

Technological breakthrough and the impact on the criticality of raw materials.



WE ARE DEVELOPING INNOVATION AND MOBILITY SOLUTIONS FOR THE FUTURE.

OUR ADVANCED TECHNOLOGIES OFFER INTEGRATED, CUSTOMER-ORIENTED, SUSTAINABLE SOLUTIONS.

Challenges



Technology Leadership / Openness




Significant progress could be achieved

- in conserving the ecosystem,
- in promoting e-mobility and autonomous driving,
- in optimizing solutions to the requirements of our customers,


by offering an expanded portfolio of drivetrains and adapting to specific situations.


We have accepted the challenges of future mobility as an opportunity for innovation in all key areas of our value chain.

THE POWER OF CHOICE - MODULAR DESIGN INCREASES THE POTENTIAL, ACCEPTANCE AND PROMOTION OF MOBILITY.





Combustion engines







Plug-in hybrid






Battery-Electric





Fuel Cell



ONE INTELLIGENT ARCHITECTURE FOR ALL DRIVETRAINS.

Modular Set A: - Energy Storage Device -

Gasoline Tank

+

-

 Battery

FC

 Fuel Cell

H₂

 Hydrogen Tank

Modular Set B - Powertrain -

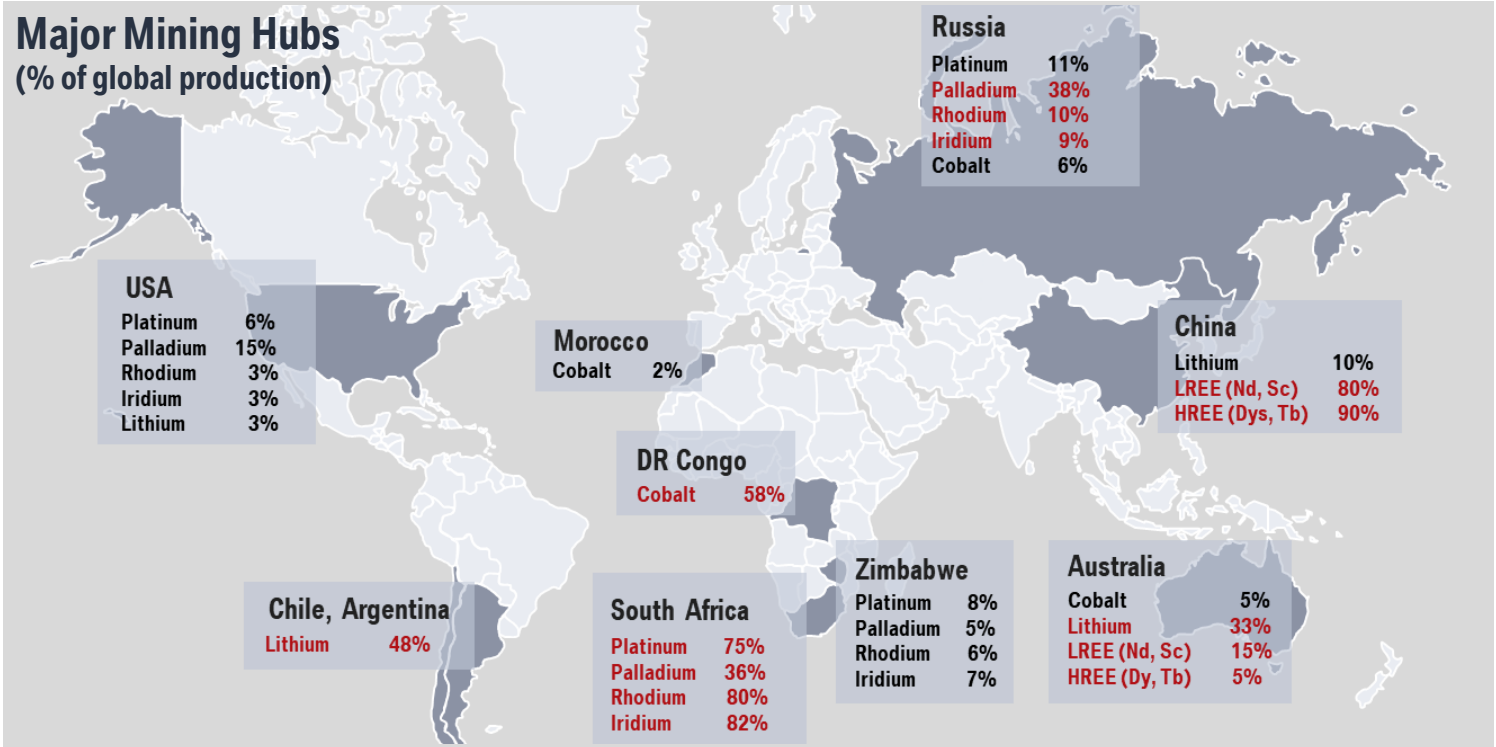
Internal Combustion Engine, Catalytic Converter

