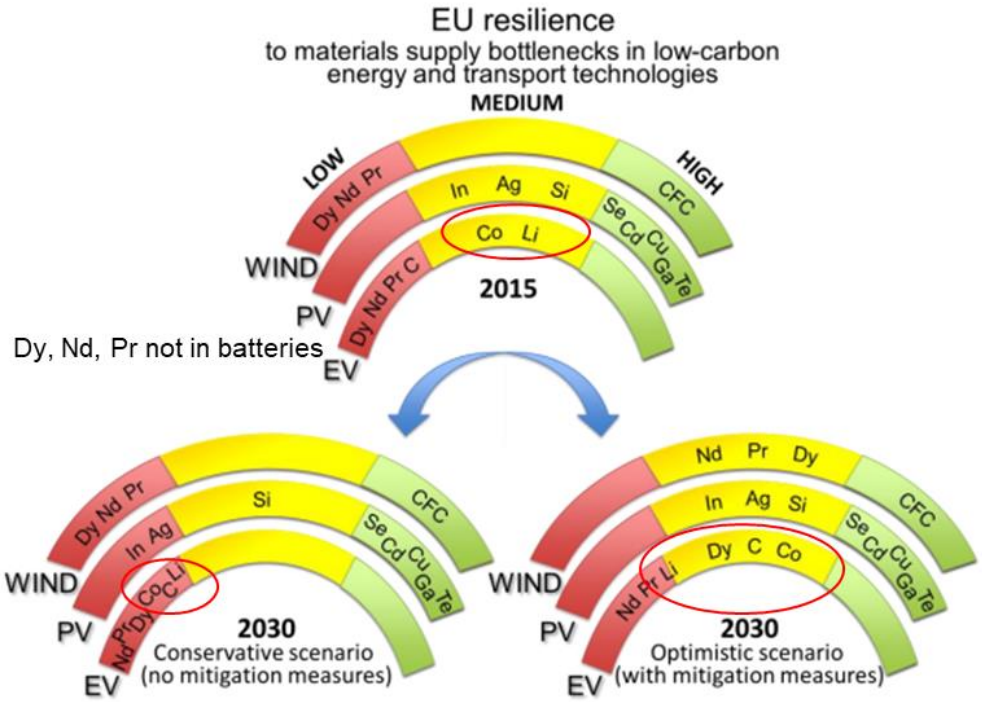
Supply – Demand balances

Li	250Kmt	375Kmt	>1.000Kmt
Ni	2.000Kmt	300Kmt	>1.100Kmt
Co	120Kmt	90Kmt	>120Kmt

Metals per car

Li	35kg	=	40kg
Ni	25kg	↗	50kg
Co	12kg	↘	5kg

● Now ● 2025 ● 2030



Source – EU Commission's JRC

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Umicore Battery Recycling Capabilities (1/2)

Existing pilot Lines for Dismantling of xEV Batteries and for recycling

· HANAU, GERMANY

Pack material
(CU cables, steel, plastics,...)

Local certified recyclers

Electronic components

Umicore Precious Metal Recycling

Battery modules / cells

Umicore Battery Recycling, Hoboken

Umicore Battery Recycling Capabilities (2/2)

