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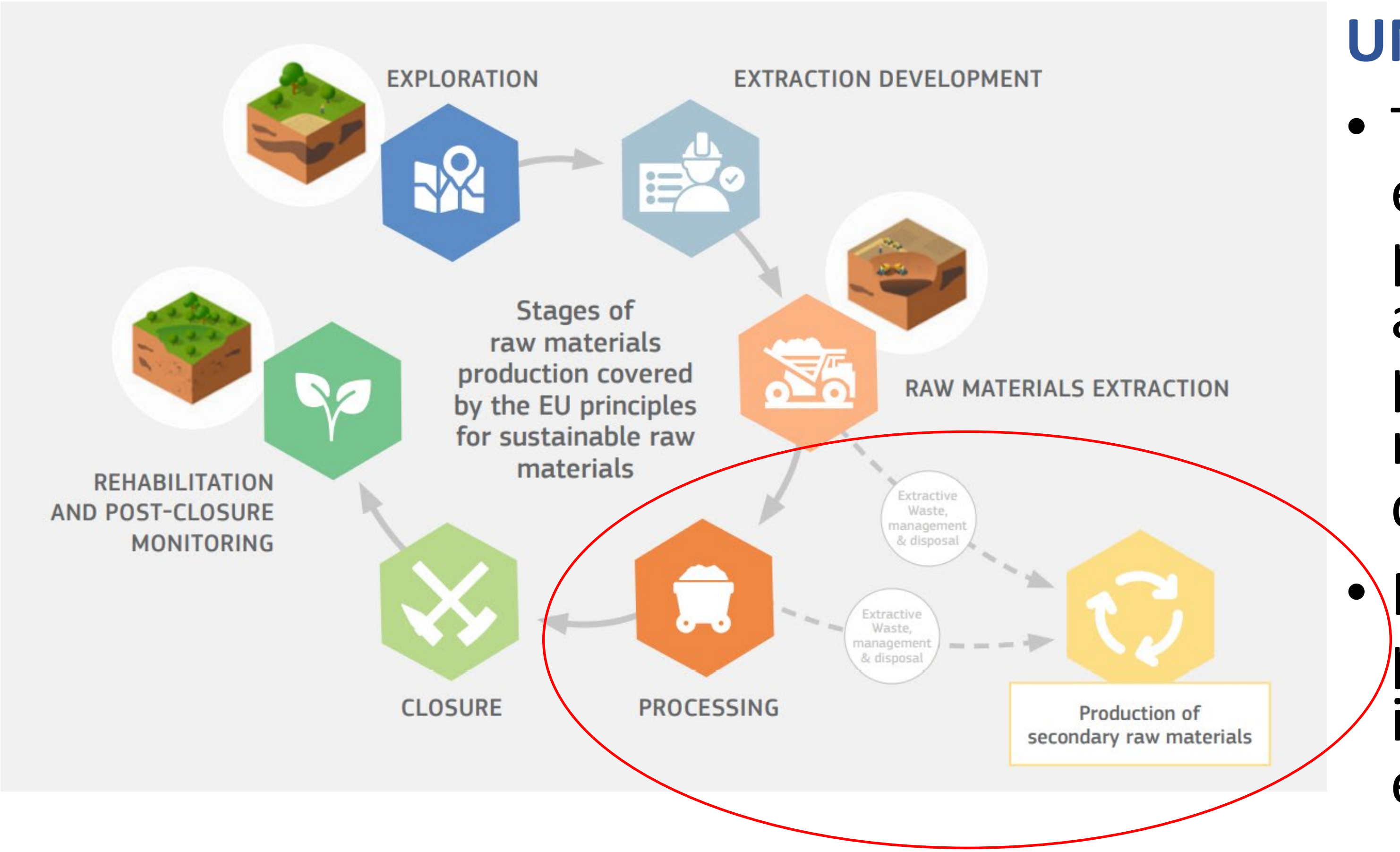
UNFC applied to Downstream Projects
General Considerations

Objectives

- Nature of downstream projects
- General downstream considerations
- Downstream E, F and G axis considerations

Raw material project life-cycle



UNFC Mineral Specifications

- The minerals cycle starts with the exploration and subsequent primary mineral production, such as excavation, beneficiation, processing and value-addition in a mineral project(s), as wells as site decommissioning and remediation.
- Mineral products reflect the primary entrance of raw materials into the stock available for economic value chains.

