Challenges of materials security for the automotive industry
Current issues and outlook

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SUMMARY

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The future of our business is linked to resources

02 Evaluate the risk
Establish a criticality matrix to know your exposure

03 Develop a materials security strategy
Ensure the robustness of your supply chain

04 Take action
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05 Conclusions
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Main messages

- Automobiles are complex systems in terms of the elements contained, and thus highly exposed to materials risk.
  Zn, Ni, Al, Mg, *and then*: Li, Cu, Mn, Co, REE …

- These risks are multi-faceted:
  costs, availability, regulation, geopolitics

- Resource strategies to counter these risks are thus needed at technical, purchasing and public action levels

- Recycling will not be sufficient to meet demand

- Our interest & action must radiate up & downstream, worldwide
01

The context

The future of our business is linked to resources
The context is putting pressure on materials

Resources
- **Strategic metals & elements**
- **Limits on availability**

![Graph showing World Refined Copper Stocks & Prices and Market Balance (Jan 06 - Jun 07)](source: ICSG)

Materials price instability
- **Speculative markets**
- **Supply-demand balance**

![Graph showing price trends for USA and Germany with S$6 (Feb), S$67 (Mar), and S$10 (Mar)]

Rapidly evolving technologies
- **New demand for materials**
- **Constraints on production capacities**

Competitive international context
- **China & India**
- **Monozukuri**

Source: ICSG
Hot spots of our materials security

- **China & India**, and to some extent **Russia** will be major market drivers influencing materials availability & price

- Mining countries are realizing and setting up to use their **geopolitical leverage**; also, **corporate concentration** effects are increasing

- **New technologies** will create temporary but sudden shifts in demand

- **Costs linked to energy** and **externalities such as water & environmental (incl. CO₂) taxes throughout the materials supply chain** are on the verge of increasing drastically & will become a major constraining factor

- **Other national & regional governments** are moving faster /stronger and more pragmatically than the **EU** on their Raw Materials initiatives & policies
Our industries have become material addicts

We have steadily progressed towards an economy based on non-renewable resources

We’re running out of some (key) materials

Non-Fuel Mineral Resources
(Source: USGS Mineral Commodity Surveys 2007)

For materials such as Ga, Nd, In, Ge, Sc, Pt, demand linked to new technologies is expected to exceed current world production by a factor of **1.6 to 6** by 2030

Note: the diagram is based on reserve base & zero-growth demand

Sources: USGS 2007, Rohstoffe für Zukunftstechnologien*, Fraunhofer ISI, 2009
Energy is at the basis of our economy

Our energy comes from dead things
More than $\frac{3}{4}$ fossil fuels – for a long time ahead

Shares of energy sources in world primary demand by scenario

- **2008**
  - Coal
  - Oil
  - Gas
  - Nuclear
  - Hydro
  - Biomass
  - Other renewables

- **Current Policies Scenario 2035**
  - Coal
  - Oil
  - Gas
  - Nuclear
  - Hydro
  - Biomass
  - Other renewables

- **New Policies Scenario 2035**
  - Coal
  - Oil
  - Gas
  - Nuclear
  - Hydro
  - Biomass
  - Other renewables

- **450 Scenario 2035**
  - Coal
  - Oil
  - Gas
  - Nuclear
  - Hydro
  - Biomass
  - Other renewables

Source: World Energy outlook 2010
Major fossil fuel sources are under scrutiny
Peak oil will lead to peak-everything-else

World oil production by type in the New Policies Scenario

- Unconventional oil
- Natural gas liquids
- Total crude oil
- Crude oil - fields yet to be developed or found
- Crude oil - currently producing fields

Source: World Energy outlook 2010
Water stress is already a reality
Evaluate the risk

Establish a criticality matrix to know your exposure
Economic impact of CO₂, energy, water in raw materials will drastically increase by 2020

<table>
<thead>
<tr>
<th>Resource</th>
<th>2020 Expected change (upper/lower)</th>
<th>For R sales of 2.3 Mveh</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 tons CO₂</td>
<td>100 € / ton CO₂ = 606 M€</td>
<td></td>
</tr>
<tr>
<td></td>
<td>32 € / m³ H₂O = 194 M€</td>
<td></td>
</tr>
<tr>
<td>300 m³ H₂O</td>
<td>+50% = 172 M€</td>
<td>+50% = 292 M€</td>
</tr>
<tr>
<td></td>
<td>+20% = 69 M€</td>
<td>+20% = 118 M€</td>
</tr>
<tr>
<td>12,5 MWh energy</td>
<td></td>
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<tr>
<td>WE energy mix</td>
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</tbody>
</table>