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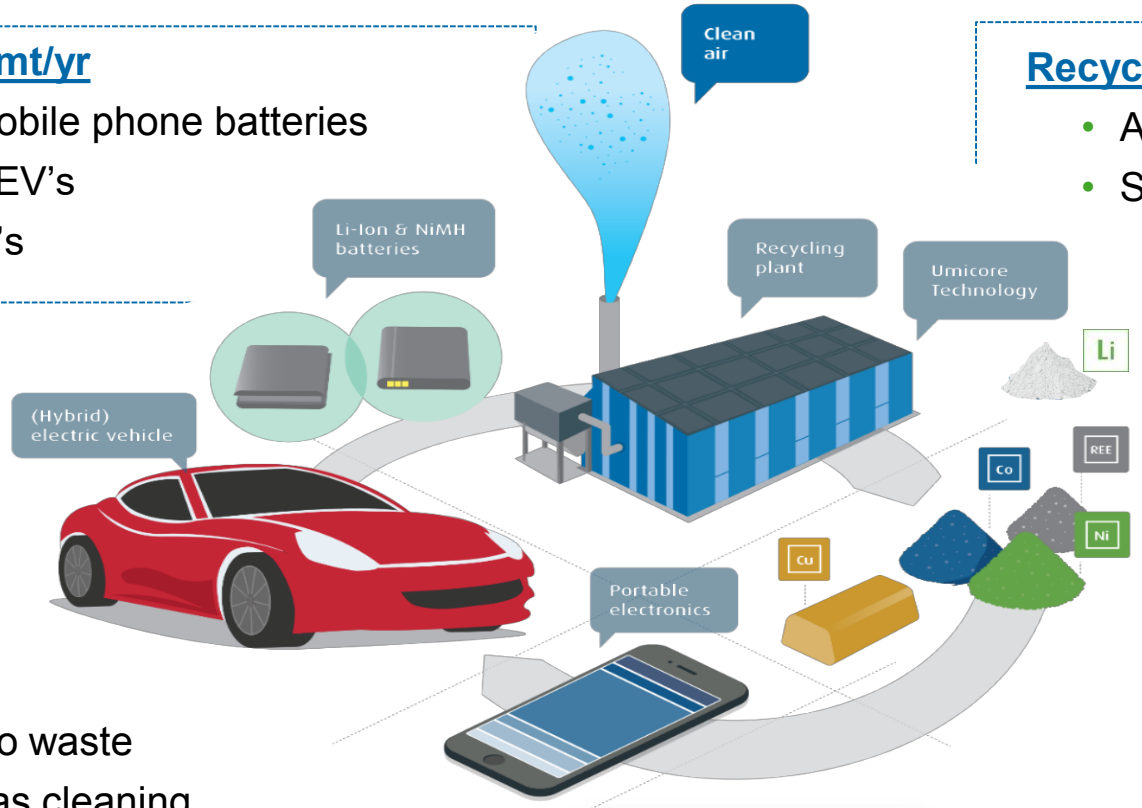
State-of-the-art technology available in Hoboken & Olen, Belgium at pilot & industrial scale for high efficiency metals extraction & refining

Capacity 10,000 mt/yr

- ± 250 mio mobile phone batteries
- ± 200,000 HEV's
- ± 35,000 EV's



Recycled products

- Alloy: Cu – Co – Ni
- Slag : for Li-Ion: lithium concentrate
  for NiMH: rare earth concentrate

Eco-efficient

- Close-to-zero waste
- Advanced gas cleaning
- Energy of battery used during processing