Downstream projects

- Examples
  - Battery materials
  - Steel
  - Hi-tech materials
  - Fertilizers
  - Petrochemicals
  - Component manufacture
  - Consumer goods
  - Recycling
- Opportunity
  - Value-added premium products
- Challenges
  - Supply risks
  - Critical raw material management
  - Governance – Transparency, conflicts, human rights (child, forced labor)
  - Technical issues
  - Social and environmental
  - Occupational safety

Why UNFC for downstream projects?

Simplification

Classification

Order

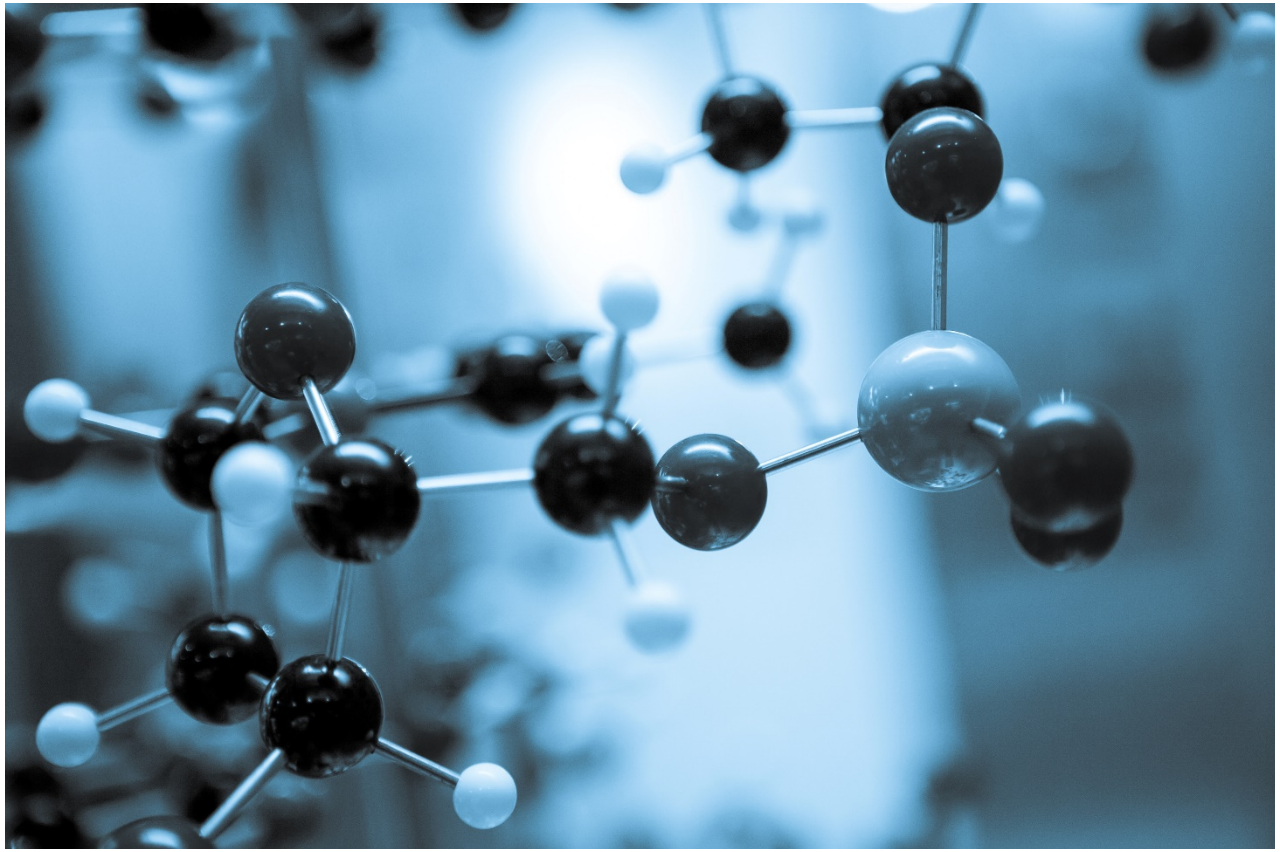
Simpler information processing

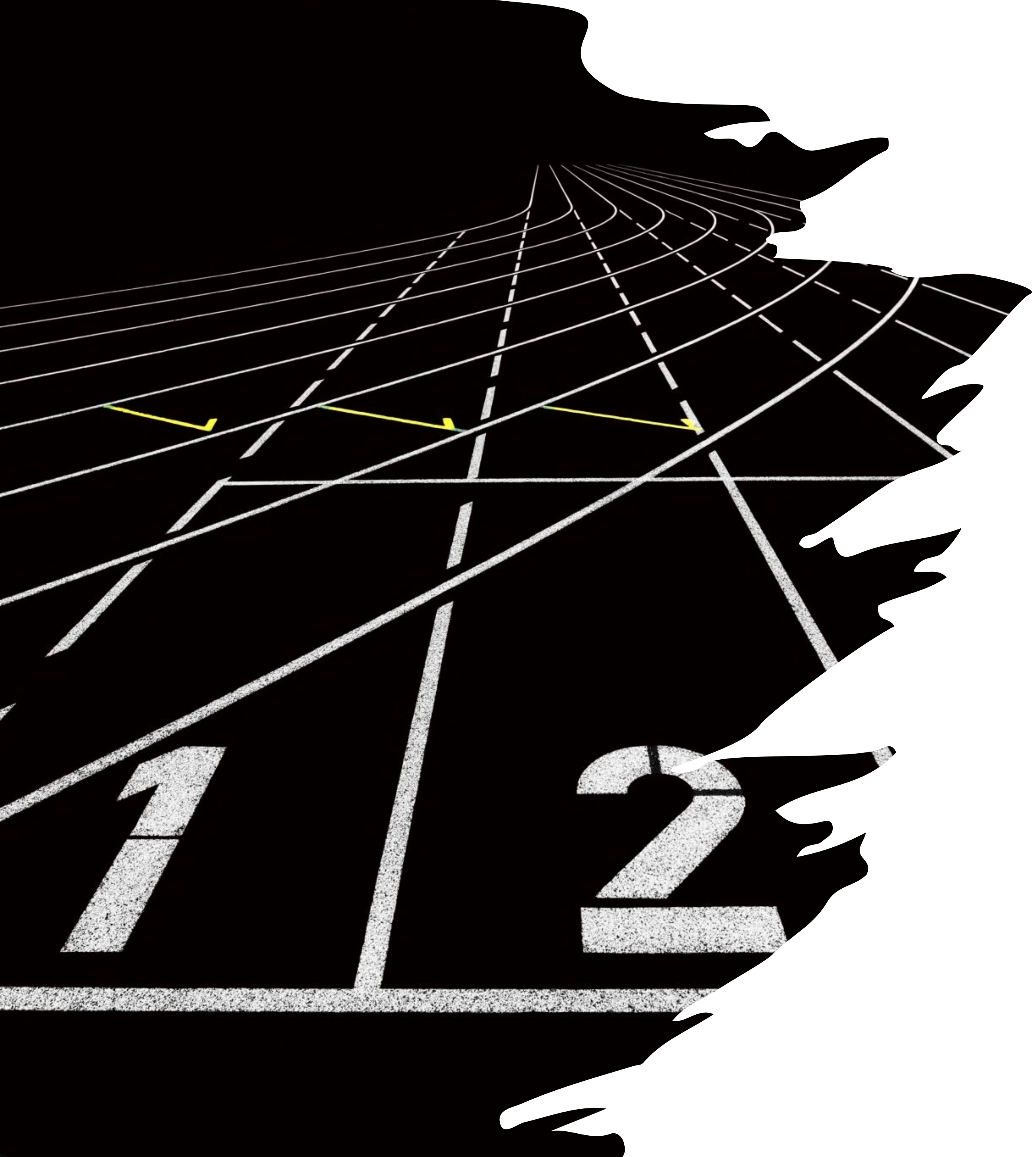
Speeds up decision making

- UNFC
  - Environmental-social-economic
  - Technical feasibility
  - Degree of confidence about sources
- E,F and G are important and interlinked

Processing methods

- Hydrometallurgy
- Pyrometallurgy
- Reprocessing
- New technologies





General considerations 1/3

- Requirements
  - E axis
    - Regulatory – Social and environmental
    - Legal (contracts etc.)
    - Safety
    - Residues and wastes
    - Infrastructure
  - F axis
    - Preliminary and detailed feasibility studies Demonstration (if required)
  - G-axis
    - Sources and quantities
    - Full characterization of source materials
    - Accounting of processing losses
    - Inventories

General considerations 2/3

- Mandatory provisions
    1. Numerical codes
    2. Effective date
    3. Transparent aggregation of sourced quantities and products
    4. Reporting basis - What is reported?
    5. Reference point
    6. Foreseeable future, reasonable expectations, reasonable prospects, reasonable time frame
    7. Unprocessed quantities, losses and wastes
    8. Basis of economic assumptions
    9. Uniform use of SI units
    10. Sufficient documentation

- Preferred
    1. Account all information prior to effective date
    2. Separate estimates for each product type
    3. Assumptions of market conditions based either on company view, qualified person view, independently published views

