


European industry dependence on critical raw materials

- Energy Sector -



14th May 2014

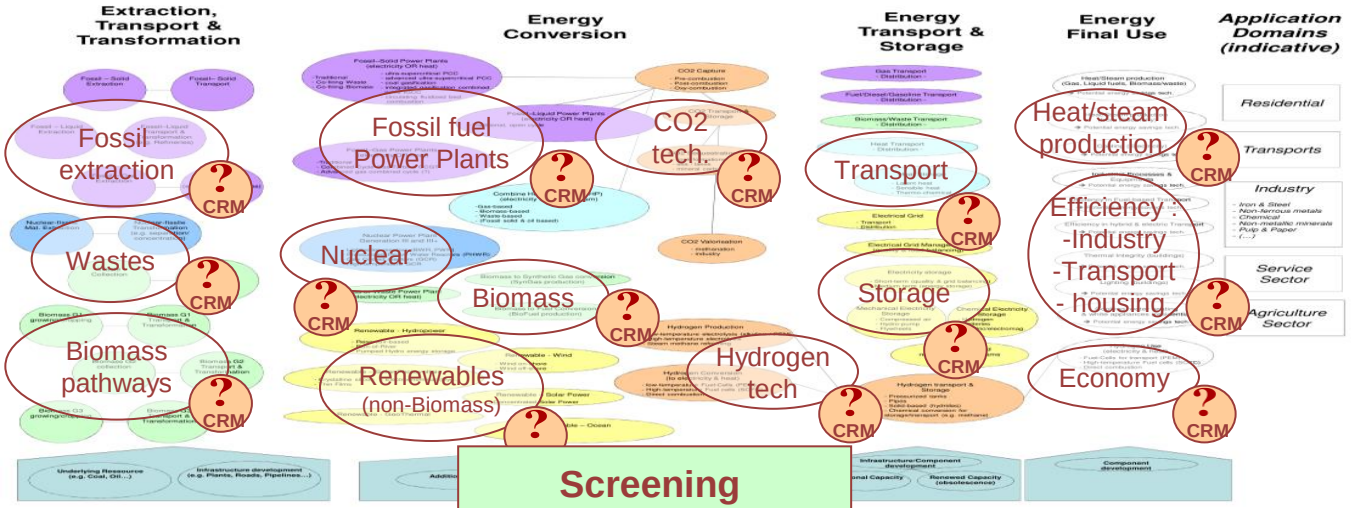
Aymeric BRUNOT – CEA
aymeric.brunot@cea.fr

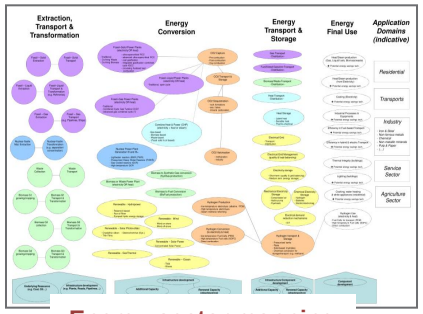
SEVENTH FRAMEWORK PROGRAMME

CRM_InnoNet
Substitution of Critical Raw Materials

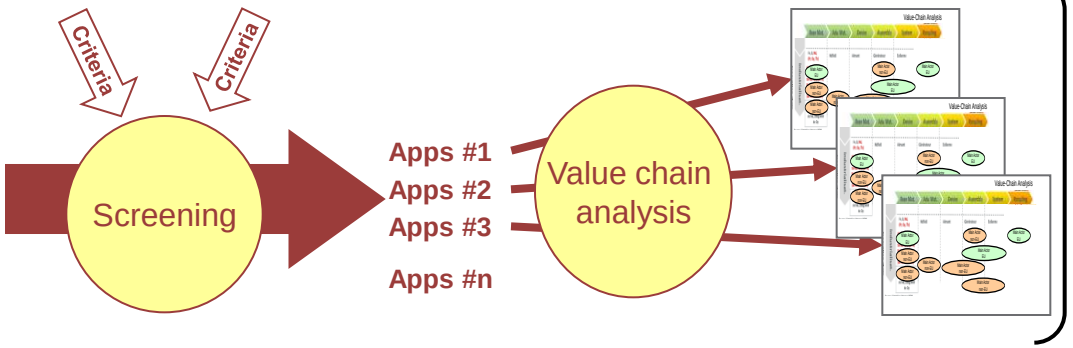
Challenges

- Energy sector is *broad* – with lots of technologies & actors





Energy sector mapping



Understanding of economic importance for EU & risks related to CRM

Screening

- Criteria used for energy application screening

EU « Strategic Energy Technologies»
(2011 Tech. Map SET-Plan)

