

# BMW GROUP TECHNOLOGY WORKSHOPS E-MOBILITY

December 2016

**BMW  
GROUP**



Rolls-Royce  
Motor Cars Limited

# BMW GROUP'S ELECTRIFICATION PATHWAY.



## PIONEERING

- Building-up expertise
- Technology innovation
- Project i



## ELECTRIFICATION OF CORE PORTFOLIO

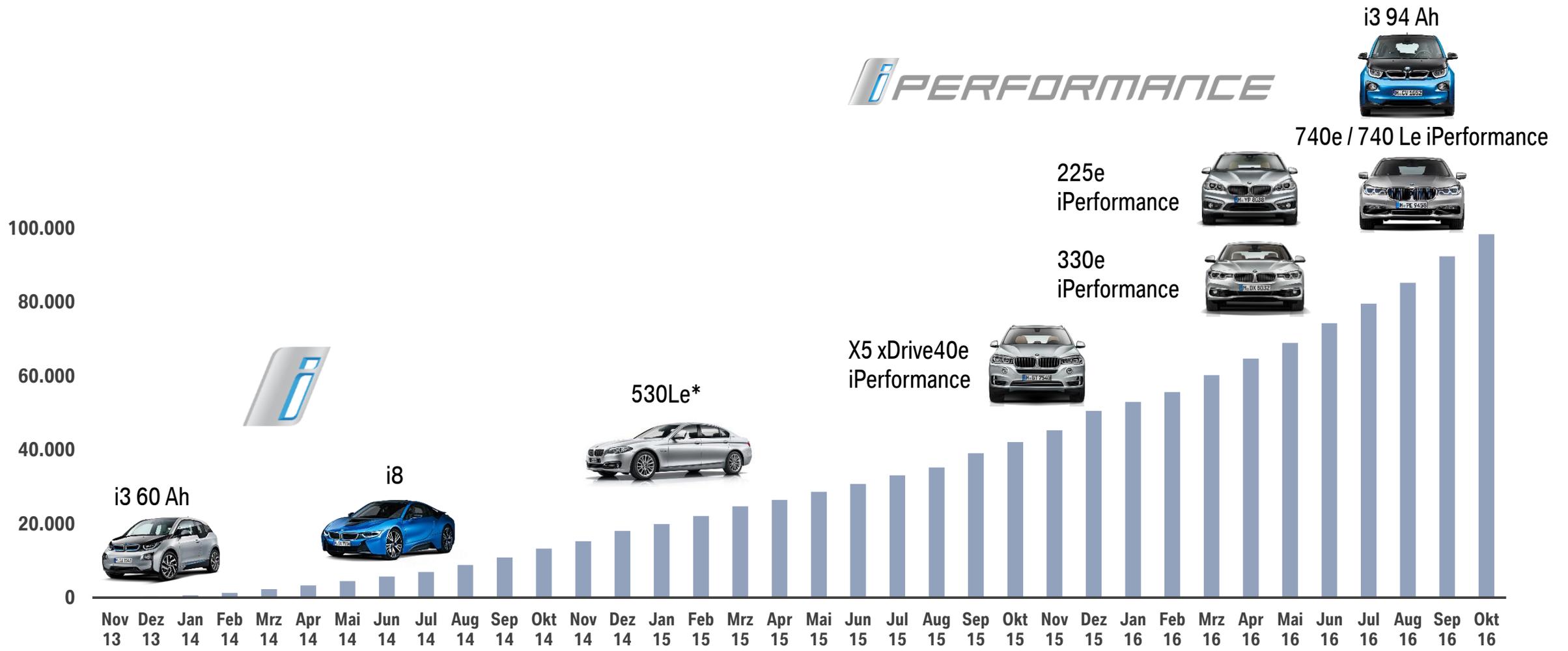
- Roll-out i Performance
- Upgrade BMW i3