Electric Motor, Generator

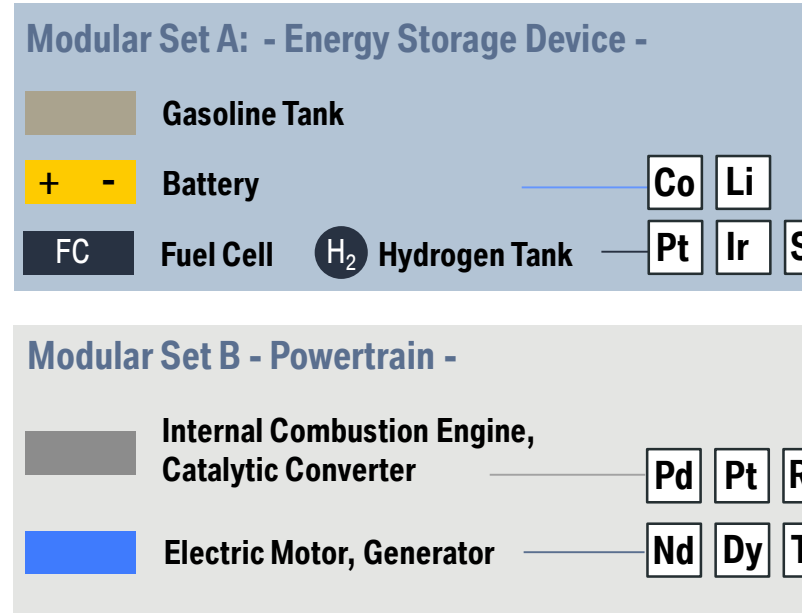
There is no universal solution covering the complete spectrum of customers' mobility needs, sustainability requirements and technological and economic constraints. Various alternative drive systems offer solutions for each situation.

CRITICAL RAW MATERIALS. WITH TECHNOLOGICAL DEVELOPMENT, THE IMPORTANCE OF HIGH-TECH MATERIAL IS GROWING.

Selected Critical Raw Materials for Energy Storage & Powertrains.

