



Importance of mineral criticality to an economy: case Finland

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VTT Group in brief

Turnover 316 M€ (2012) • Personnel 2900 (31.12.2013)



Customer sectors

- Biotechnology, pharmaceutical and food industries
- Chemical industry and environment
- Electronics
- Energy
- Forest industry
- ICT
- Machine, vehicle and metal industries
- Real estate and construction
- Services and logistics



Focus areas of research

- Applied materials
- Bio- and chemical processes
- Energy
- Information and communication technologies
- Industrial systems management
- Microtechnologies and electronics
- Services and the built environment
- Business research



VTT's operations

- Research and Development
- Strategic Research
- Business Solutions
- Business Development
- Group Services
- VTT's companies
 - VTT Expert Services Ltd (incl. Labtium Ltd and Enas Ltd)
 - VTT Ventures Ltd
 - VTT International Ltd (incl. VTT Brasil LTDA)
 - VTT Memsfab Ltd

VTT Business Units 2014



**Knowledge
intensive
products and
services**

**Smart industry
and energy
systems**

**Solutions for
natural
resources and
the environment**

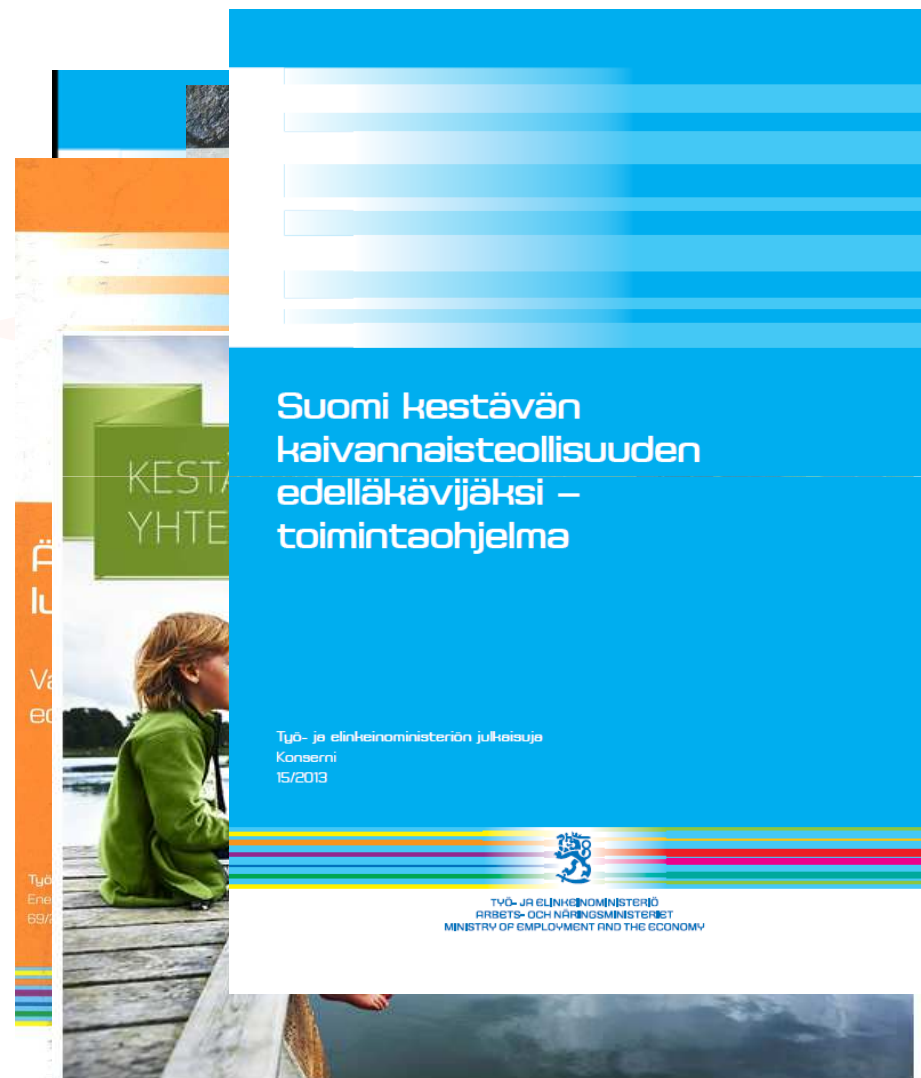
**Business criticality of mineral
raw materials: users vs
producers**

