European Commission

Improving materials resource management through optimized waste prevention, reuse and recycling, with special emphasis on critical materials

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Joint Research Centre

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Background

Viewing angle departs from waste

Production of waste still increasing

Emerging resource challenges for critical raw materials

Aims

Build model for quantifying environmental and economical impact of changing prevention, reuse and recycling

Scope

Classic materials:

- Al, glass, paper, etc

Emerging materials:

- indium, beryllium, rare earths

Execution

Initial phase in collaboration with consultant (BIO IS/Eunomia)

Data and model to be used for future modelling and policy support (INPUT OUTPUT modelling)

Task 1

Screening for key waste streams on criteria

- Relevance
- Potential for improving waste prevention & management
- Resource substitution
- Environmental benefit of recycling
- Other criteria for critical raw materials (e.g. geopolitical)

Ranking to be made according to potential for improving resource management

Task 2

Building a model

- All material flows from mining to recycling to be mapped
- Flows completed by other data
  - Energy
  - Commodities
  - Capital investment
  - Value added and employment
  - Emissions
  - Environmental impacts
  - Origin info of flows

Link to input-output model

Task 3

Scenario analysis

- A) Current situation
- B) Full implementation of existing policies on r.m. and waste
- C) Broad implementation of best practices

By means of model check impact of changes linked to above scenario’s on economy and environment

Sensitivity analysis (what if material demand changes)?

Timeline

- Project started beginning 2012
- Task 1 finished
- Task 2-3 under development
- Expert consultation end November 2012
- Project completion 1Q2013

Results

Task 1: Ranking and prioritization: CRITICAL

High
Gallium
Indium
PGMs (Platinum Group Metals)
Rare earths
Subgroup: Rhodium
Subgroup: Dysprosium

Medium
Antimony
Magnesium
Niobium
Tantalum
Tungsten

Low
Beryllium
Cobalt
Fluorspar
Germanium
Graphite
Subgroup: Ruthenium

Results

Task 1: Ranking and prioritization: materials retained for modeling

Rare earths: high waste generation, low recycling, low resource substitution rate (secondary materials for virgin materials), 100% import dependency, secondary market price aligned with virgin market price, high future growth rate of demand, high geo-politically caused scarcity, high potential to increase substitution of secondary materials for virgin materials.