- MINI BEV
- BMW X3 BEV



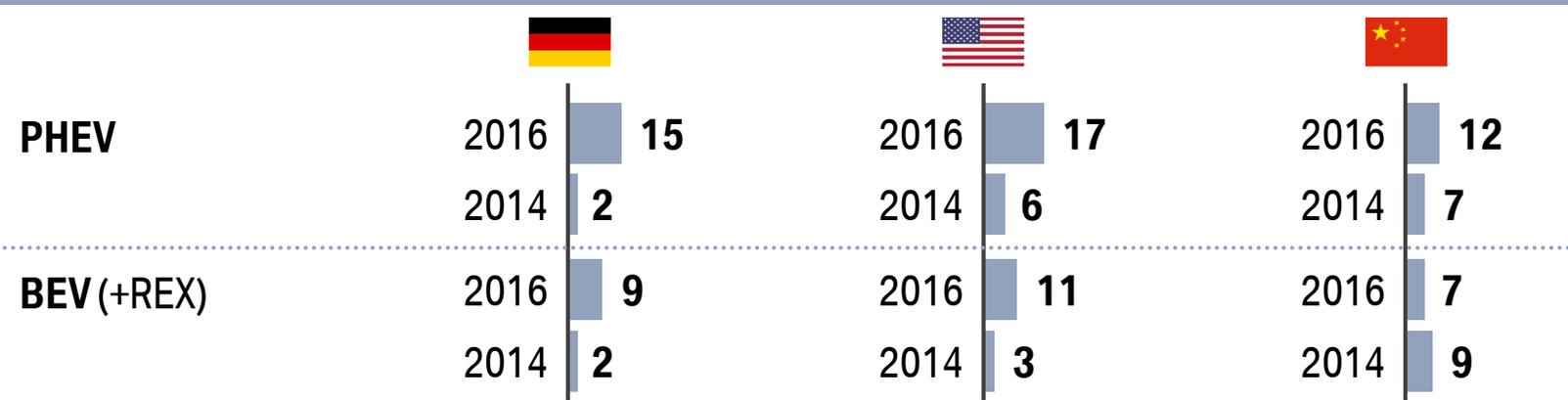
## SCALABILITY AND FLEXIBILITY

# OVER 100,000 ELECTRIFIED BMW VEHICLES SOLD YTD 2016.

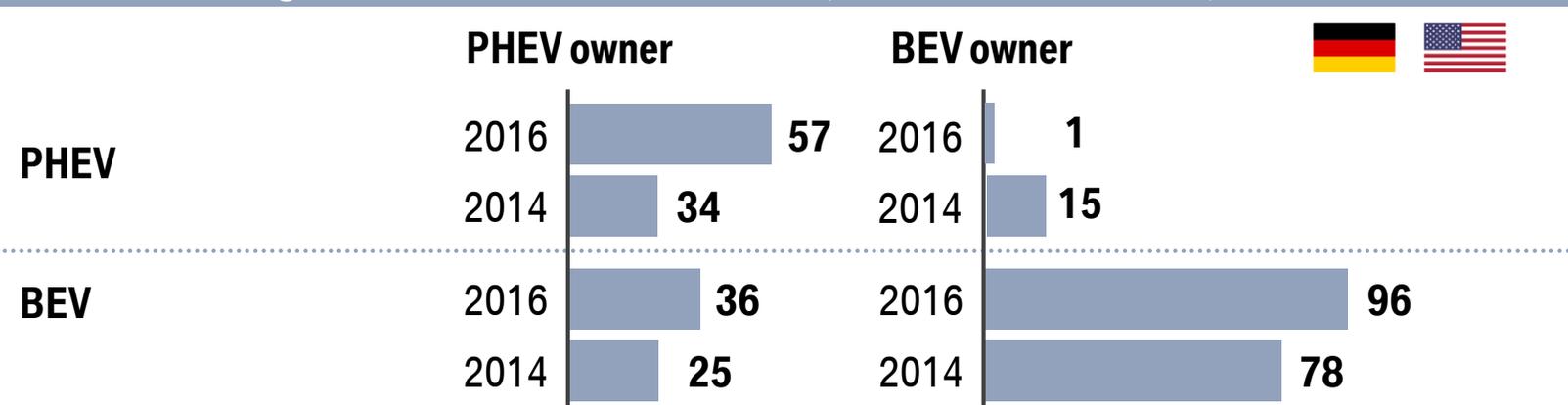


# CUSTOMERS ARE WARMING UP FOR E-MOBILITY. FIRST TIME CUSTOMERS OF BEV AND PHEV ARE CONVINCED.

## Favored powertrain next car: 2014 vs. 2016 (Driver conventional car, 1st choice)