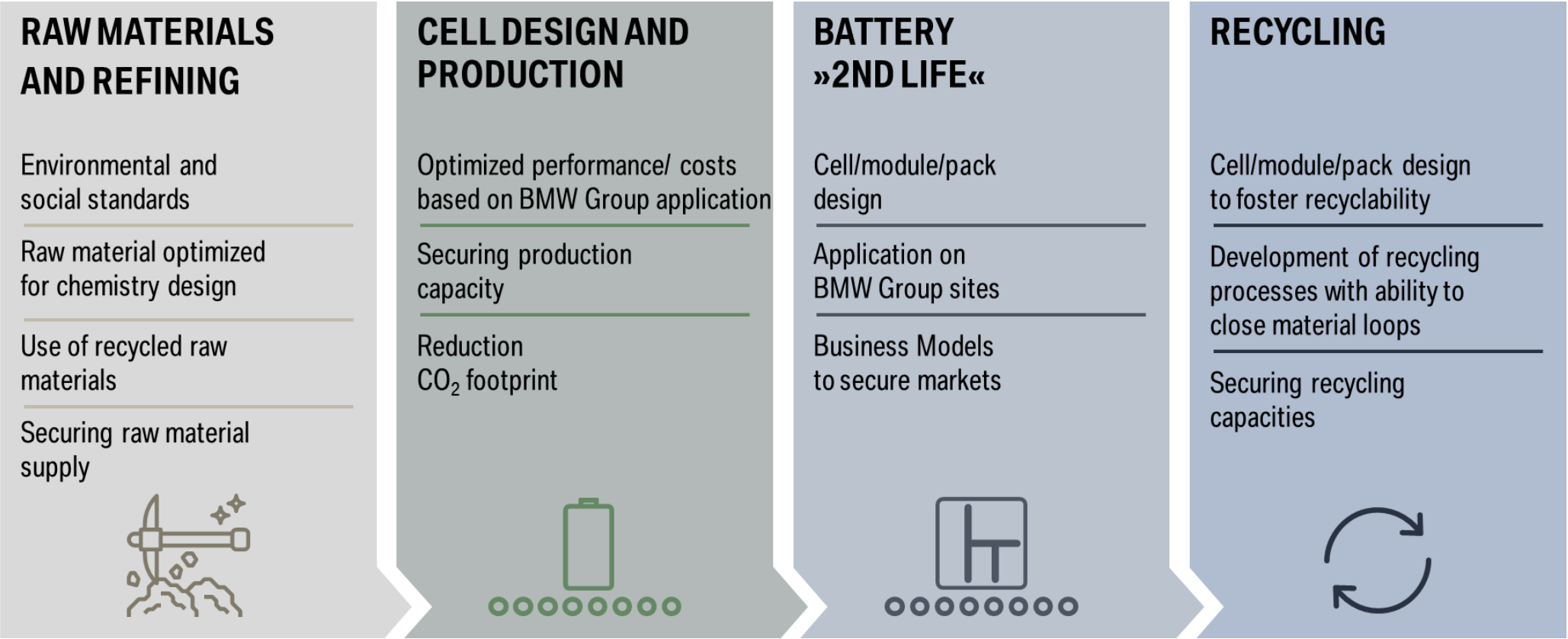


ONE INTELLIGENT ARCHITECTURE FOR ALL DRIVETRAINS.



The BMW Group develops and implements optimal strategies taking into account the demand for critical raw materials.

THE BMW GROUP IS STRONGLY ENGAGED ACROSS THE BATTERY VALUE CHAIN TO
MANAGE RISK OF CRITICAL MATERIALS AND SECURE LONG-TERM PROFITABILITY.



Integrated risk management approach has already been successfully implemented for Cobalt and Lithium.

HYDROGEN FUEL CELL POWERED VEHICLES ARE VERY PROMISING ADDITIONAL OPTIONS TO BATTERY-ELECTRIC DRIVE SYSTEMS.

Fuel cell module

FC

H₂

Why hydrogen will play a role in mobility 2030+

Key Perspectives

Customer

FCEVs are attractive for customers ...

- without charging possibility (home, work),
- with need for flexible usage,
- with high demand for availability.

Vehicles

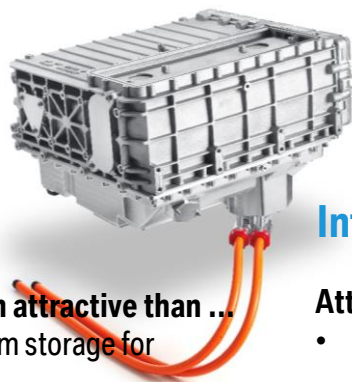
Advantageous in relation to

- high energy demand / throughput,
- large ranges and / or trailer operation,
- less weight compared to BEV.

Energy System

H₂ in the energy system attractive than ...

- transportable long-term storage for renewable energy,
- sector coupling energy system with buildings / industry / traffic.



Infrastructure

Attractive because

- Construction of H₂-Industry + fuel station network (state funding JP, CN, Ko, CA, D),
- Studies: H₂ fuel stations cheaper than extensive charging infrastructure.

“BMW i Hydrogen NEXT” (IAA Frankfurt, 2019)



The BMW Group is proving its competence and potential in hydrogen-powered fuel cell technology, thereby expanding its electrified vehicle portfolio.

ADVANCED DRIVE TECHNOLOGY BASED ON FUEL CELLS INCREASES FUEL OPTIONS. AVAILABILITY OF PLATINUM GROUP METALS IS CRUCIAL.