**New directions: design and
systemic innovations**

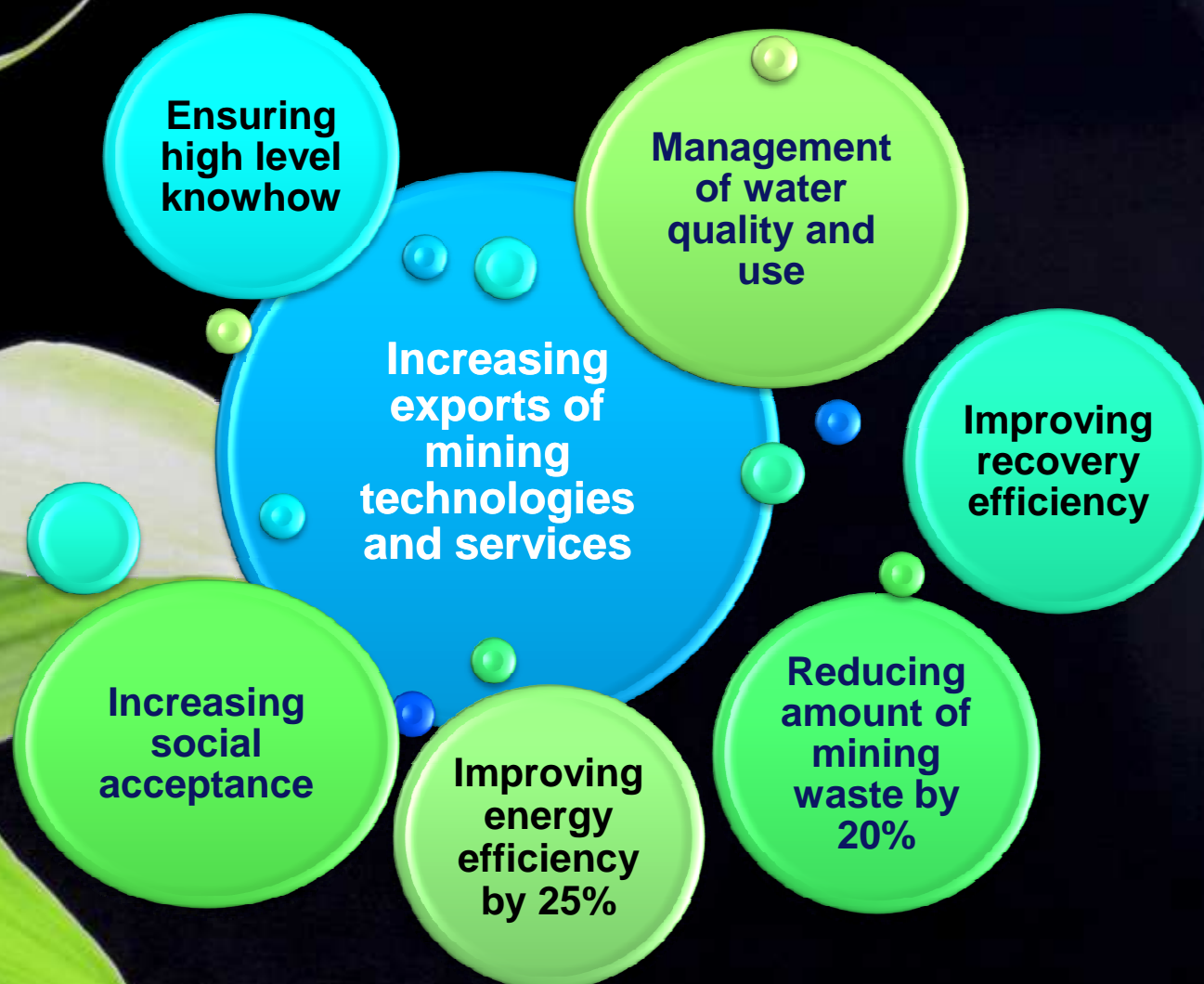


Much has been done on the national and EU levels

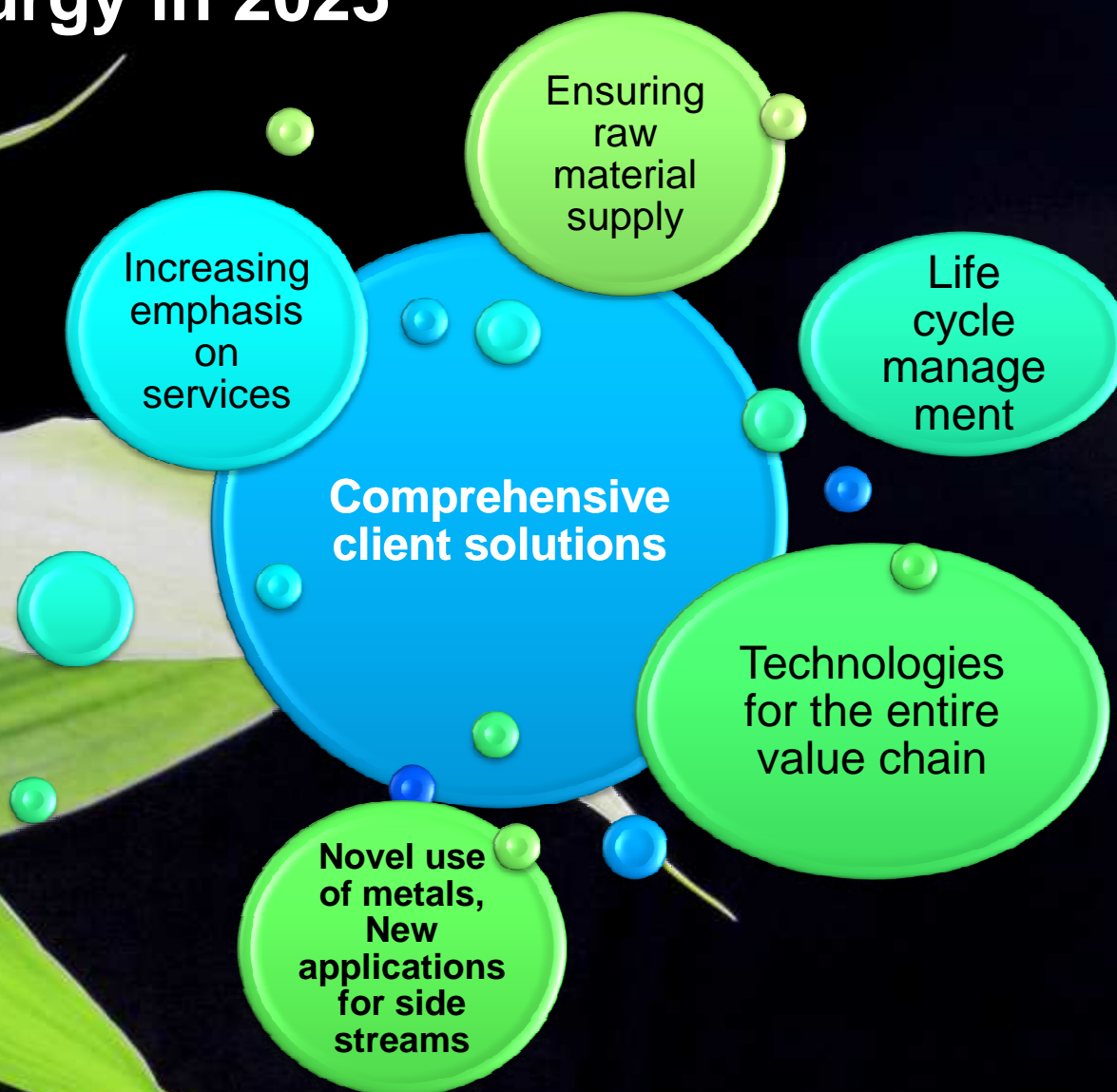
- EIP SIP
- Eramin roadmap
- Roadmap for resource efficient Europe
- Finnish mineral strategy
- Finnish action programme on material efficiency
- Finnish construction sector material efficiency programme
- Action programme for sustainable mining
- National Clean Tech Strategy
- Government commitment on sustainable development
- National raw material roadmap