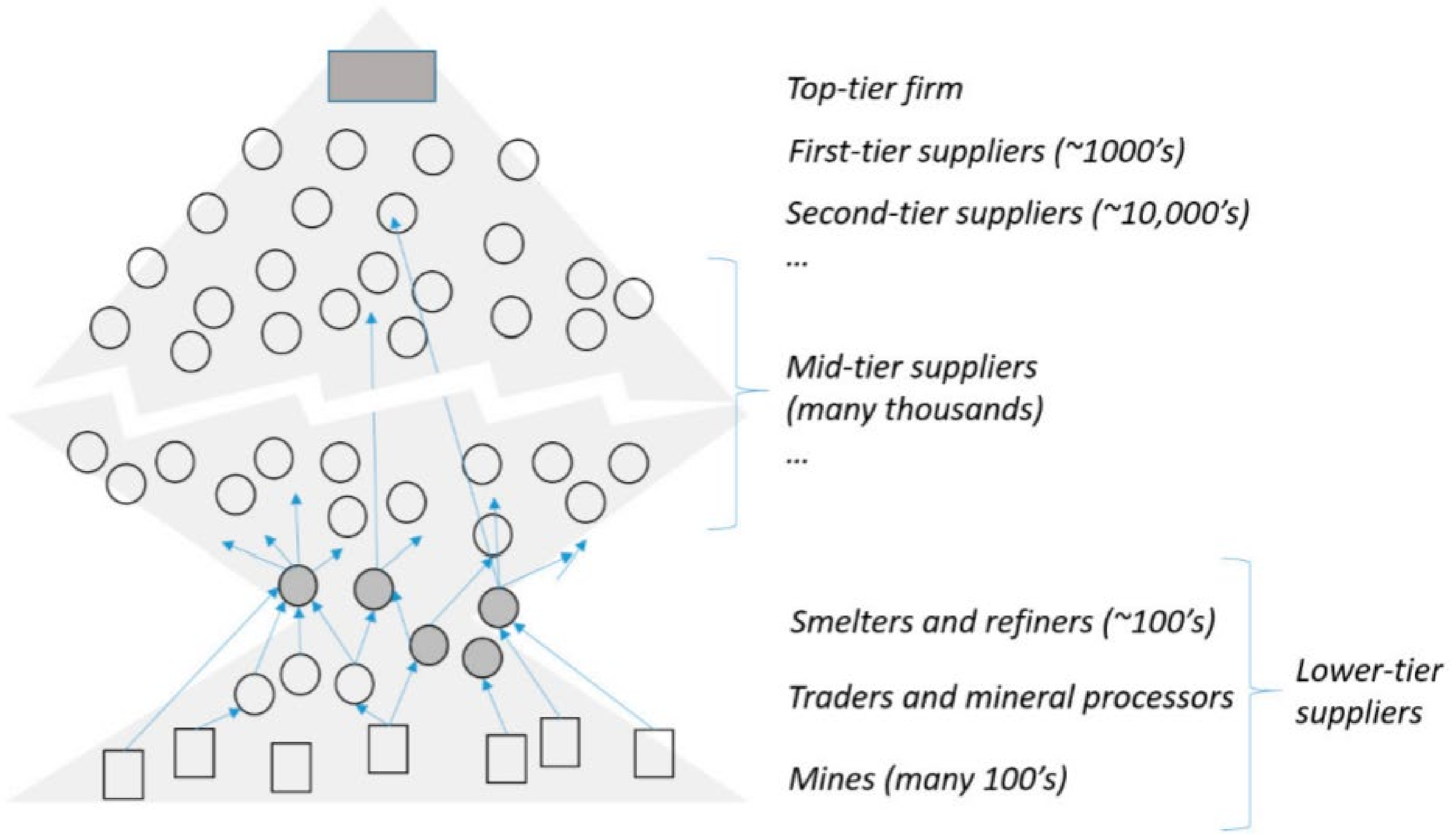
General considerations 3/3

- Alternatives acceptable
  - Use of sub-classes (will allow faster decision making)
  - Quantities attributable to whole project or share of reporting entities economic interest
  - Reference point may be sale point, or an intermediate point
  - If processing technology is not confirmed, quantities with reasonable prospects may be reported
  - Early development project may be classified on the basis of maturity
  - Additional quantities (unprocessed, losses, wastes, etc.) may be reported.

G axis - Quantities

- Measurement techniques
- Types of raw material sources
- Confidence levels – low, medium or high
- Consideration for G4
- Reference point
- Co-product and By-product accounting

G axis - Supply chain risks



Responsible sourcing

- Responsible sourcing, based on due diligence guidance and standards
- EU Conflict Minerals Regulation
- EU Mineral Supply Due Diligence Regulation
- OECD Due Diligence Guidance
- European Partnership for Responsible Minerals

F axis - Project feasibility

- Processing methodology
- Recovery factors
- Technological development
- Level of maturity
- Studies
  - Pre-evaluation/Preliminary economic assessment (less than 5% of the CAPEX) - by comparison with similar existing operations, more advanced projects, or using general cost curves.
  - Pre-feasibility studies (5-15% of the CAPEX) - based on more specific data
  - Feasibility studies (15-20% of the CAPEX) - Final detailed study