1. Wind power
2. Solar PV
3. Concentrated Solar Power
4. Hydropower
5. Geothermal
6. Marine energy
7. Cogeneration & CHP
8. Carbon Capture & Storage
9. Advanced Fossil Fuel power gen.
10. Nuclear fission
11. Nuclear fusion
12. Smart grids
13. Bioenergy – power & heat generation
14. ~~Biofuel for transport~~
15. Fuel cells & Hydrogen
16. Electricity storage (+ more general)
17. ~~Energy-efficient & CO2 emission red.~~
18. ~~Energy performances of buildings~~

Strategic importance for Europe (future-oriented)

Dependance on materials potentially « at risk »

Economic importance for Europe (present-oriented)

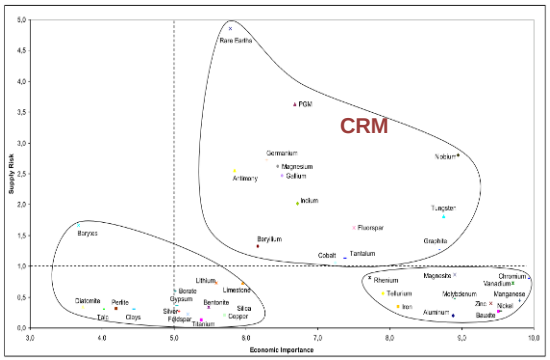
Public Market Information

Analyst reports

Eurostat Database information

European 14 « CRM »
(2010 Ad-hoc Group)

Antimony	Indium
Beryllium	Magnesium
Cobalt	Niobium
Fluorspar	PGMs (Platinum Group Metals)[1]
Gallium	Rare earths[2]
Germanium	Tantalum
Graphite	Tungsten



Further simplification :
- Technology focus, link to other sectors (e.g. transports)

Screening : Selection of applications for further study

		CRM Use ? (e.g.)	Potential economic weight (order of mag.)
Wind power		⚠ Permanent Magnets	€€€
Solar PV		⚠ Active Materials	€€€
Concentrated Solar Power		✓	
Hydropower		✓	
Geothermal		⚠ Alloys Casings	€€
Marine energy		✓	
Cogeneration & CHP		⚠ Alloys	€€€
Carbon Capture & Storage		⚠ Alloys	✗
Advanced Fossil Fuel power gen.		⚠ Alloys	€€€
Nuclear fission		⚠ Control Rods	€€ / €€€
Nuclear fusion		⚠ ?? Shields	✗
Smart grids		✓ (Transport)	
Bioenergy – power & heat		⚠ Cf. fossil	Cf. fossil power gen.
Fuel cells & Hydrogen	Electrolyser Fuel Cells	⚠ Active Materials	€€
Electricity storage	Accumulators, Flywheel, magnetic/SMES,	⚠ Acti mat. Alloys	€€€ Accumulators
	Pumped hydro, CAES, supercapacitor	✓	€ Flywheel, magnetic/SMES