## Re-Purchasing Interest EV: 2014 vs. 2016 (BEV and PHEV driver)

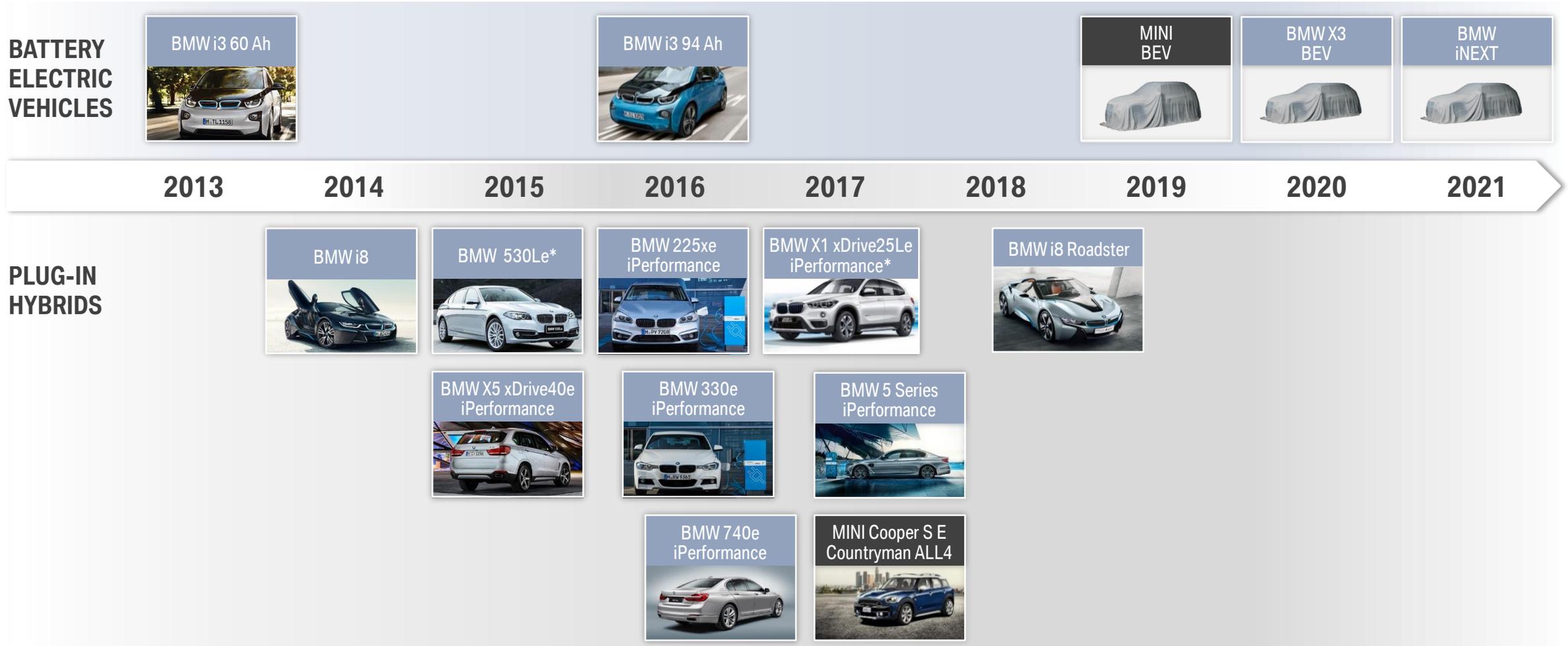


Source: Powertrain Study 2014/16 | June 2016

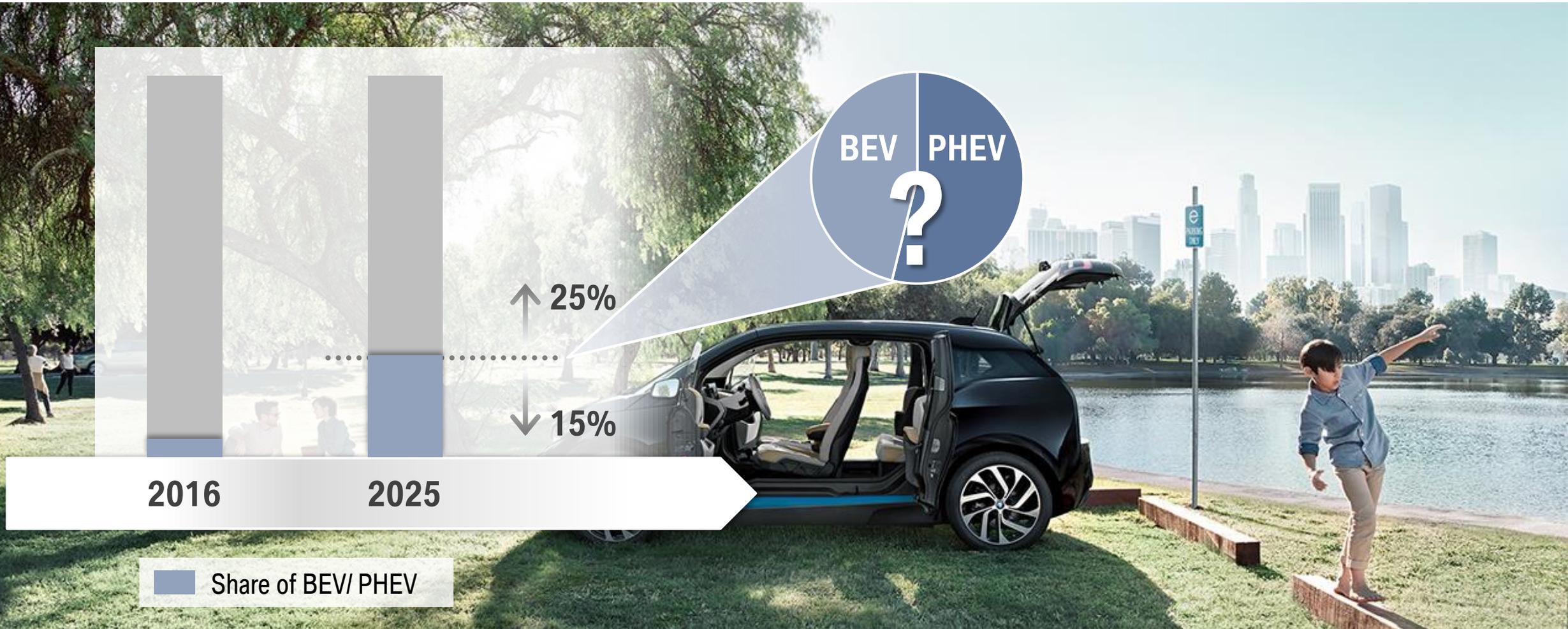
# HOW DO WE DETERMINE THE IDEAL PORTFOLIO FOR E-MOBILITY?



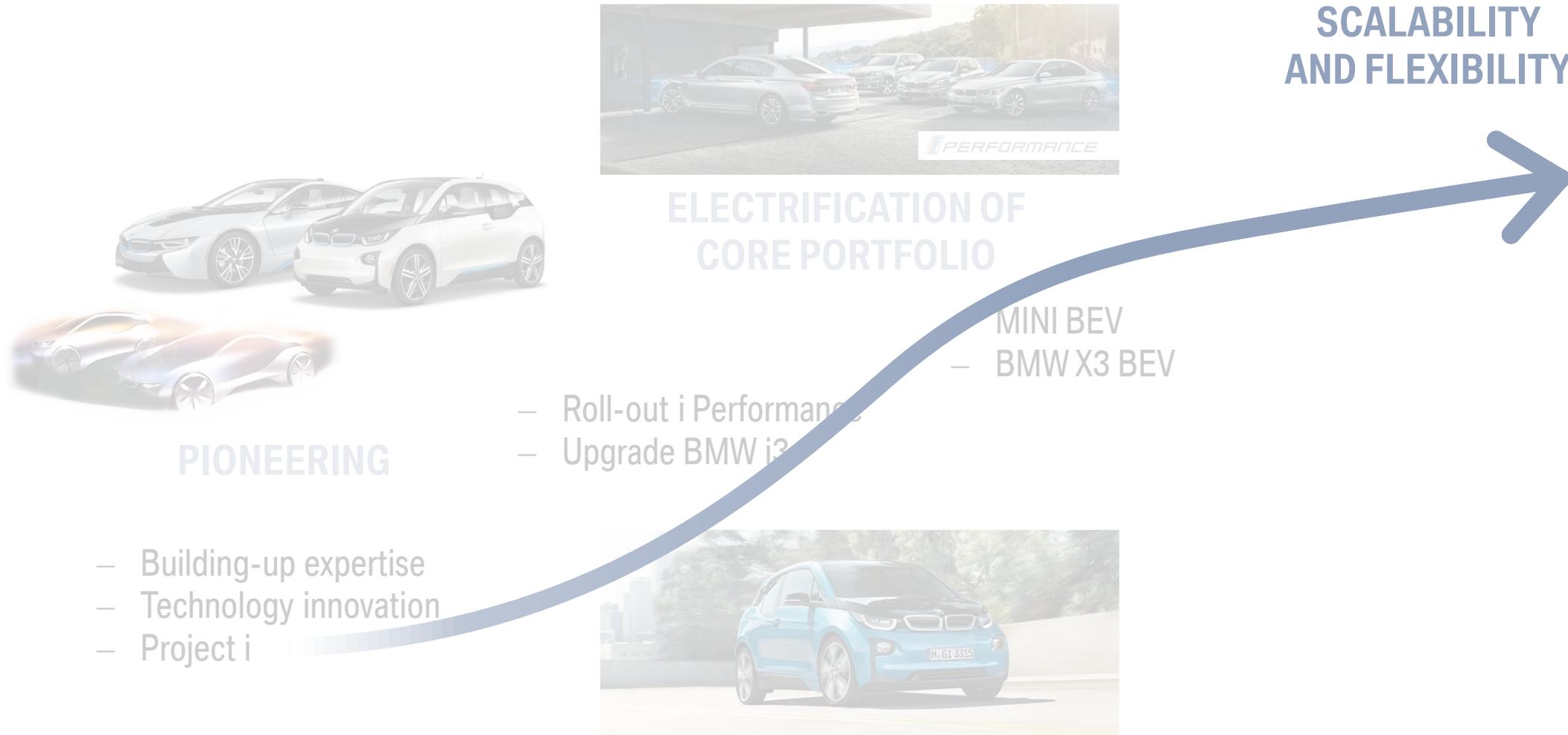
# SIGNIFICANT NUMBER OF ELECTRIFIED MODELS ARE ALREADY ON THE STREET.