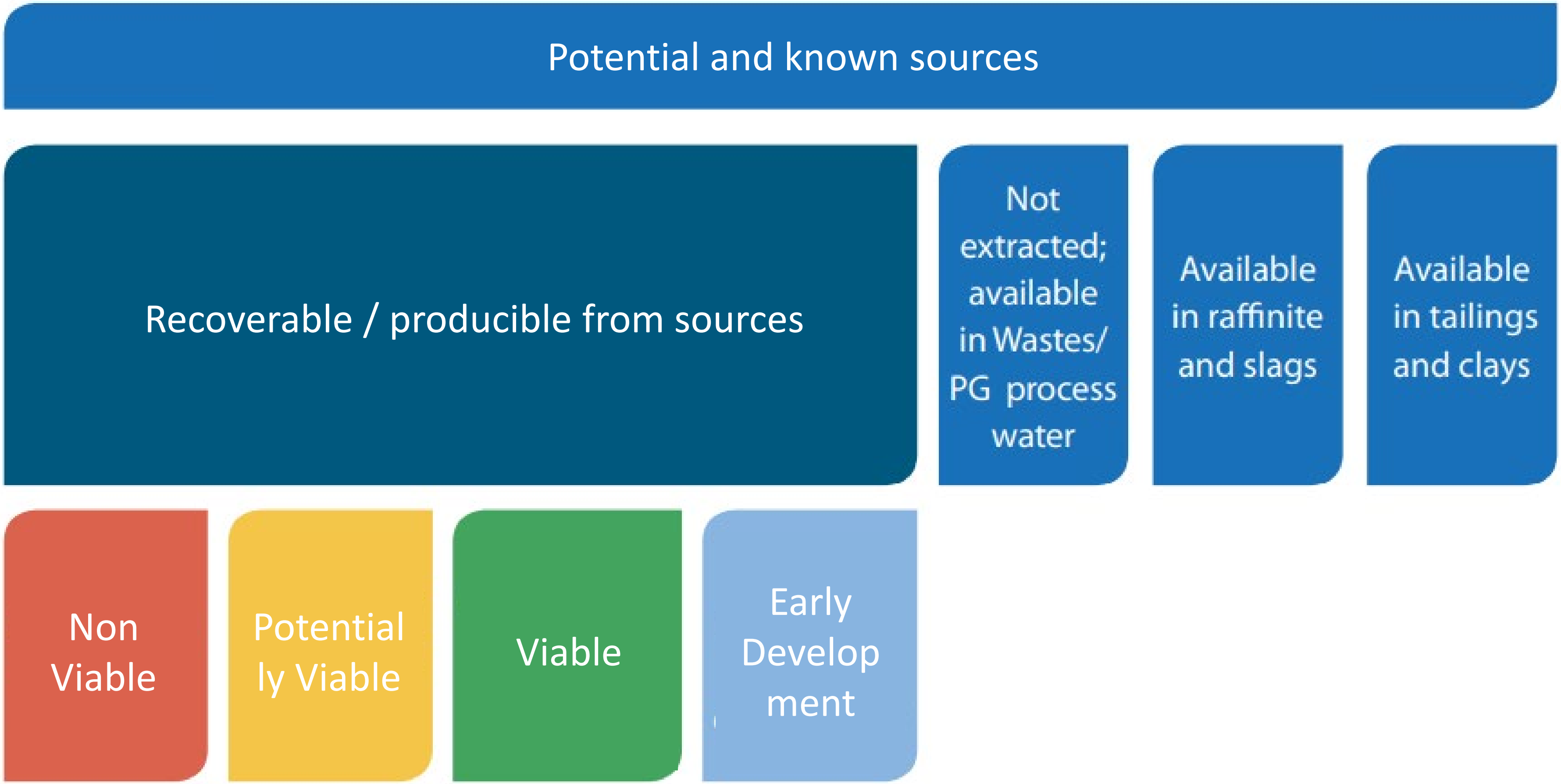
- Detailed studies
  - Demonstrate the feasibility
  - Accurately and completely describe the proposed project
  - Supported by adequate test work and studies
  - Design of a processing method
  - Process equipment, infrastructure details
  - Recovery factors at all steps
  - Mitigation of undesirable environmental impacts

