Going Green
CARE INNOVATION 2014

FP7 RECLAIM OUTLOOK

Reclamation of Gallium, Indium and Rare-Earth Elements from Photovoltaics, Solid-State Lighting and Electronics Waste
Growing waste mountains
No or little alternatives for certain materials
Collection

Awareness
Efforts
Infrastructure
Regulations, Politics
Recycling fees

Separation/sorting

Need for technology, automation
Recovery

- Unhealthy situations → Improve working conditions

RECLAIM

- Industrialize and scale-up methods, for the efficient and economical retrieval of the identified key metals (gallium, indium and rare-earth elements) from E-waste, that are not existing today
- The recycling system and the underlying pre-treatment technologies are to be tuned towards the treatment of waste from emerging green technologies (PV and SSL) that is presently still insignificant but anticipated to be a crucial source of these key metals in the (near) future
E–waste is changing

Recycling easier said than done

Anything is possible
It’s a question of economics
[Yale, 2013]

... but also mind set

Change

› Logistics
› Smart efficient green recycling factories
› 1 fluorescent lamp = 65000 LED’s

1 Lamp
65000 LED’s

Red phosphor = \( Y_2O_3:Eu(3%Eu^{3+}) \)

Less REE
More light
Longer life
Less waste
Recycling of production waste

Mining

- Early vs Urban
- By products: In from Zn, Ga from Al (bauxite) ores (dependance)
- Demand most REE > Primary production
Myth?

- REM stocks not exhausted in 20–30 years

New mines:
Mount Pass in California by Molycorp Inc.
Mount Weld in Australia by Lynas.

Future/after RECLAIM

- REM remain necessary for the industry, e.g electronics and automotive
- 2009–2015 e–waste 50 → 72 Mton
- EU e–waste 20 kg/p/y
- REM in e–waste ~42 ton/y in 2014 (ex LED, PV, In, Ga)
- 40% of REM is not recycled [Umicore]
- Prices fluctuating, now going down, availability going up, but...
Forecasts, consumption

Forecast global development of gallium consumption for emerging technologies

Example, i-phone

- Smartphone ~8 different REM’s for screen, speakers, vibration function

[Scharnagel, M, Zeldzame aarden, de situatie in 2013, Aluminium, 3/2013]
RECLAIM Database

- Quantities
- Physical properties
- Chemical compositions
- Concentrations
- Locations
- Variations

of the targeted critical metals for various existing and emerging waste streams
→ Decision support

Emerging green electronics

- More REE needed and more Green(?) e–waste
- Batteries for hybrid cars
- Solar energy
- Solid State Lighting
European study of critical raw materials

7 July, 2011

Reuse …

- Ultimate recycling
- Components, sub-assemblies
- Glass (PV)

- Reduce: production efficiency and use less
- Find substitutes: Replace with alternative materials
Another R

- Reliability
- Increase Life

- But also **design** for Recycling, for Reliability

More future

- More recycling by more/better regulations (e.g. collection, design, material use)
- Replacements of REE by research
- New/Improved Recovery processes (higher yield)
- Solve monopolies:
  - Improve/increase early mining sources, technology and yield
  (China only has 23% of the known deposits)
- New yet unknown (green) products
- More biometallurgical recovery processing
There are risks
Reducing scarce and toxic materials

- Too low concentration for efficient recovery
- Additional energy needed to create small amount or thin films of materials
- Material may become unhealthy or even toxic due to the size of particles and fibres (e.g. nano wires, nano-tubes for light conversion)

[Gielen, S., SSL–erate D2.1]

Next steps in RECLAIM

- Further developing Separation and Recovery processes
- Evaluate at bench/lab scale
- Setup Pilot plants
- Initiate exploitation
Conclusion 1

- Growing demand for gallium, indium and rare-earth elements by emerging green technologies as photovoltaics and solid-state lighting

- Growth rate is expected to increase by implementing the green technologies on large scale

Conclusion 2

Besides Reduce, Reuse, Replace, Redesign..

Recycling:
A balanced selection of Sorting, Separation, Dissolution, Recovery, Concentration and Purification processes should make “Urban mining” of In, Ga and REEs economically viable
Thank you!

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