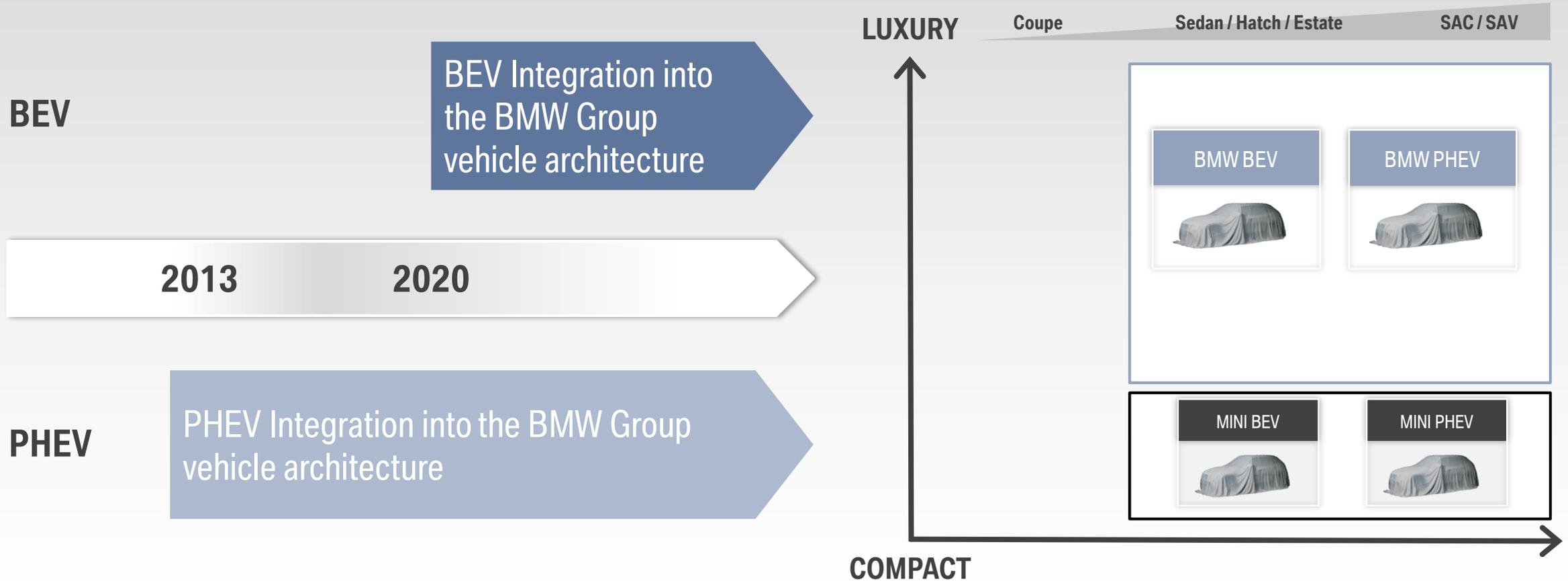
# FLEXIBILITY IS KEY FOR E-MOBILITY.