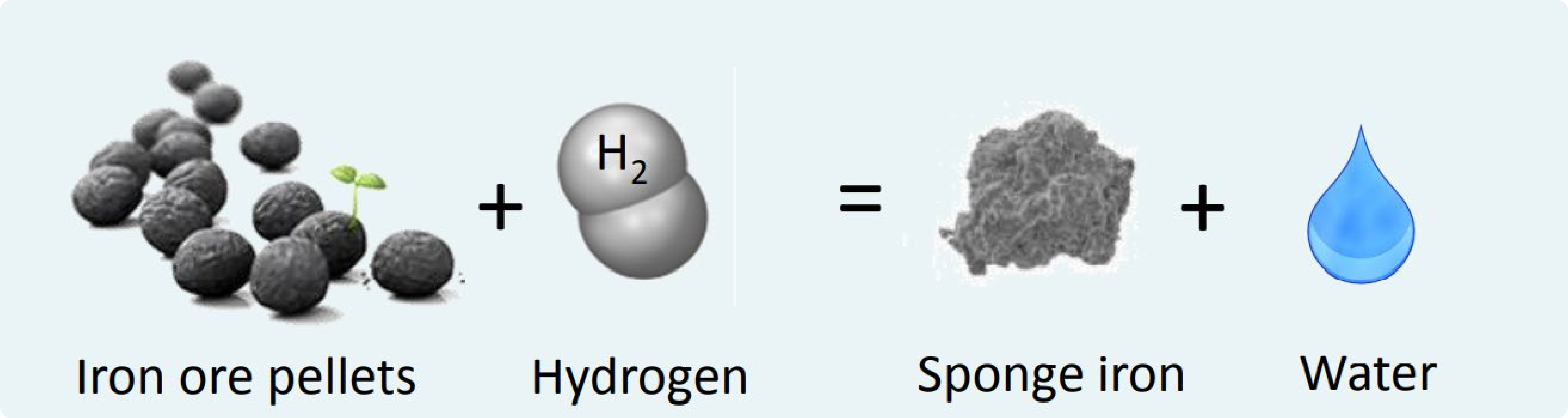
E axis - Project licensing and operations

Political stability
Appropriate regulations
A coherent and transparent licensing strategy
Stakeholder engagement
Tax regime
Land use planning and legislation
Complementary industrial laws
Fair resolution of any consequences

- Legislation framework for sustainability and environmental protection
- Water requirements
- Disposal paths of hazardous chemicals
- Disposal of slags, wastes
- Radioactive materials handling
- Human resources
- Transparency
- International regulations
- Milestones and decision gates
- Social contract
- Occupational safety
- Closure and decommissioning plans

