

Futu RaM

# An example of Recycling and Recovery Projects

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**1** DG GROW request in 2021 → Map ongoing and potential primary CRM projects in France using UNFC

- But France is...
  - ... already a producer of some CRM as a by-product (In from Zn and Hf from Zr)
  - ... also a CRM producer via recycling, mostly Waste from Electrical and Electronic Equipment (WEEE)

**2** Include ongoing projects producing CRM after recycling or after by-product recovery process


44 projects have been classified in France with UNFC, for

- primary resources
  - Sb, bauxite, fluorite, Ge, Li, Mg, Mo, Ta, W, Si
- and secondary resources
  - Co, Ni, Li, In, Hf, PGMs

| Commodity               | UNFC class | Number of projects |   |
|-------------------------|------------|--------------------|---|
| Antimony                | 322        | 1                  | 5 |
|                         | 332        | 2                  |   |
|                         | 333        | 1                  |   |
|                         | 334        | 1                  |   |
| Bauxite                 | 111        | 2                  | 2 |
| Cobalt                  | 211        | 1                  | 1 |
| Cobalt, nickel, lithium | 223        | 1                  | 2 |
|                         | 233        | 1                  |   |
| Fluorine                | 322        | 2                  | 6 |
|                         | 332        | 1                  |   |
|                         | 333        | 3                  |   |
| Germanium               | 334        | 2                  | 2 |
| Hafnium                 | 111        | 1                  | 1 |
| Indium                  | 111        | 1                  | 1 |
| Lithium                 | 222        | 1                  | 7 |
|                         | 223        | 1                  |   |
|                         | 332        | 3                  |   |
|                         | 334        | 1                  |   |
|                         | 343        | 1                  |   |
| Magnesium               | 111        | 2                  | 2 |
|                         | 211        | 1                  |   |
| Molybdenum              | 333        | 1                  | 1 |
| PGMs                    | 112        | 1                  | 2 |
|                         | 233        | 1                  |   |
| Silicon                 | 111        | 7                  | 7 |
| Tantalum                | 333        | 3                  | 3 |
| Tungsten                | 323        | 1                  | 2 |
|                         | 333        | 1                  |   |

# CRM recycling projects in France

## Potentially viable projects

Checklist 

E

Projects in industrial plants with already granted environmental authorizations?

F

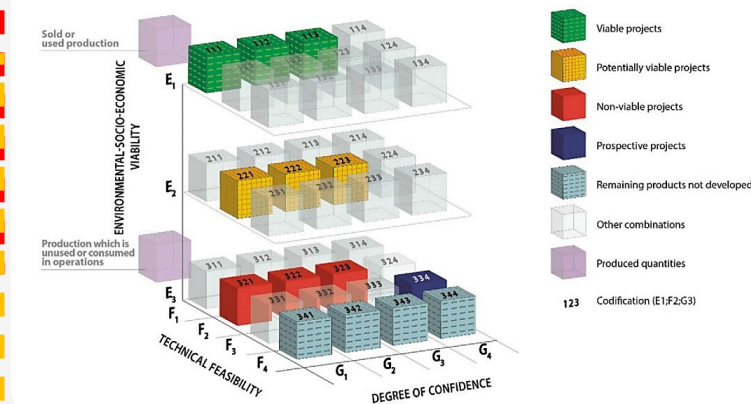
- The degree of maturity of recycling processes
- Knowledge of the composition of the recycled products/flows
  - Chemistry of batteries,
  - Chemistry of permanent magnets
  - Etc.



G

- Which capacity to collect the waste streams? Partnership with waste collector?
- Information about quantities. Expected annual production?

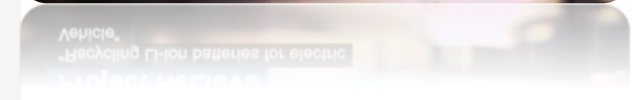
FIGURE 1  
UNFC Categories and Examples of Classes



# Example of secondary resources project classification

ReLieVe project (Ni, Co, Li, Mn)

- Collaborative research and innovative project ReLieVe (for Recycling of Li-ion batteries for Electric Vehicle) aims
  - to develop an innovative process for recycling lithium-ion batteries used in electric vehicles
  - to structure an integrated industrial sector - from the collection and dismantling of end-of-life batteries, to the recycling of the elements they contain
  
- **E axis - Social, economic and environmental axis**
  - Environment
    - Project located in industrial facilities in operation under the ICPE regime (i.e. with the necessary environmental authorizations)
  - Economic
    - Secure funding (€4.7 million - over 60% funded by EIT RawMaterials)
    - European recycled battery market still very immature
  - Social
    - No social opposition at this stage



|           |  |  |
|-----------|--|--|
| <b>E2</b> | Project potentially viable in the future | <ul style="list-style-type: none"> <li>• Secure funding and partnerships</li> <li>• First estimations of economic costs</li> <li>• Environmental authorizations obtained but more specific diagnostics will be required</li> </ul> |
|-----------|--|--|

- **F axis – Technical feasibility axis**

- Extraction and transformation at the pilot scale of Ni, Co, Li, Mn into new metals of battery grade

|           |  |  |
|-----------|--|--|
| <b>F2</b> | Project potentially viable in the future | <ul style="list-style-type: none"> <li>• Pre-feasibility phase</li> <li>• Proven results at the pilot scale</li> </ul> |
|-----------|--|--|

- **G axis – Geological knowledge axis**

- Known possible battery chemistry
  - Uncertainties about the amount and types of batteries collected in the future
  - Battery life uncertainties

|                 |  |   |
|-----------------|--|---|
| <b>G2 to G3</b> | Project potentially viable in the future | <ul style="list-style-type: none"> <li>• Need of additional data</li> </ul> |
|-----------------|--|---|

# CRM recycling projects in France

## Conclusions

- UNFC
  - to evaluate/compare projects at different scales using a multi-criteria approach
  - to determine economic/social/environmental/technical barriers (acceptability, feasibility, waste collection, etc.)
    - ⇒ **UNFC = decision making tool (investments, policy governance, etc.)**
- Keep in mind the comparability with primary resources
- Issues on :
  - Data needed to classify projects : public AND confidential data => trust and partnerships with industrial players
  - Interdependence between the different axes of classification
  - Uncertainties concerning the G axis, in particular with regard to the compositions and flows of materials to be recycled
    - ⇒ Importance of FUTURAM and GSEU projects to coordinate internationally the methodology of the UNFC and the actions of the various European actors



**Thank you for your attention!**



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