Winner of 2012 European Business Awards for the Environment

Remaining challenges

- Collection
- Separation and dismantling
- Reverse logistics

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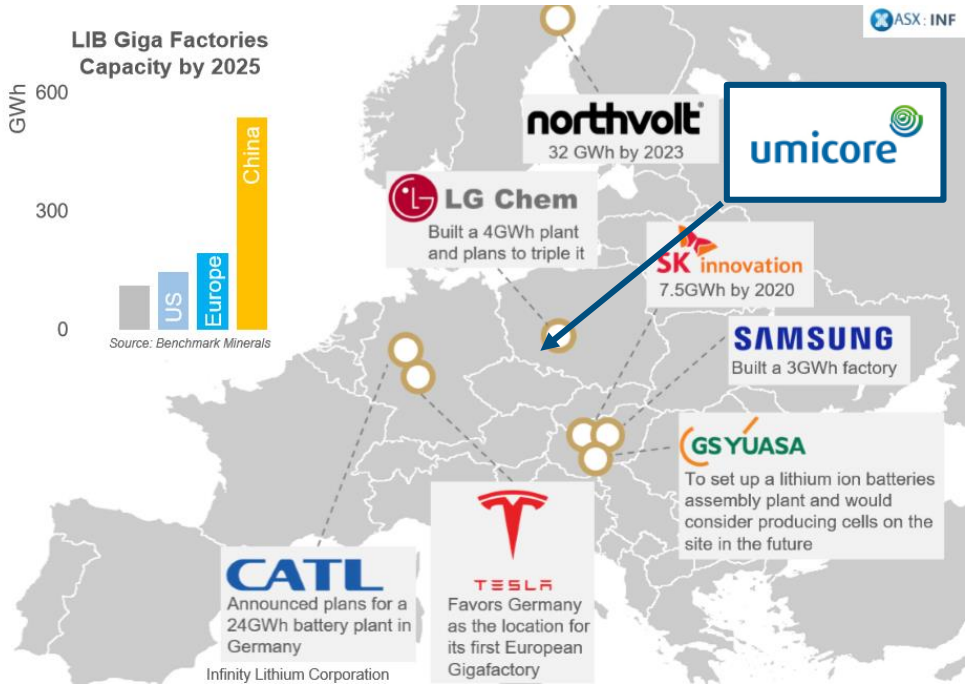
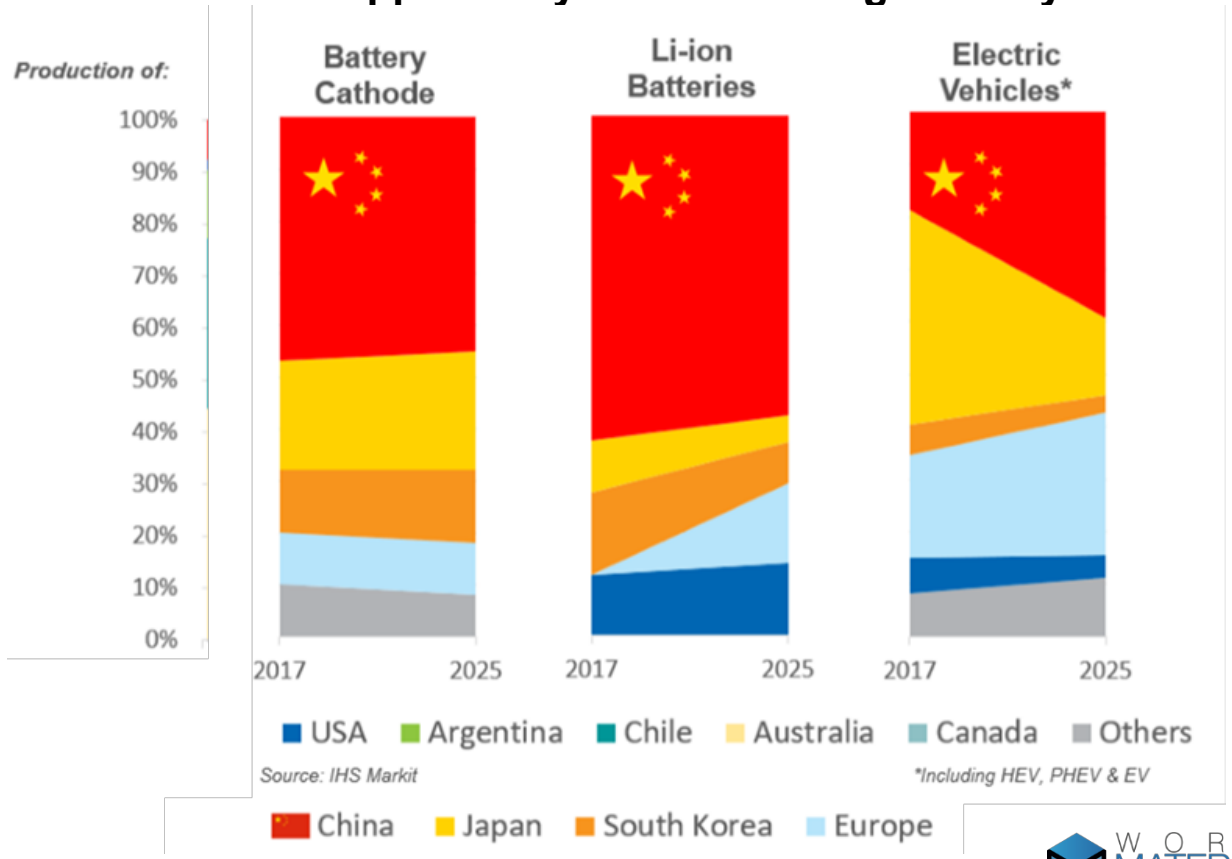
Use smarter and less
Regionalization of supply chains