# FUTURE OF ELECTRIFICATION.



# SCALABILITY AND FLEXIBILITY – FUTURE ELECTRIFICATION BASED ON A MODULAR ARCHITECTURE.



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# E-MOBILITY

STEFAN JURASCHEK

VICE PRESIDENT RESEARCH AND DEVELOPMENT E-POWERTRAIN



December 2016

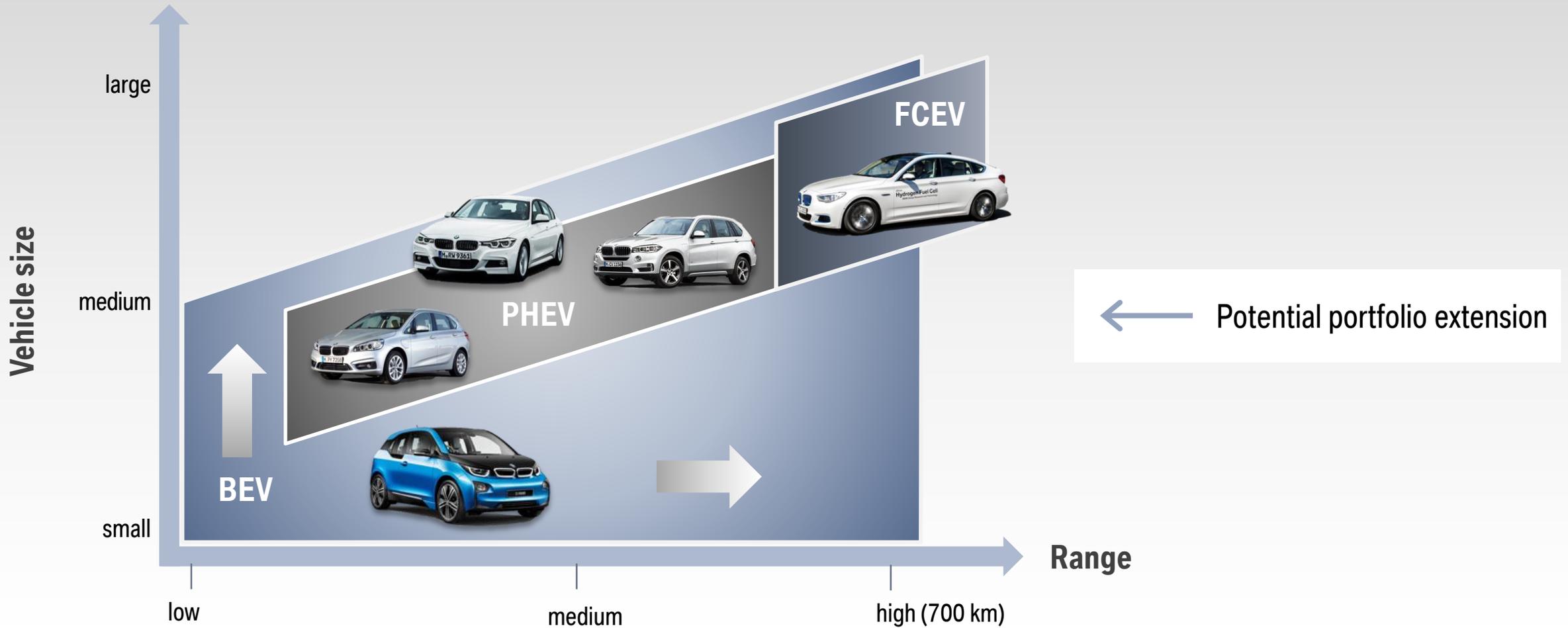
**BMW  
GROUP**

THE NEXT  
100 YEARS 



Rolls-Royce  
Motor Cars Limited

# ZERO EMISSION VEHICLE STRATEGY. CONCERNING VEHICLE SIZE AND OVERALL RANGE.



# IN-HOUSE DEVELOPMENT & PRODUCTION OF KEY COMPONENTS.

**Technology lead:** Lighter, faster, more powerful and more flexible than the competitors.

## Power & charging electronics



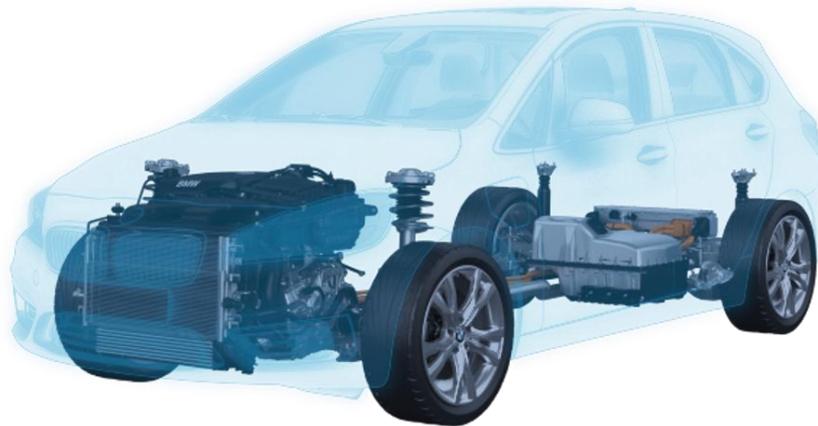
Development (Build to Print)

## E-Machine



Development & Production

## HV Battery



Example:  
BMW 225xe

## GOALS OF THE INHOUSE STRATEGY.

Downright top performance by the use of new technologies.

Flexibility in the choice of technologies and suppliers.

Cost structure transparency.

Modular kit: flexible and scalable.

Key factor: considerable acceleration of development & production.

# CURRENT BMW GROUP PLUG-IN HYBRID & BATTERY ELECTRIC APPROACH.

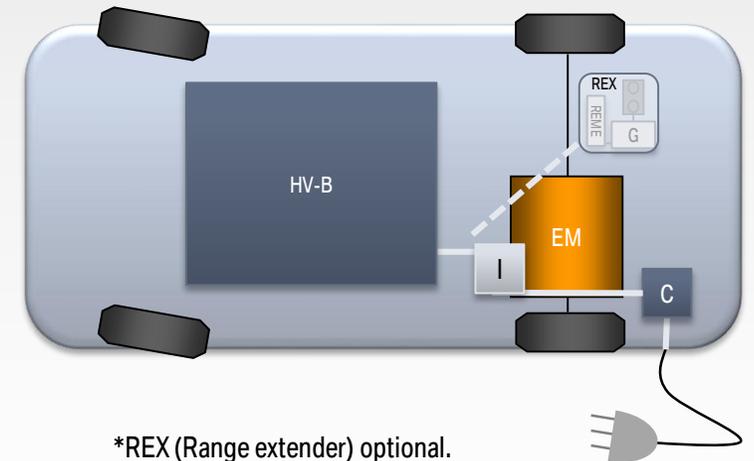
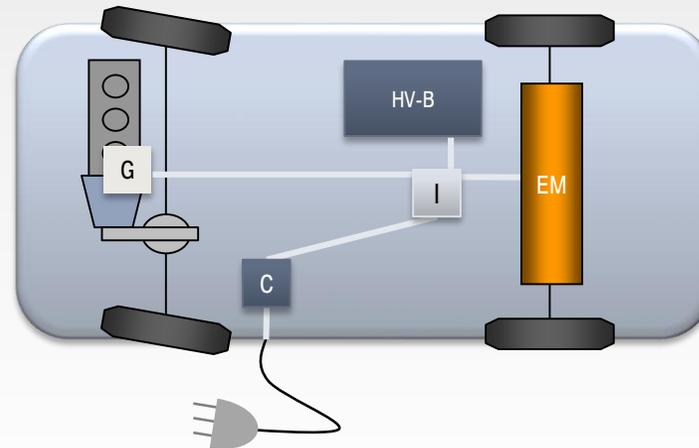
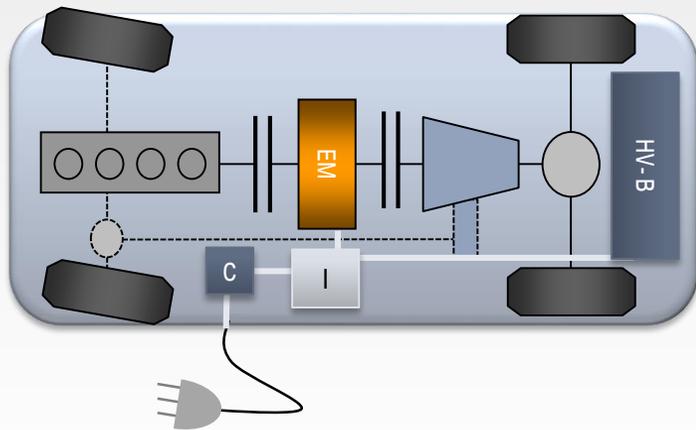
## PHEV (Plug-in Hybrid Electric Vehicle)