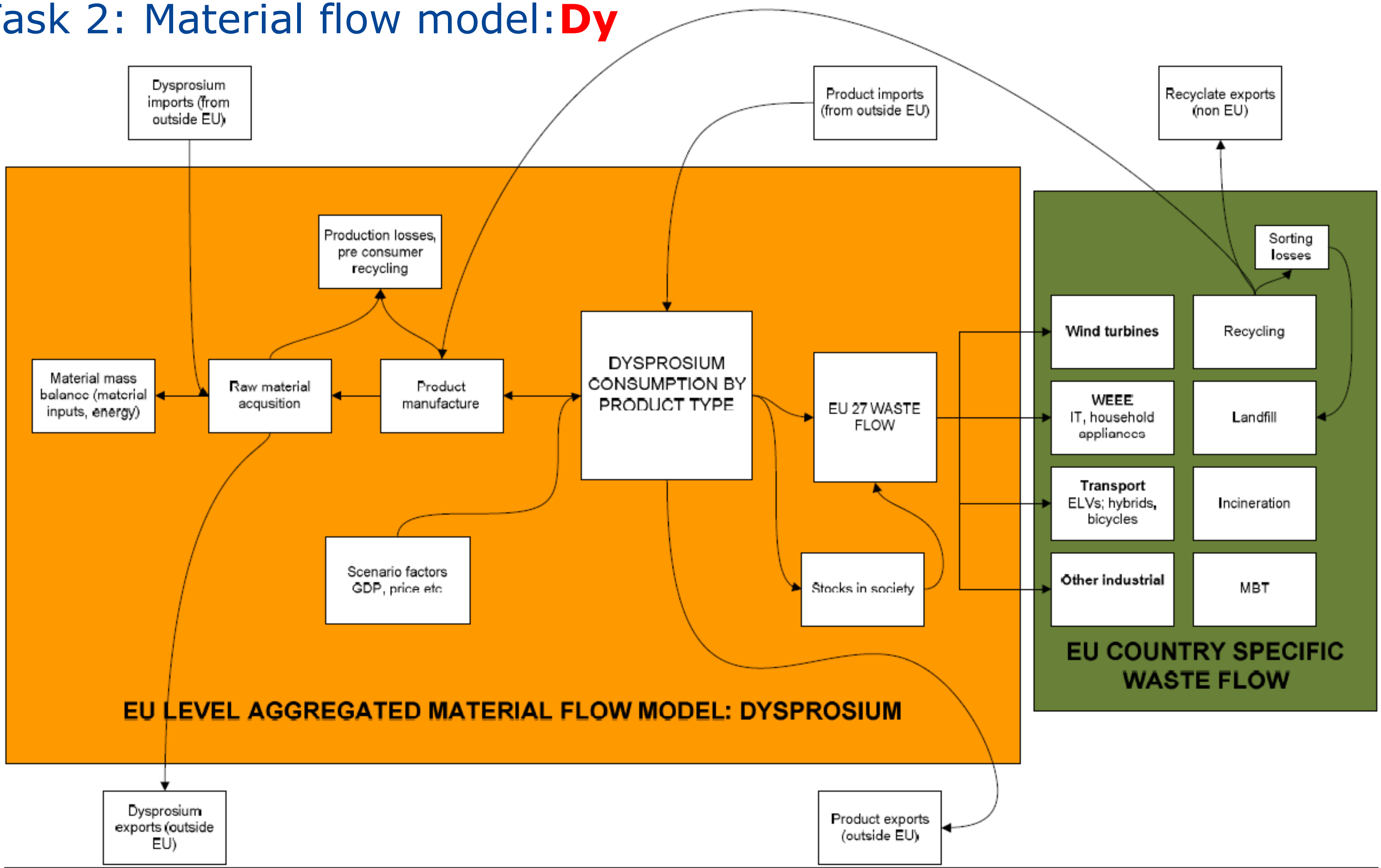
Subgroup – ***Dysprosium***: diverse use, distinguished as critical by expert partners

Note: Dysprosium use

- Wind turbines constructed using the newer direct-drive turbine technology, particularly favoured for offshore installations
- The Neodymium Iron Boron (NdFeB) magnets within computer hard drives (use is not considered to be essential);
- Electric bicycles (approximately half contain dysprosium);
- Electric and hybrids cars (almost all of these have motors which contain dysprosium);
- Some large electrical appliances such as air conditioning units and fridges, freezers and washing machines (data on quantities used are highly uncertain)
- Other industrial machinery that uses permanent magnets;
- Some multimedia equipment such as loudspeakers as well as DVD players.