Logical from (geo)economical standpoint

A number of Li-ion battery factories in EU …
with active materials players establishing presence

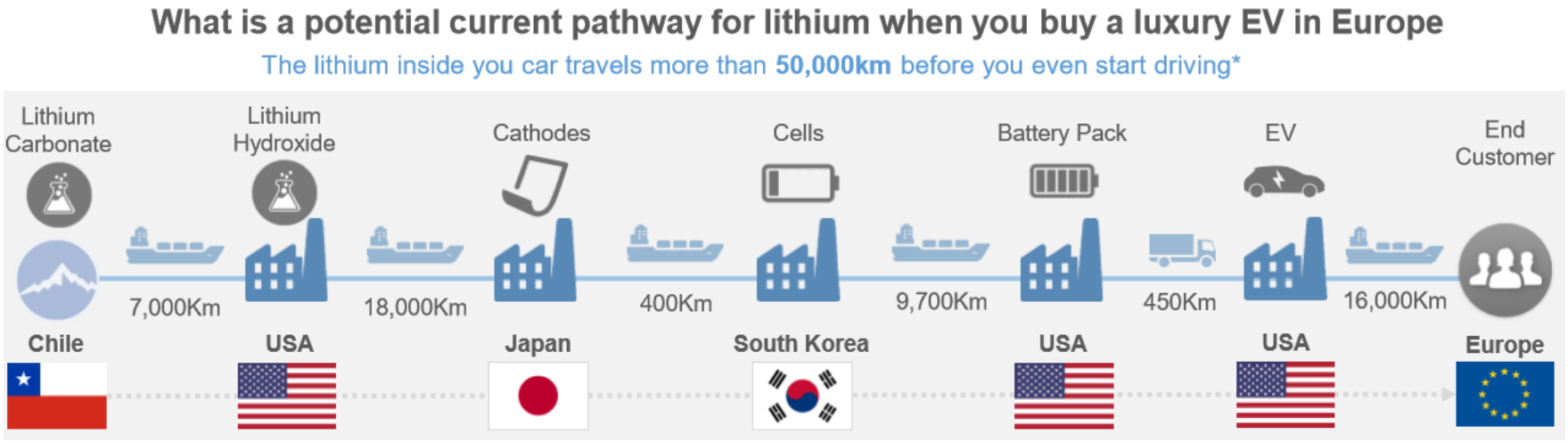


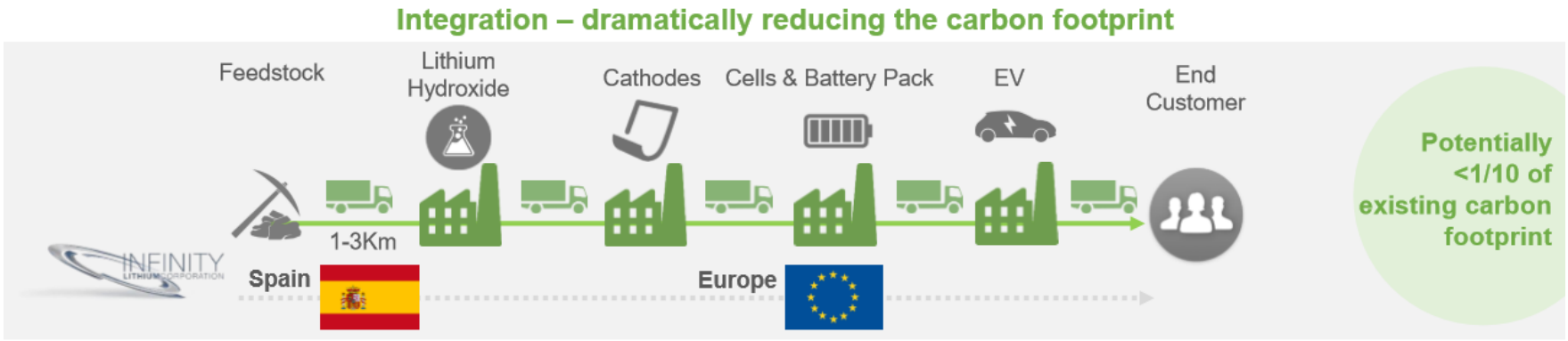
EU share of the global
opportunity to increase signifcantly



Source – Infinity Lithium

Use smarter and less
Regionalization of supply chains
Logical from environmental standpoint