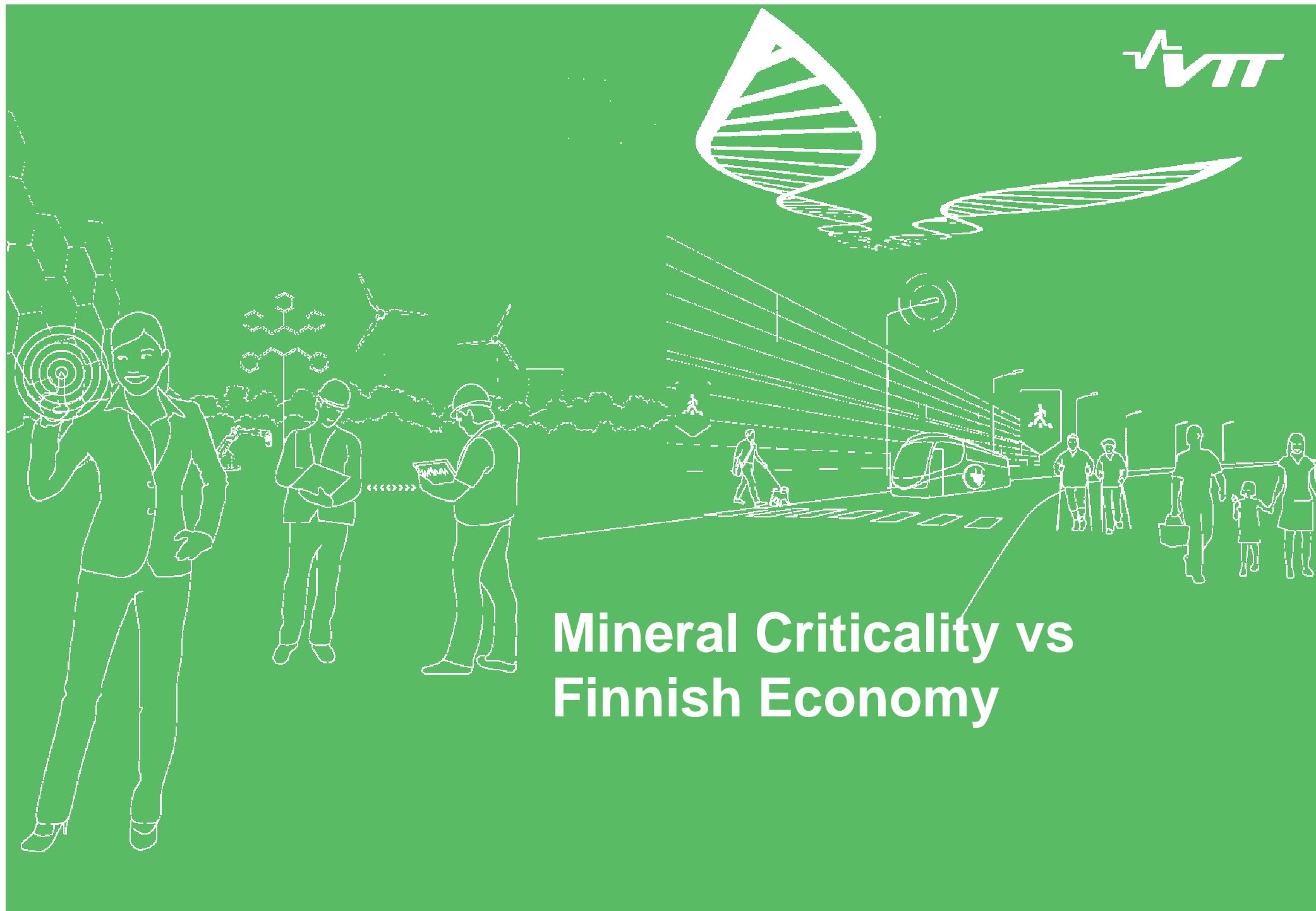


Goals for mining in 2025