Fuel cell module

FC

H₂

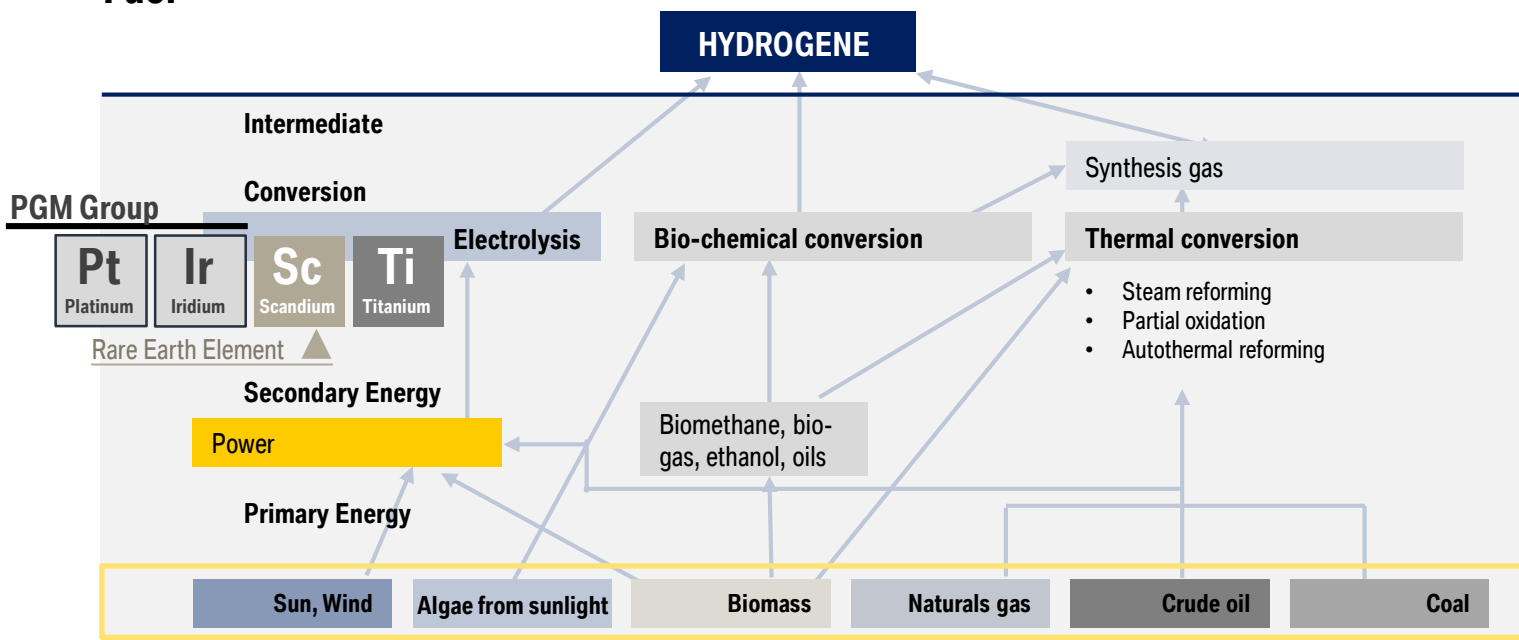
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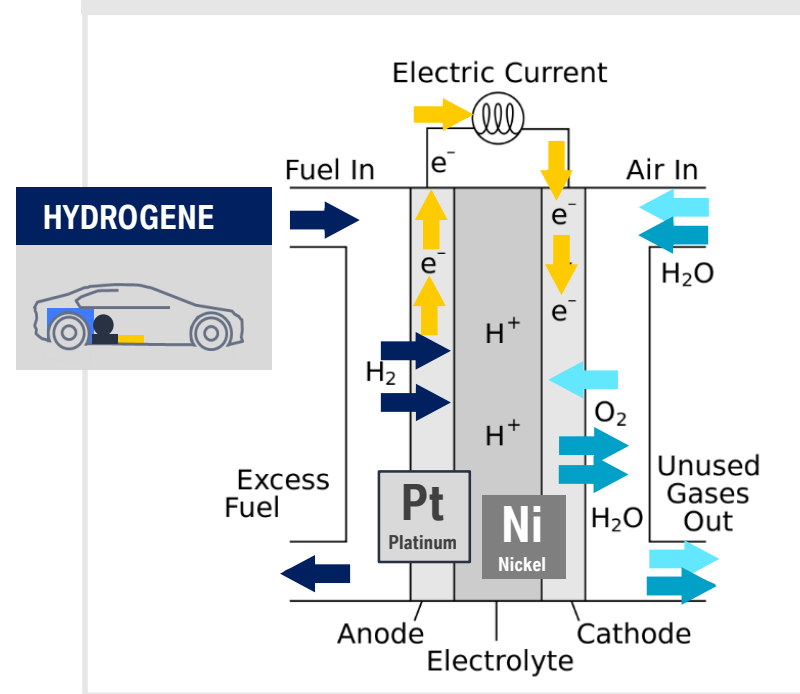
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Fuel