## BEV (Battery Electric Vehicle)

**PHEV**  
with coaxial hybrid system  
(BMW 740e, 330e, X5 40e, ...)

**PHEV**  
with electric drive axle  
(BMW i8, 225xe, X1 CN, ...)

**BEV**  
(with REX\*)  
(BMW i3)



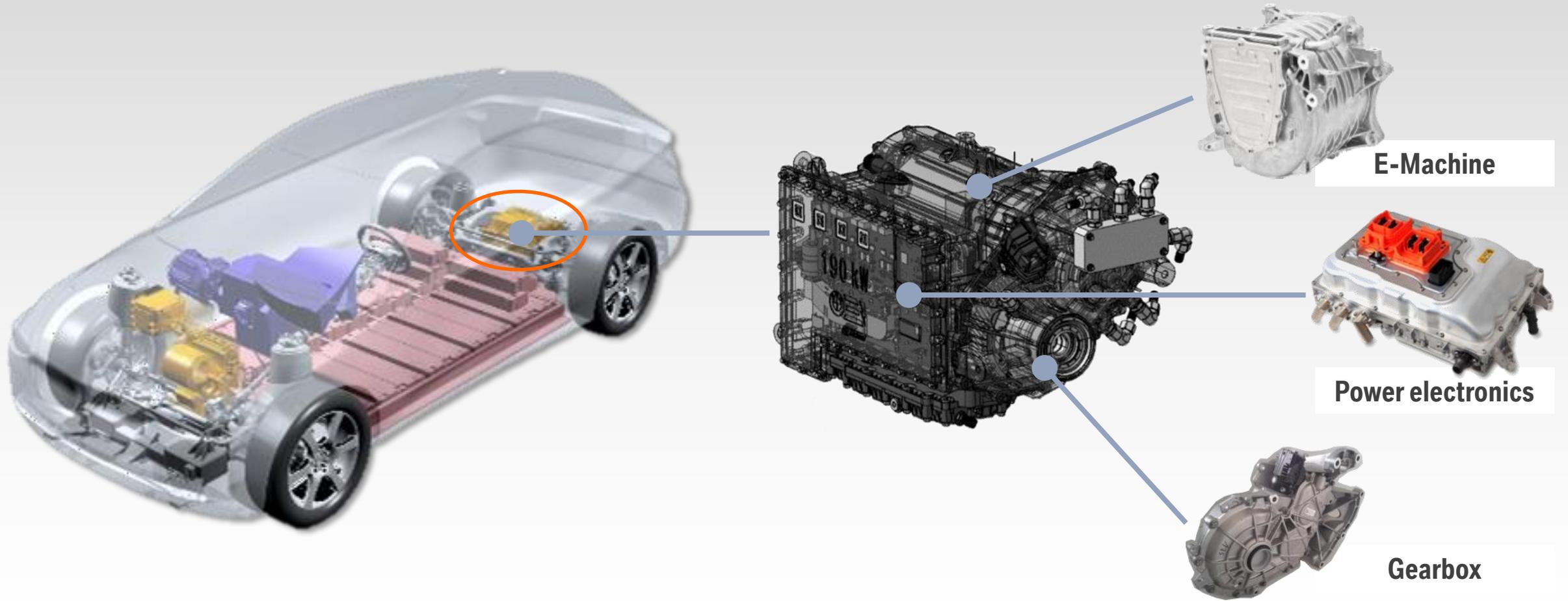
\*REX (Range extender) optional.

**Legend:** C Charger   G Combustion engine   HV-B High-Voltage Battery   G Generator   I Inverter   EM E-Motor   — Power path

# BMW GROUP BEV AND PHEV E-POWERTRAIN COMPONENTS.

							
	BMW i3	BMW i8	BMW X5 xDrive 40e	BMW 330e	BMW 740e	BMW 225xe	BMW X1 CN
Power Electronics							
E-Machine							
HV Battery							

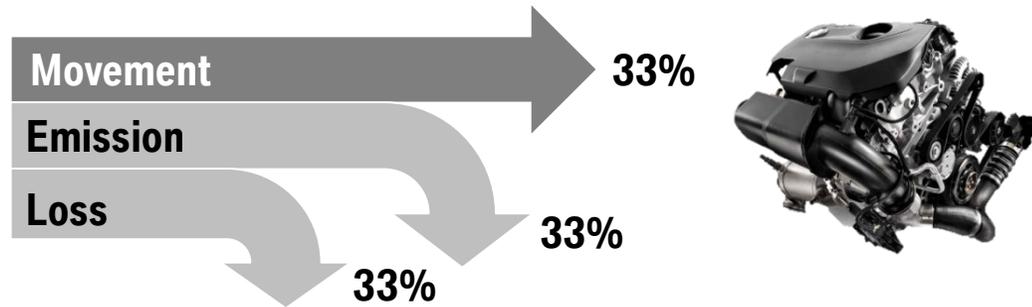
# BENEFITS HIGH INTEGRATION. FUTURE GENERATION OF E-POWERTRAIN.



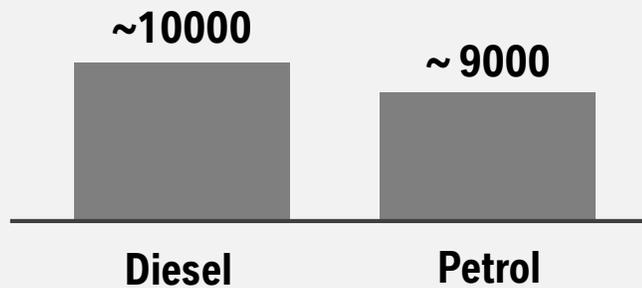
# ENERGY DENSITY HAS AN IMPORTANT ROLE IN THE SUCCESS OF ELECTRIC MOBILITY.

## Combustion engine

Efficiency [%]



Energy density [Wh/l]



## Electric powertrain

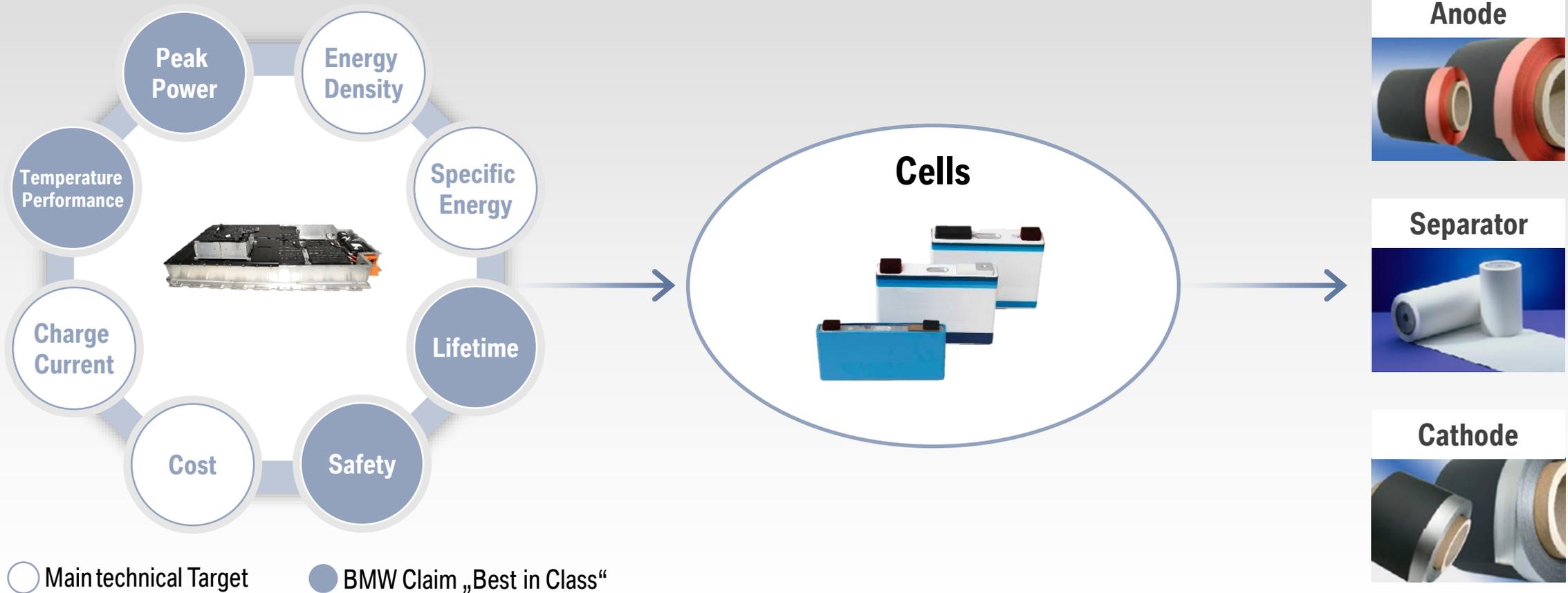
Efficiency [%]