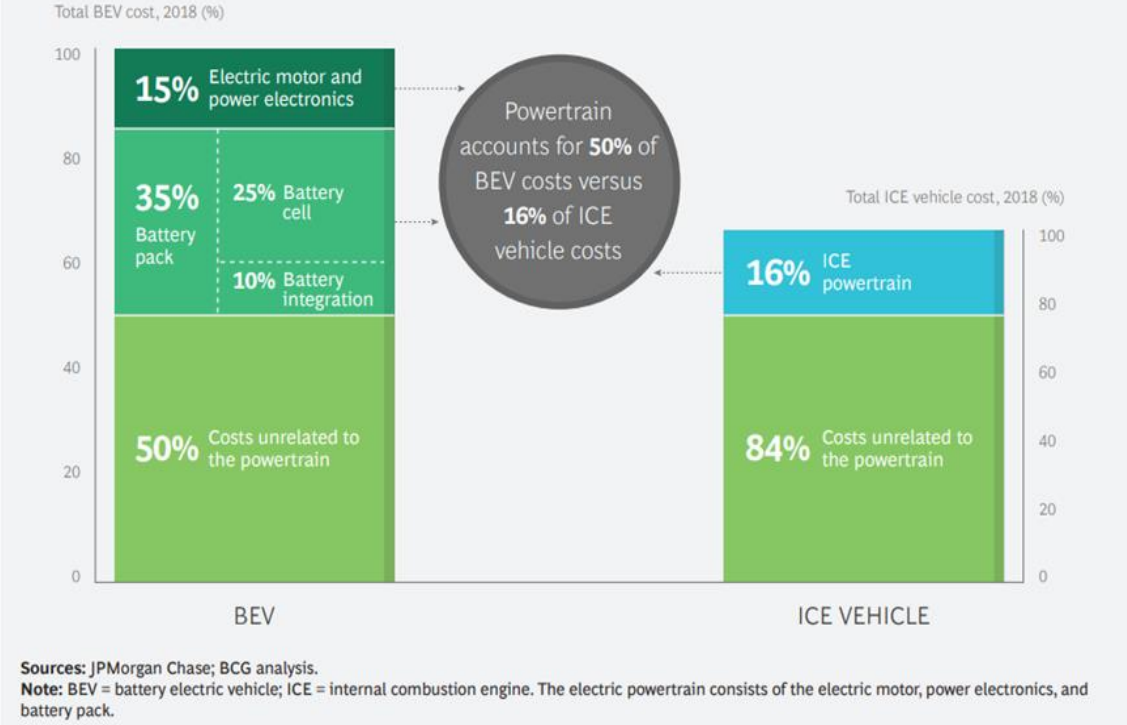


Source – Infinity Lithium

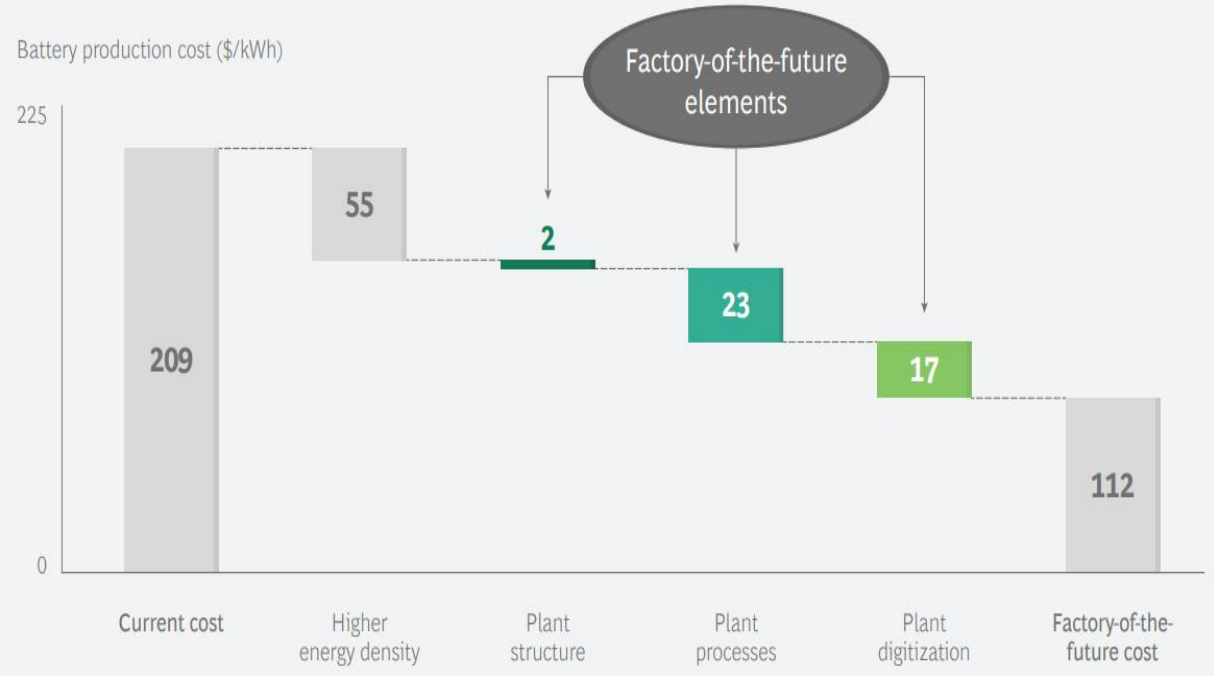
Use smarter and less
Cost of BEVs must also further come down

Move to higher energy density batteries is key

BEV 35% more expensive than ICE



Higher energy density & process innovation are key to reducing costs



Source – BCG

Summary… Umicore's key contributions to the introduction of battery enhanced vehicles

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Innovative active materials and new processes

- Key is increasing energy density without compromising on safey, stability, lifetime
- Move towards reduced Co content for the cathode active materials
- Development of new sustainable production processes
- Shift towards new anode active materials
- Going beyond Li-ion with active materials for solid state batteries

Sustainable metal sourcing

- EVs still continue to rely on primary sources of metals
- Recycling will play a growing role in roll-out of electromobility
- Umicore leads the way with a sustainable procurement framework for Co
- A 10.000 ton recycling facility is already operational at Umicore as well as a dismantling pilot

Regionalizing supply chains

- Umicore first investing in Poland (Nysa) on cathode active materials production to serve the growing European market
- Supporting an EU supply chain for EU
- Further investments needed to reinforce upstream and downstream positions in EU

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