PRIMARY FOCUS

Wind Power

Photovoltaic Power

Electric Accumulators

SECUNDARY

Advanced power& cogen plant

€€€ >1b€

€€ 100s M€

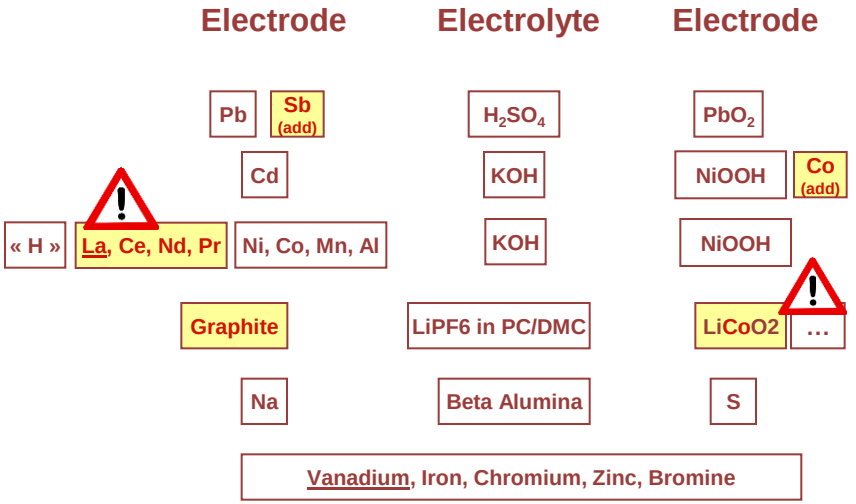
€ 10s M€ or less

SEVENTH FRAMEWORK PROGRAMME

CRM_InnoNet
Substitution of Critical Raw Materials

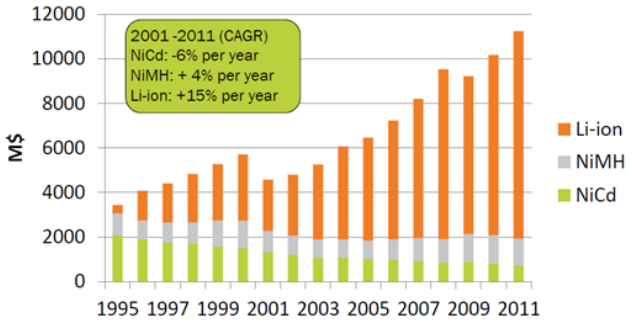
Detailled analysis – Battery illustration (1)

- Analysis of CRM challence for batteries :
  - Lead-acid batteries
  - Ni-Cd batteries
  - Ni-MH batteries
  - Li-ion batteries
  - NaS batteries
  - Redox-flow batteries

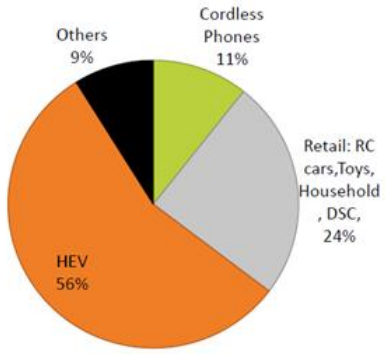


- Analysis of need & technology dependence

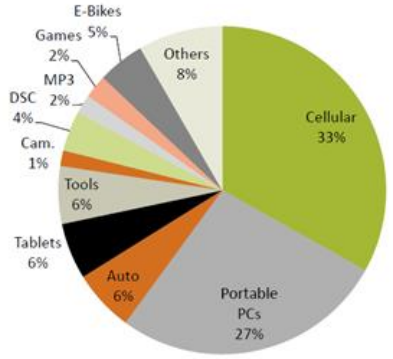
Worldwide battery sales by Chemistry (M$)