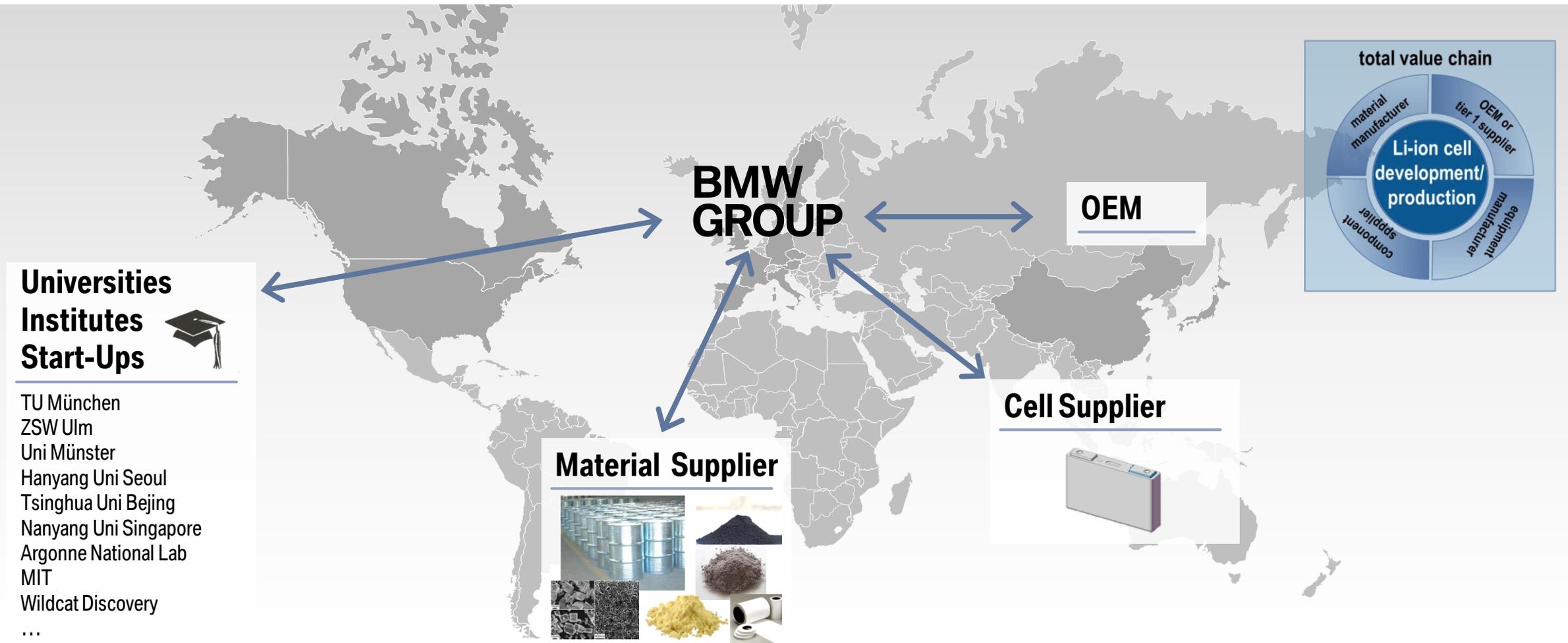
Energy density [Wh/l]



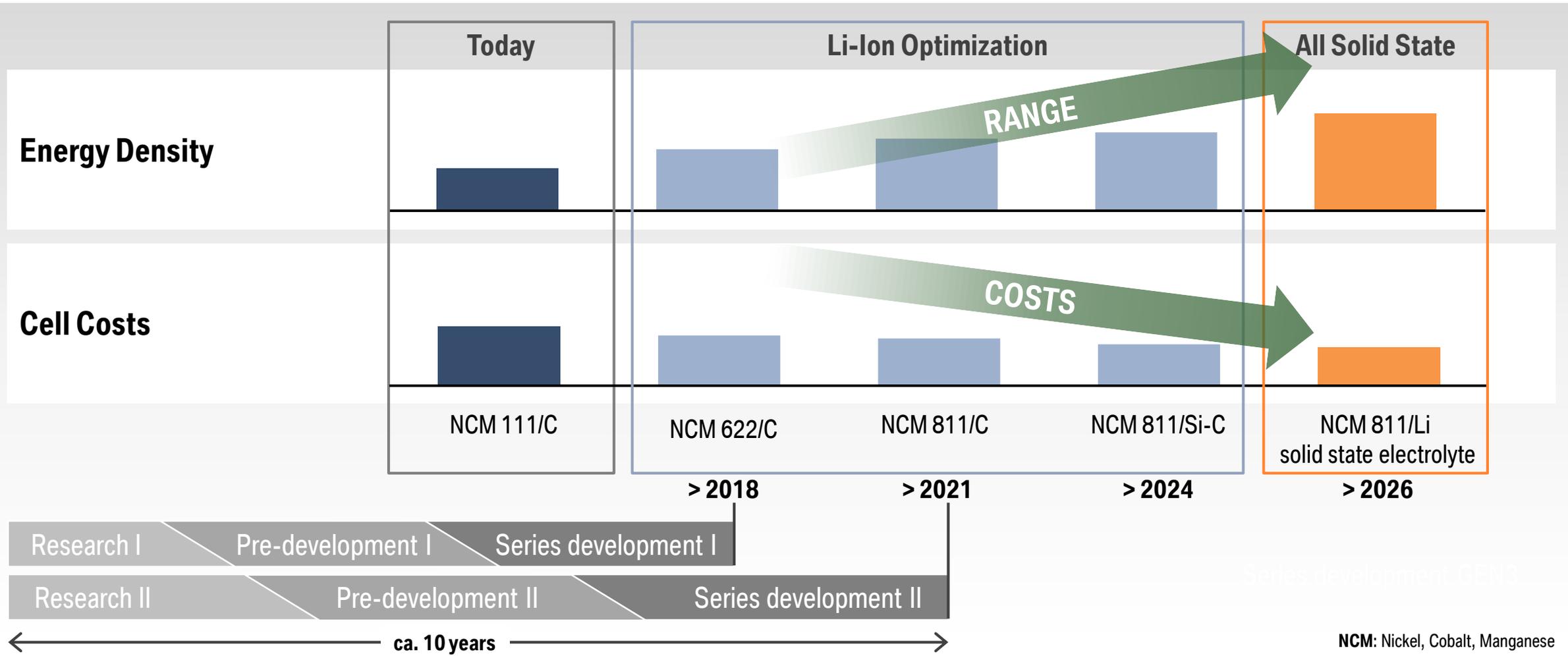
# CHALLENGE TO FULFIL ALL REQUIREMENTS. FROM BATTERY PACK LEVEL TO ACTIVE MATERIAL PROPERTIES.