UNFC Downstream Classification



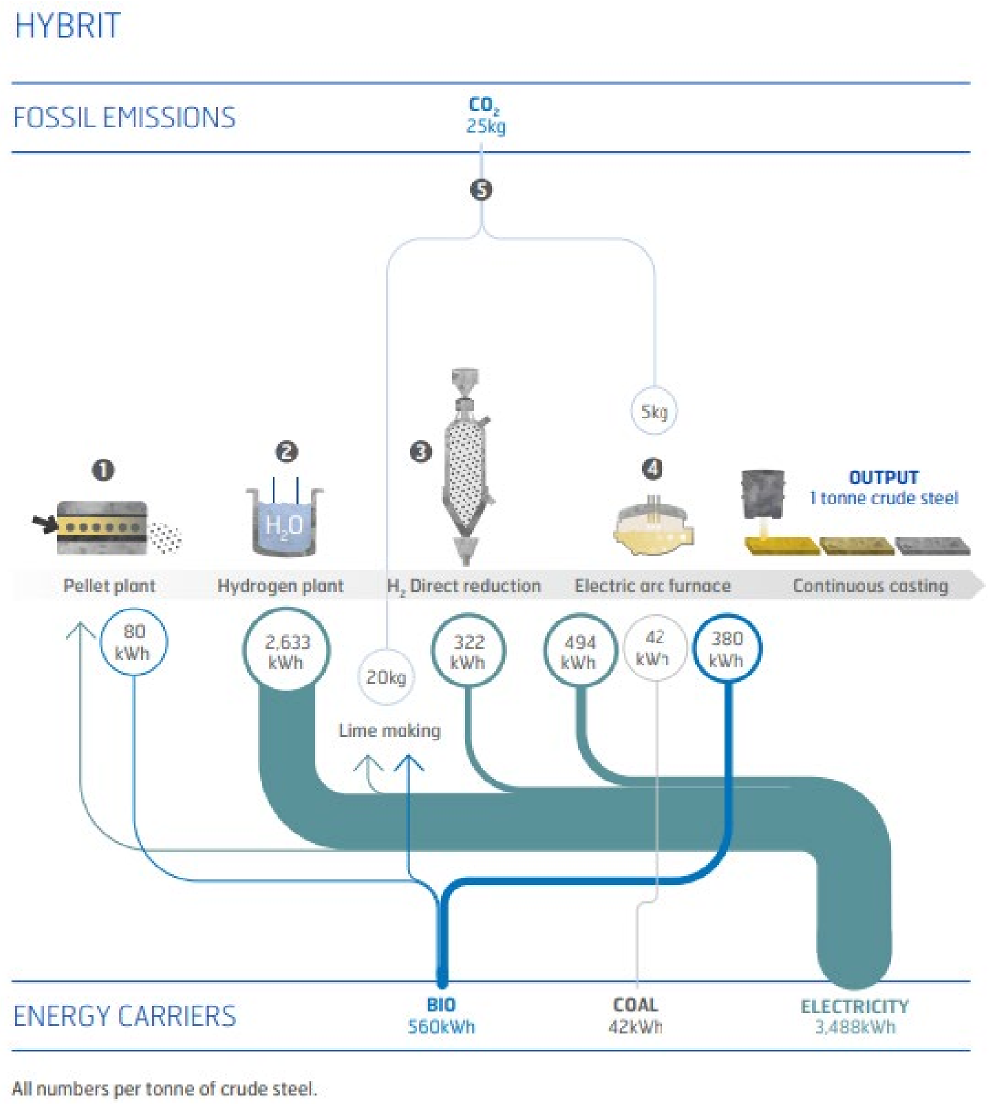


SSAB HYBRIT Project, Sweden

- HYBRIT, acronym for Hydrogen Breakthrough Ironmaking Technology, is a development project with the aim of implementing fossil-free steelmaking in all stages of production; from iron-ore extraction, through pelletisation and reduction (iron-making), to the final steelmaking (in electric arc furnaces).
- Fossil free electricity production for hydrogen production for
  - parts of the mining and processing of iron ore (pelletisation).
  - direct reduction of iron ore
  - electric arc furnaces (for melting of sponge iron and adding materials, most notably carbon, to make steel)

E axis

- PRODUCTION COSTS SEEM VIABLE Considering current cost levels, an iron- and steelmaking value chain based on the HYBRIT concept would result in a **20 to 30 per cent increase in the cost of producing crude steel.**
- This innovation is **probably only viable under conditions of (global) ambitious climate policies, which require more than 80 % reduction of greenhouse gas emissions before 2050,** since that would require that at least CCS be implemented on all primary steelmaking.
- **No unintended consequences can be identified at this stage.**
- E 2



F axis

- The prefeasibility study results underline that **no major, previously unknown technical obstacles have been identified.**
- Nevertheless, considerable **future development efforts will be required** to realise and verify the concept, and to handle risks. These include fundamental research projects using models and laboratory scale experiments, as well as trials in pilot and demonstration plants.
- Considering current cost levels, an iron- and steelmaking value chain based on the HYBRIT concept would result in a **20 to 30 per cent increase in the cost of producing crude steel**

- Large-scale hydrogen production and storage is also planned to be built and following the pilot plants, 2 demonstration plants are envisioned before commercialisation in 2042.
- The mining and pelletisation is not envisioned to be fossil free until 2045.

\- F 2.1

G Axis

- 3 plants to be converted to HYBRIT process by 2045
- EAC at SASB Oxelösund and Demo of HYBRIT at Oxelösund by 2025 – 1 million tonnes/a (G2)
- SSAB Raahe converstion to HYBRIT by 2045– 4.9 million tonnes/a (G3)
- SSAB Luleå converstion to HYBRIT by 2045 – 3.6 million tones/a (G3)

To Summarize

- Downstream projects could be varied and complex.
- Mandatory, preferred and non-mandatory rules of UNFC classification
- Pay attention to sourcing.

Thank you!

Hari Tulsidas
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UNECE
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