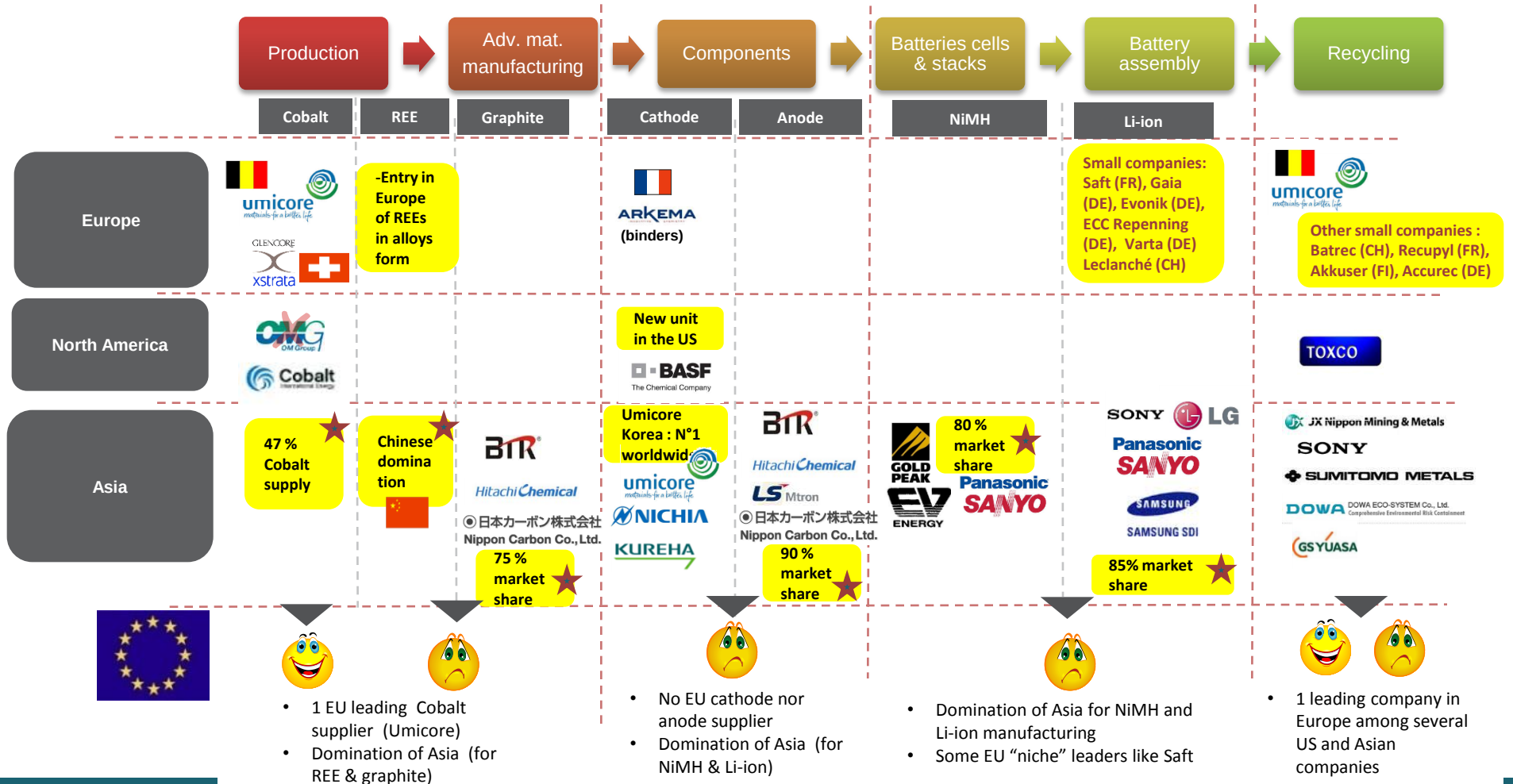
NiMH battery by application in 2011 (% in value)



Li-ion battery by application in 2011 (% in value)

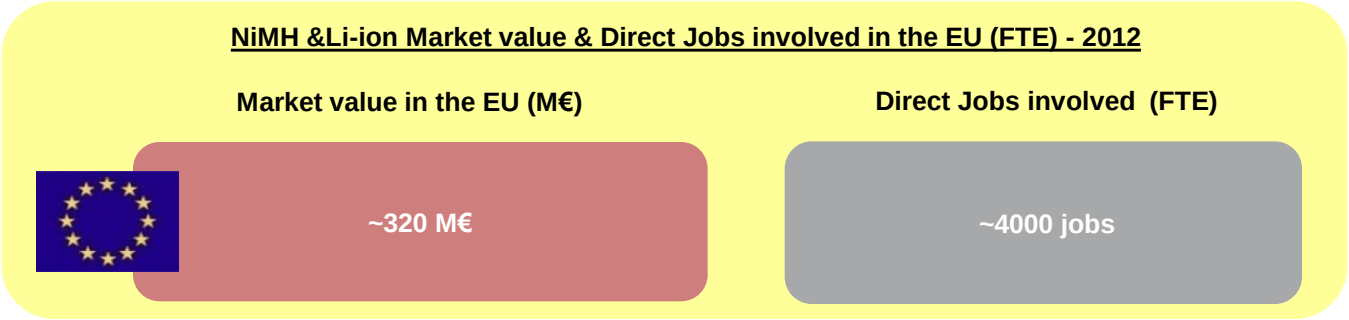


Detailled Analysis – Battery Illustration (2) – Value-Chain



Batteries – Main Conclusions

- NiMH & Li-ion are both CRM dependant
- NiMH is still present, but with decreasing market value
- Li-ion is the key technology for future battery market, with huge potential linked to the transportation sector
- However, EU battery industry is limitted in size, and there is strong dependance towards Asia
- Active research in EU may spawn new Li-ion technologies in EU