Fuel cell



Developing new technologies, criticality of raw materials as an important factor must be given special attention.

THE USE OF PLATINUM GROUP METALS SHOULD BE REDUCED AND AVOIDED IN NEW TECHNOLOGIES AS MUCH AS POSSIBLE .

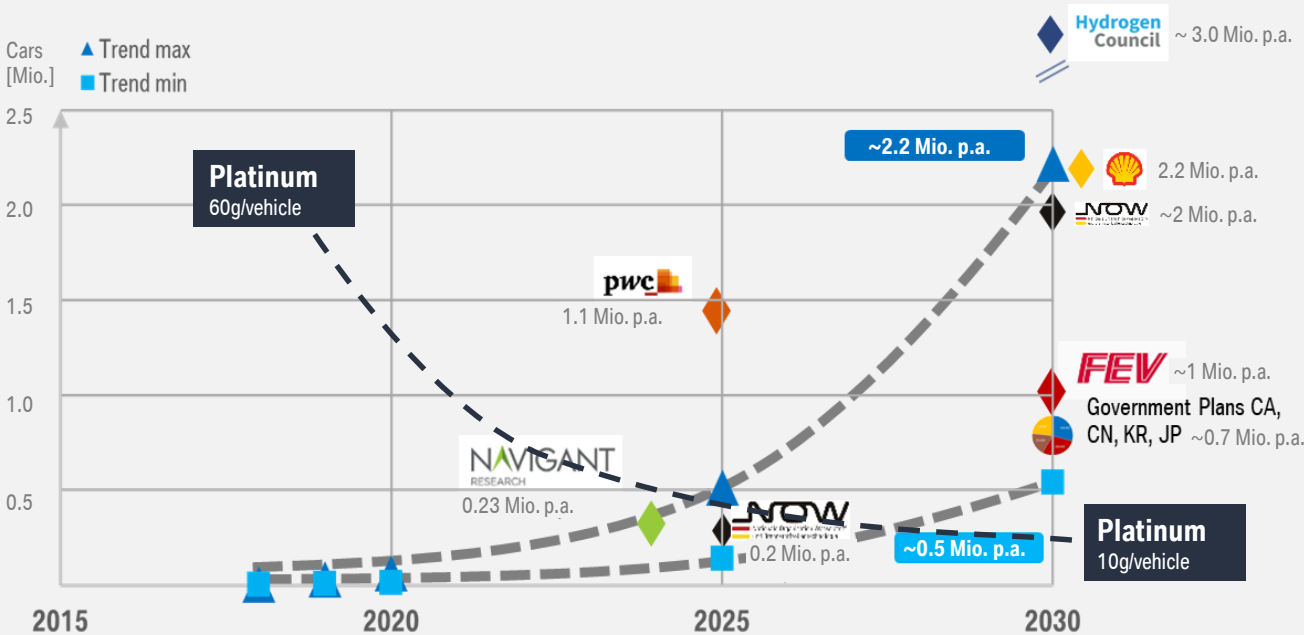
Fuel cell module

FC

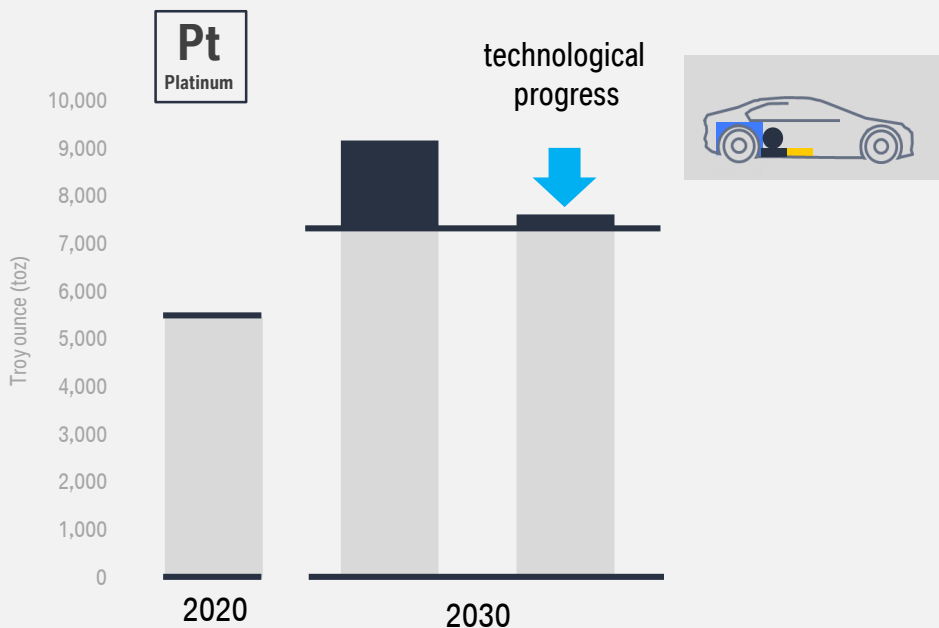
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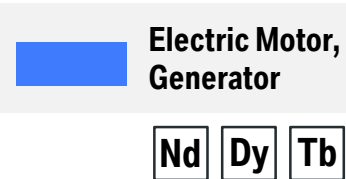
Worldwide FCEV New Car Sales trend p.a.



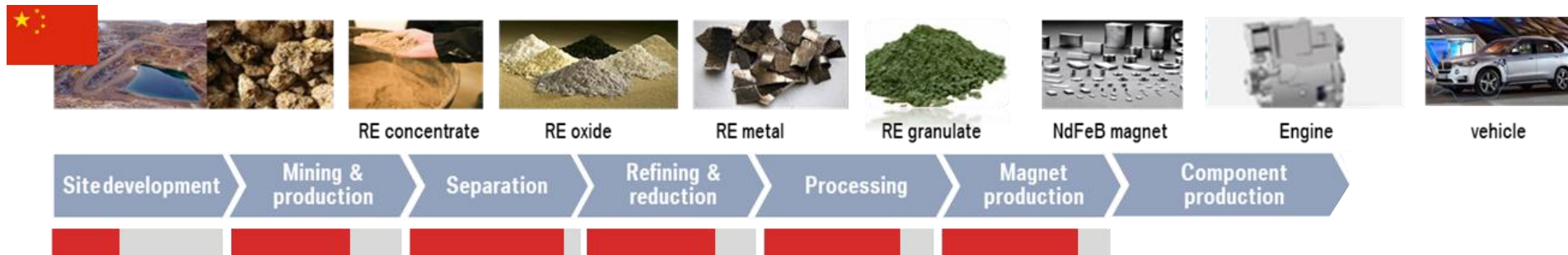
Platinum Demand (toz)



BMW GROUP - SOLVING CHALLENGES WITH INNOVATIVE SOLUTIONS. OUR 5TH GENERATION ELECTRIC DRIVETRAIN WILL BE **RARE-EARTH-FREE**.



Extraction and processing of rare earth elements in production of magnets.



Risk management through technological advances.

The BMW Group is systematically reducing its dependence on critical resources by introducing **relectric drivetrains free of rare-earth materials** (2020).

BY OFFERING “THE POWER OF CHOICE” THE BMW GROUP MEETS THE FUTURE REQUIREMENTS OF A SUSTAINABLE SOCIETY.



Challenges on the way to a sustainable future

- Find global solutions taking into account all relevant aspects.
- Openness to technological ideas and strategies.
- Cross-sectoral approaches and integrated solutions.

The BMW Group ensures product / technology leadership through

- Pursuing unbiased technological strategies and offering top products.
- Modular designs and customer-tailored solutions.
- Promoting sustainability in the supply chain. Active resource management.
- Close cooperation with our strategic partners