380 M€ to 1070 M€ total impact on materials cost throughout our supply chain

For R sales of 2.3 Mveh
Critical elements for the EU
(EC RM Initiative macro-economical approach, multi/megasectors, July 2010)
China & India will change the balance

Since the early 2000s China has driven a policy to promote OFDI flows under the title of “go global” (zou-chu-qu – literally “go out”)

OFDI = outward foreign direct investment
03

Develop a materials security strategy

Ensure the robustness of your supply chain
Dematerialization: is it a reality…

Source: Prosperity without growth, a report by T. Jackson, UK Sustainable Development Commission, 2009

CO₂ emissions
1980: 1000 g/$
2006: 770 g/$
… or a myth that we need to turn into reality

Source: Prosperity without growth, a report by T. Jackson, UK Sustainable Development Commission, 2009

CO₂ emissions
40% more in 2009 than in 1990 (Kyoto protocol)
Our industries are at a turning point
This will require new business creativity

Material costs:
43% of total production costs, cf. 1.8% energy
(Germany, 2006)

Source: G. Angerer et al., Rohstoffe für Zukunftstechnologien", Fraunhofer ISI, 2009
Criticality analysis & consequences

- Speculative price impacts
- Production bottlenecks
- Trade restrictions
- Externalities (resources, emissions)
- Limits of availability
- ELV materials flows

- Cost of business, COP
- Production continuity
- Geographic availability
- Reduce the footprints
- Need for substitution
- Involvement in 3R loops

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DREAM / DIMat – P. Kim

2011-01-27

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3R must be at the base of our engineering design practices

34 kg of plastics in the latest Renault models are recycled.

- How far can we go?
- What if everybody does it?
Raw materials risks:
multi-dimensional problems require multi-modal action

- Any weak link in your supply chain constitutes a risk
  ensure that your suppliers have sustainable practices

- Implement resource strategies at technical, purchasing, management and public action levels
  coordinated mobilization is the key

- Recycling will not be sufficient to meet demand
  develop a range of measures

- Our action must radiate up & downstream, worldwide
  coordinate regional action with main industry sectors,
  take good measure of the R/O global sourcing & production,
  develop life-cycle schemes and green CAPEX
Corporate design for sustainability: beyond eco-design
Corporate security calls us to design for sustainability

Know & master stocks & flows

- Find more
- Substitute
- Recycle
- Reduce
- Do without

Aim for a closed system ➔ “3R loops”

Design for materials efficiency
04

Take action

Join forces to increase your leverage
Orientations for solutions

**Technical**
- Technology choices based on stronger resource intelligence
- LCA-based technical strategies for improved materials efficiency
- R&D to promote substitution and recycling
- Green CAPEX

**Others**
- Mobilize your community
- Long-term contracts and sustainability pacts
- Global design of our sourcing / supply chain
- Partnerships and leverage through associations
Consequences on R&D management

- Build a more integrated picture to model the future with *scenarios* for the mid & long term
- Step up *corporate* implication in the public domain, to solve “big” problems
- Re-define *Design for Sustainability* to include long-term business continuity
Our product strategy – such as Renault EV – can not be dissociated from a resource security strategy

Renault, a people-centric and innovative Company, offering sustainable mobility for all
Conclusions

... and recommendations
Conclusions & recommendations

- Recycling schemes must be considered in the framework of LCA and stocks & flows— but **recycling will not be sufficient to meet demand**

- Know & control materials costs & **risks** (3 Rs, substitution & diversification) within a context of competition on the materials market

- Know the environmental impacts and factor **externalities** into the evaluation of future cost evolutions

- Reinforce corporate as well as government **R&D** to improve performance **for materials efficiency**

- Develop integrated downstream business concepts, and launch stronger **industry partnerships with a more pronounced long-term component**
The future of our business is linked to resources

Energy

Minerals

Water

Source: Petroconsultants, Materials in the economy, USGS 1221-508 (2002), & UNEP
Thank you for your attention
Recommended readings

- L. Brown, Plan B 4.0, 2009
- T. Graedel & E. van der Voet, eds., Linkages of Sustainability, MIT Press, 2010
- J. Morrison et al., Water Scarcity & Climate Change: Growing Risks for Businesses & Investors, the Pacific Institute, A Ceres Report, 2009