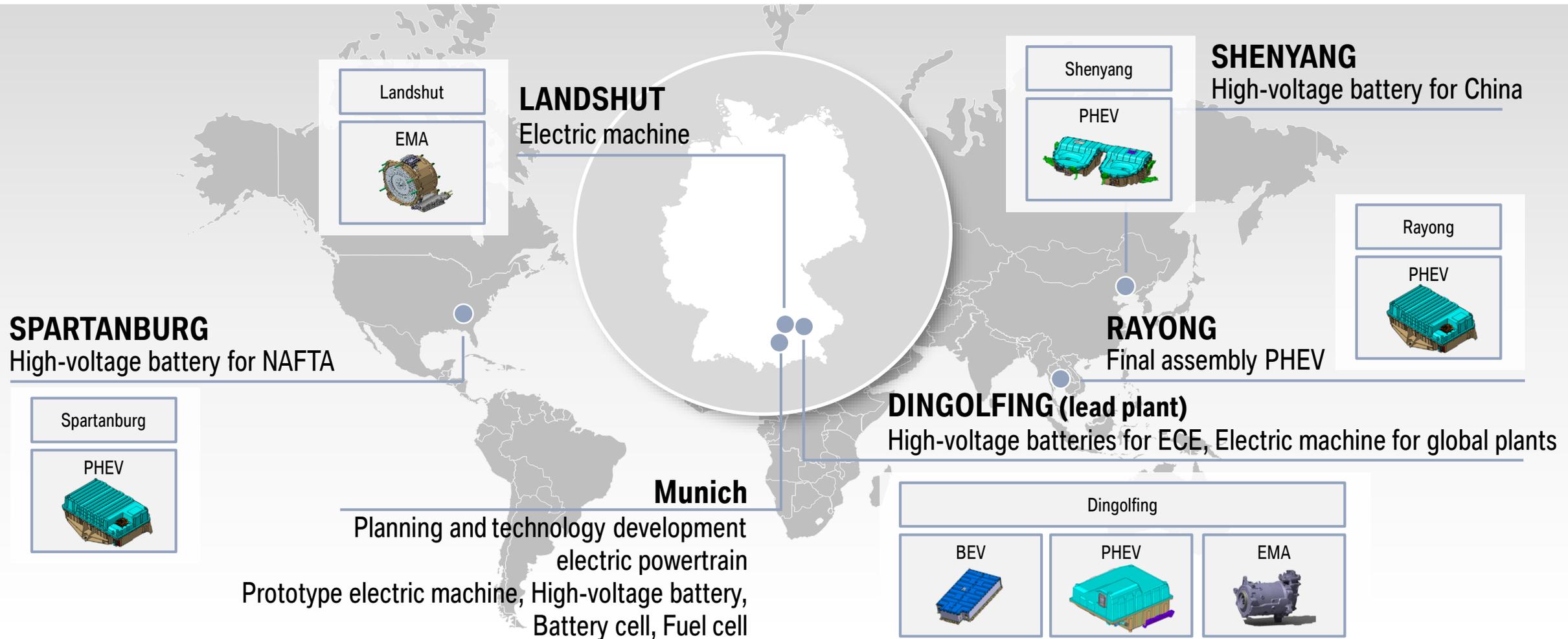
# BMW GROUP STRATEGY: GLOBAL NETWORK AND IN-HOUSE RESEARCH.



# MATERIAL DEVELOPMENT AND CELL ROADMAP.



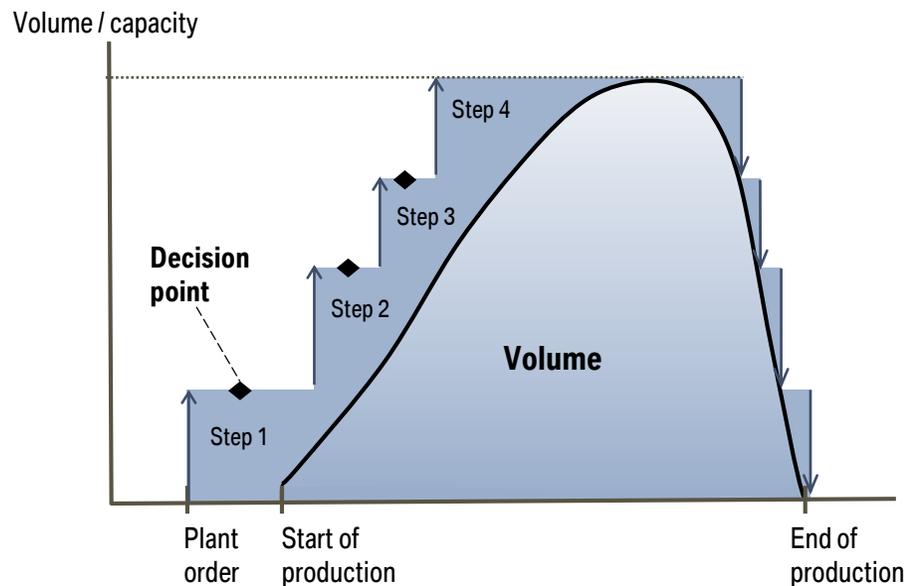
# PRODUCTION NETWORK WITH STRATEGIC EXTENSION OPTIONS ON THREE CONTINENTS.



# ADAPTIVE PRODUCTION SYSTEM FOR VOLUME-INDUCED CAPACITY.

## “Flexible response and speed“ in adaptive production system

### Volume induced capacity



- ✓ **Reaction time < 12 months**  
Doubling production capacity until peak-quantity
- ✓ **Minimal initial investment**  
Scalability with manual specification
- ✓ **Reduction of manufacturing costs and investments**  
Compared to predecessor
- ✓ **Significant cost reduction**  
Electric machine & High-voltage battery