Can be matched against the economic weight for EU of other CRM-containing applications…

Conclusions – The case of Wind Energy

- Important existing and future needs for wind energy technologies
- CRM-dependant technologies (hybrid, direct-drive) are great facilitators, and even enablers for off-shore deployment
- EU has a strong positionning in the end of the value-chain: component, systems…
- But rely heavily on supply for CRM-based permanent magnets from abroad !!
- Economic & employment risk related to CRM is significant

Market value direct drive turbine in the EU* - 2012 (M€)

- **Total European wind energy market was 9-15 billion€ in 2012 of which 1400-2200M€ may related to direct drive wind turbine technology***
- **The revenue growth rate 2010-2017 is medium with a CAGR of 12%**
- **High growth rates between 2012 and 2015 are expected due to offshore wind developments**

~1400 - 2200 M€

Estimation of direct Jobs involved in the EU (FTE) - 2012

Wind power
~102 000 – 135 000 FTE

Wind turbine and component manufacturers
~60 000 – 80 000 FTE

Wind direct drive turbine *
~9000 – 12 000 FTE

*Assumptions: 40 % of the market value is captured by wind energy developers and 60 % by wind turbines and components manufacturers.
Revenues and direct jobs related to wind turbine direct drive industry is about 15 % of the global wind turbine industry (average EU JRC and Research and market scenarii;

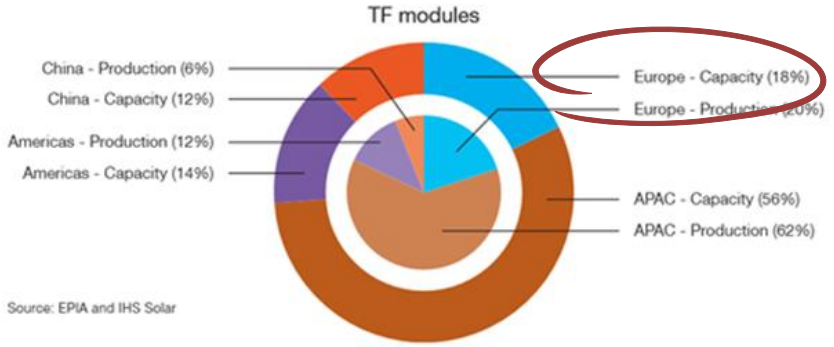
SEVENTH FRAMEWORK PROGRAMME

CRM_InnoNet
Substitution of Critical Raw Materials

Conclusions – The case of photovoltaics

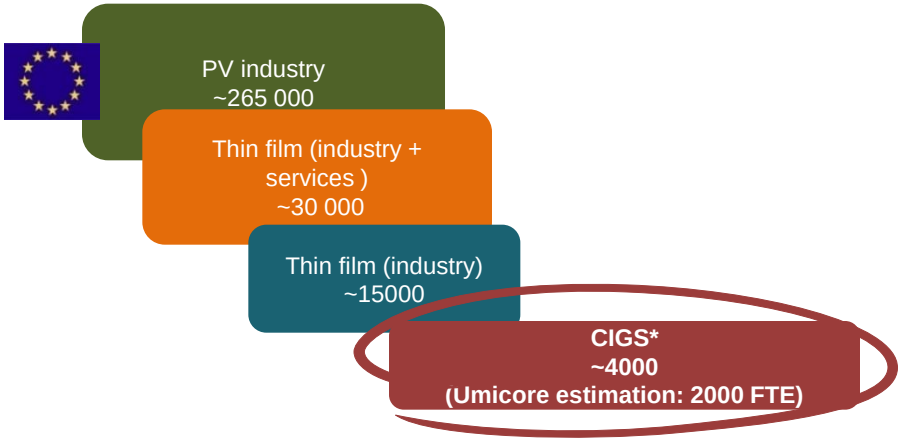
- CRM challenge for PV is ***today*** mostly related to CIGS technology (In, Ga)
- PV has a strong potential, ***but*** CIGS is currently a small part of the picture
- Highly dynamic market/industry led to decrease of EU importance lately for TF/CIGS
- After analysis, ***some*** EU economic risk is still currently associated with CRM/CIGS, but limited : CIGS economic risk for EU is relative !
- Future technologies (e.g. HET, CPV) may change the picture…