Results

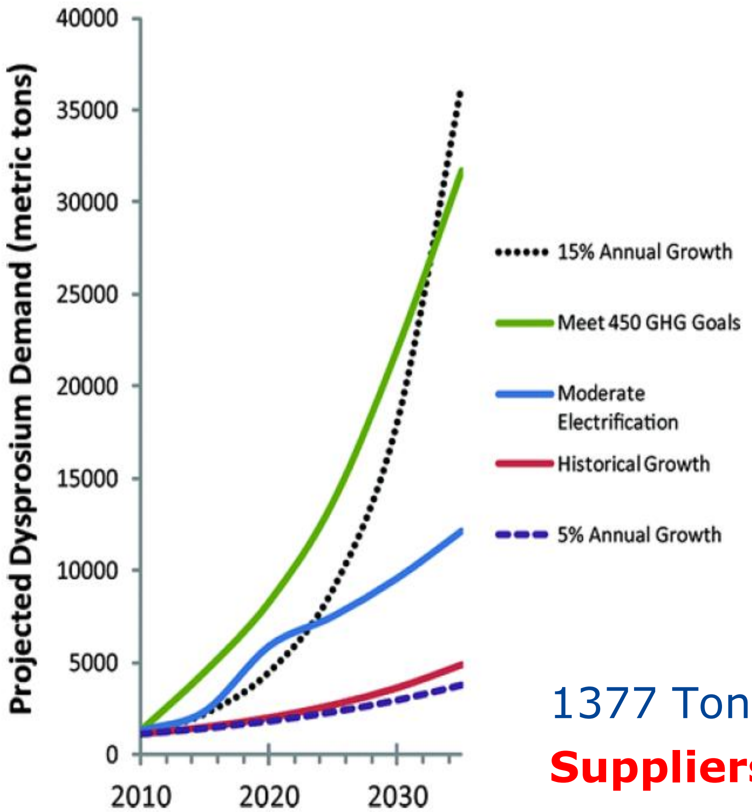
Task 2: Material flow model: Dy



Scarcity of Dysprosium

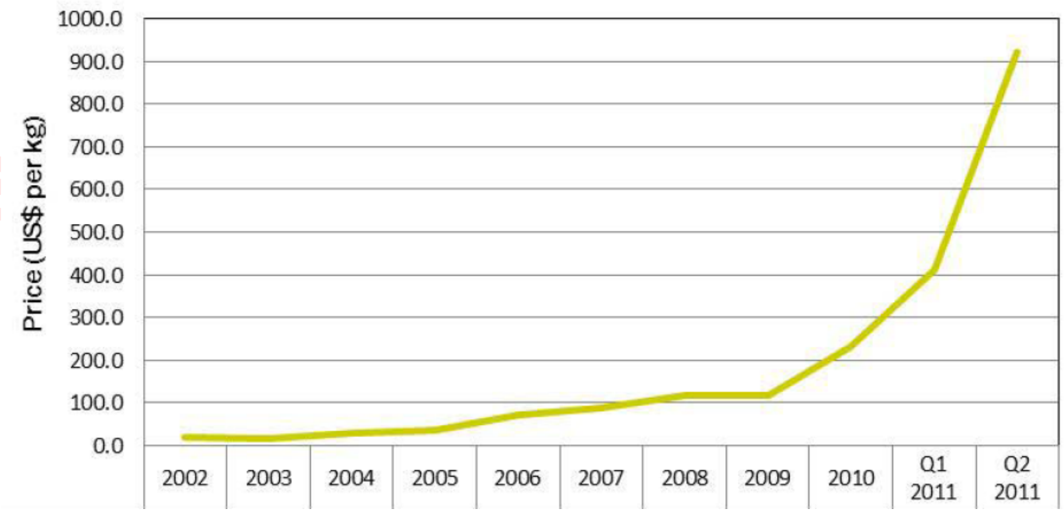
Projected **Demand** evolution

(Source; Alonso et al., ES&T)



Historical **Price** evolution

(Source: British Geological Survey)



1377 Tonne produced in 2010

Suppliers:**China (97%)**, India (2.2%), Brazil (0.53%)

Scarcity of Dysprosium

Global initiatives against dysprosium scarcity:

- The opening of new mines and the re-commissioning of mines which were forced to close when prices were low (e.g. Mountain Pass in the USA);
- Increased research and development – both private and public – to reduce/eliminate the use of dysprosium; and
- Improved recovery and recycling of dysprosium

Example case Japan:

- High consumer and at high risk of supply (political issues with main supplier China)
- Launched a 50 M€ campaign, hoping to reduce domestic Dy use by 30%

Modelling scarcity of Dysprosium in EU

- Model currently under development, only in initial stage
- Major usable variable = price (rather inelastic due to limited alternatives)
- Price/supply fluctuations can be tackled by different strategies with clearly different environmental impacts (e.g. additional mining vs. recycling efforts)
- Recycling/recovery efficiency of dysprosium may compete with that of other materials
- Influence in economic INPUT-OUTPUT model: relatively low monetary value, but can cause rather important changes due to high price inelasticity (e.g. certain economic sectors threatened by supply shortages/cuts)

Conclusions

- Rare earths as critical raw materials show highest potential for improved resource management
- Dysprosium selected for case study
- Optimization depends on chosen priorities (economic and environmental) and chosen policies

SPC Waste group Contact

Info on Waste activities JRC IPTS

http://susproc.jrc.ec.europa.eu/activities/waste/index.html