Available raw materials and resources used in electric cars

Outline

1. The criticality of resources: state of the art, concepts and limitations
2. What will be the major impacts of electric cars on future raw material demand?
3. Raw material supply risks for the mass deployment of electric cars
4. Conclusion and recommendations

The concept of criticality

12 principal studies
4 basic concepts
- supply/demand modeling
- multi-criterial assessments
- single risk indicators
- criticality matrices

Major limitations
- arbitrary use of methods
- no accounting for uncertainty

Source: Erdmann & Graedel 2011

Value chains
- 1970: federal government issue (Metallgesellschaft, Preussag)
- 2000: liberalisation und globalisation (e.g., NA)
- 2010: market distortions (e.g., Aurubis)

Public discourse
- BGR until 2008: base metals, supply & demand balance
- ISI/IZT study: minor metals, technological chance, market failure
  ⇒ emerging risks require new concepts

Raw material availability in transition

Raw material availability

IZT
Selected components of electric cars

traction motors  

Nd  Cu

supercaps  

Al

high performance batteries  

Co  Li  Pt

fuel cells

Critical raw materials for electric traction devices
Commissioned by VDMA to IZT (2010)

Scope

Components  Materials  Co  Li  Nd  Dy

Li-ion-batteries (cathode)  

LiCoO₂  X  X  

LiCoNiMnO₂  X  

LiFePO₄  X  

LiMn₂O₄  X

Electric machines (magnets)  

NIB traction motors (X)  X  X  

NIB wind power generators (X)  X  X  

NIB servo motors (X)  X  X

Time horizons: 2008, 2015, 2030

Key variables:
- technology demand accounting for future material efficiency
- various diffusion scenarios (IEA, McKinsey)

Dysprosium demand by electric cars

Emerging supply risks
Criticality of raw materials GER: commissioned by KfW to IZT (2011)

Main dimensions

market risk  

physical disruption  

import country risk  

home country risk

speculation  

natural  

strategic policy

land use competition

price increase and volatility  

supply break-down  

supply limitation  

supply limitation

Source: IZT/KfW 2011

Source: IZT/FVA 2011

vgl. 2030:
Nd: 0.9-1.6  
Li: 3.5-6.6  
Co: 3.7-1
Supply risks for electric car materials

Policy suitability screening

Conclusion and recommendation

Criticality assessment
- Global SCM to Europe essential (sensitivity, substitutability, future GVA)
- considerable short- and mid-term supply concerns (e.g., REEs)
- strong effort needed to ensure mid- to long-term supply (e.g., Cu)

Call for action
- coordinate efforts for resource efficiency (e.g. R&D, policies)
- improve assessment methodologies for criticality
- develop mass tailored policies