Regional distribution of production capacity and actual production



➔ **Thin film market in Europe reached 300 €millions in 2012**
➔ **CIGS European market is estimated about 81 M€ in 2012***

Estimation of direct Jobs involved in the EU (FTE) - 2012



*Assumptions : TF market 2012 = 55 % CdTs, 27 % GIGS, 18 % a-Si ; direct jobs related to TF technology is about 11 % of the global PV employment (similar to the production market share); 100 % of direct jobs = 50% services +50% industry ; CIGS : 27 % global Thin Film jobs (similar to the production market share)

Reference: GTM Research's "Thin Film 2012-2016: Technologies, Markets and Strategies for Survival ; Solar Buzz Market Buzz, march 2013 ; EPIA Global market outlook for photovoltaics 2013-2017; Umicore thin film products and Manz personal communications

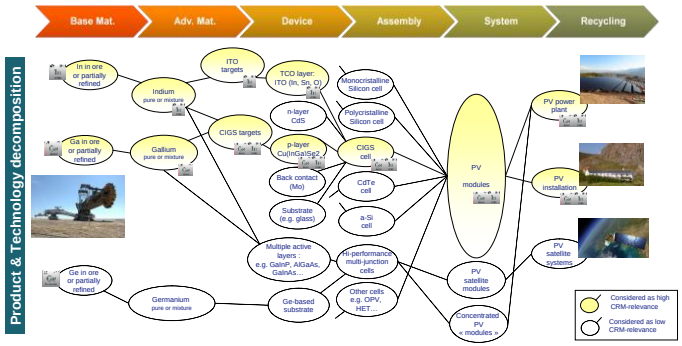
General Conclusions – Energy sector analysis

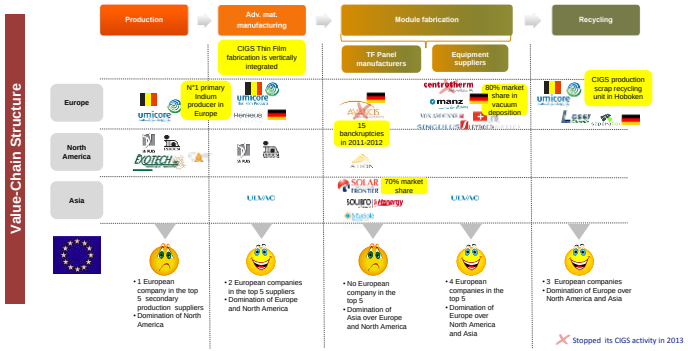
- Technologies, in particular new energy technologies, are highly dynamic by nature (e.g. ITO for PV), but industry structure may also be dynamic (ex. thin-films PV).
- Understanding the actual industry value-chain is needed for estimate the real EU economic/job exposure and risk path.
- Based on *current market*, **wind value-chain** appears particularly at risk…
- But *future market* should also be considered (e.g. Li-ion in light of R&D developments ?)

Thank you !

CRM Value Chain Analysis of Photovoltaic

Aymeric BRUNOT, Environmental Assessment Project Manager, CEA
Véronique CHARREYRON, Market Analyst, CEA





Europe position

- EU companies are well placed in advanced manufacturing, equipment supplying and recycling.
- Global materials technology and recycling group Umicore is a key player in Europe
- EU companies have a large share of equipment supply but the downturn in new fabs investments and the difficult market expectations seem very risky for the next 2 years.
- Importance of CRM-related PV for Europe appears after analysis as a case of potential "false-positive" result (ie. not so important).

CRM_InnoNet
Substitution of Critical Raw Materials

SEVENTH FRAMEWORK PROGRAMME

CRM_InnoNet
Substitution of Critical Raw Materials


TNO innovation for life
Knowledge Transfer Network
Chemistry Innovation
D'APPOLONIA
RINA GROUP
PNO
ASD
AeroSpace and Defence Industries Association of Europe
VTT
E-MRS
semi
SP
your Science Partner
cea
FROM RESEARCH TO INDUSTRY
feiQue
Knowledge Transfer Network
Environmental Sustainability
cefic
tecnalia
Inspiring Business
TU Delft
Delft University of Technology
SINTEF
swerea MEFOS
Fraunhofer ISI