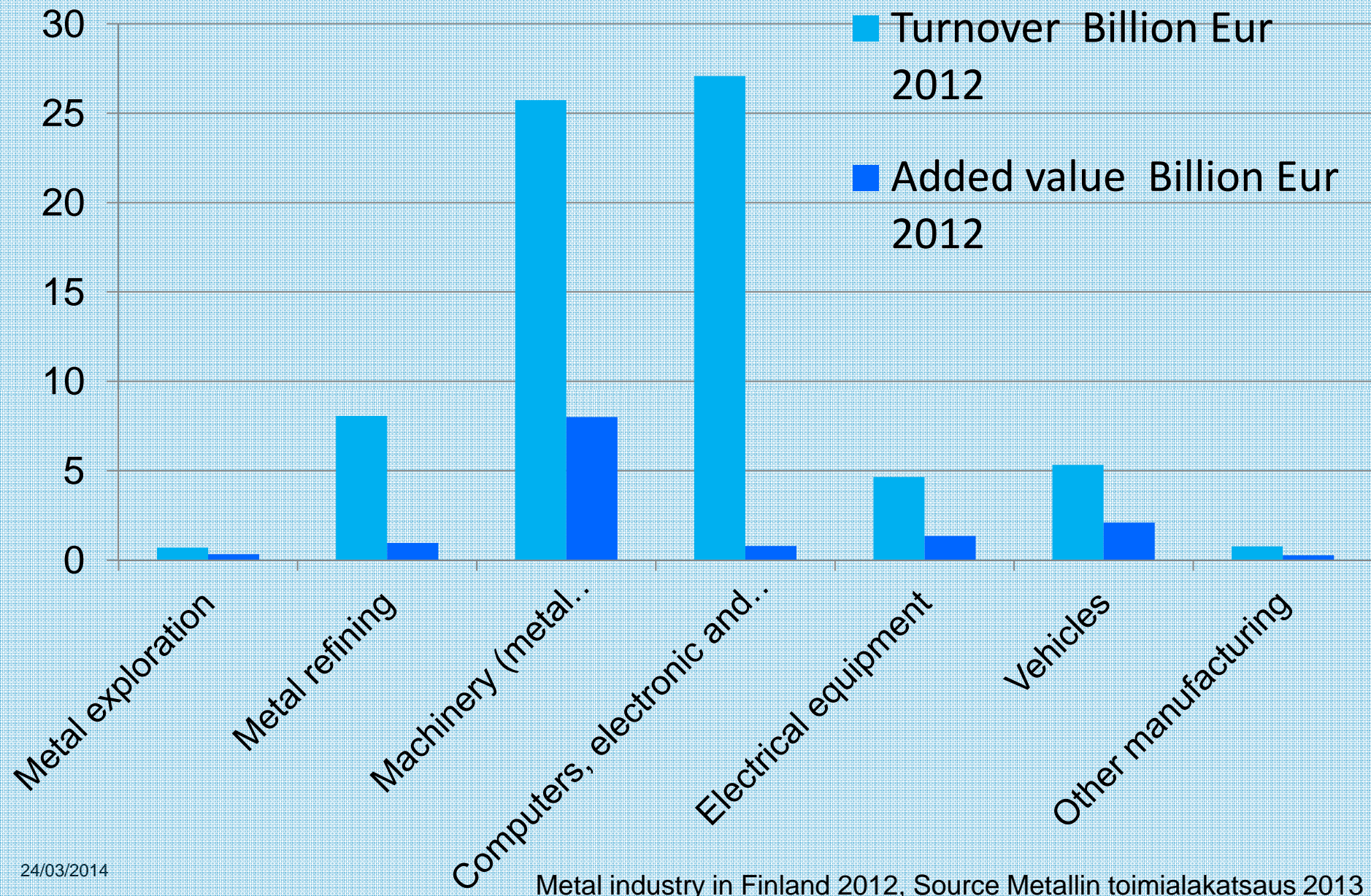
Goals for metallurgy in 2025



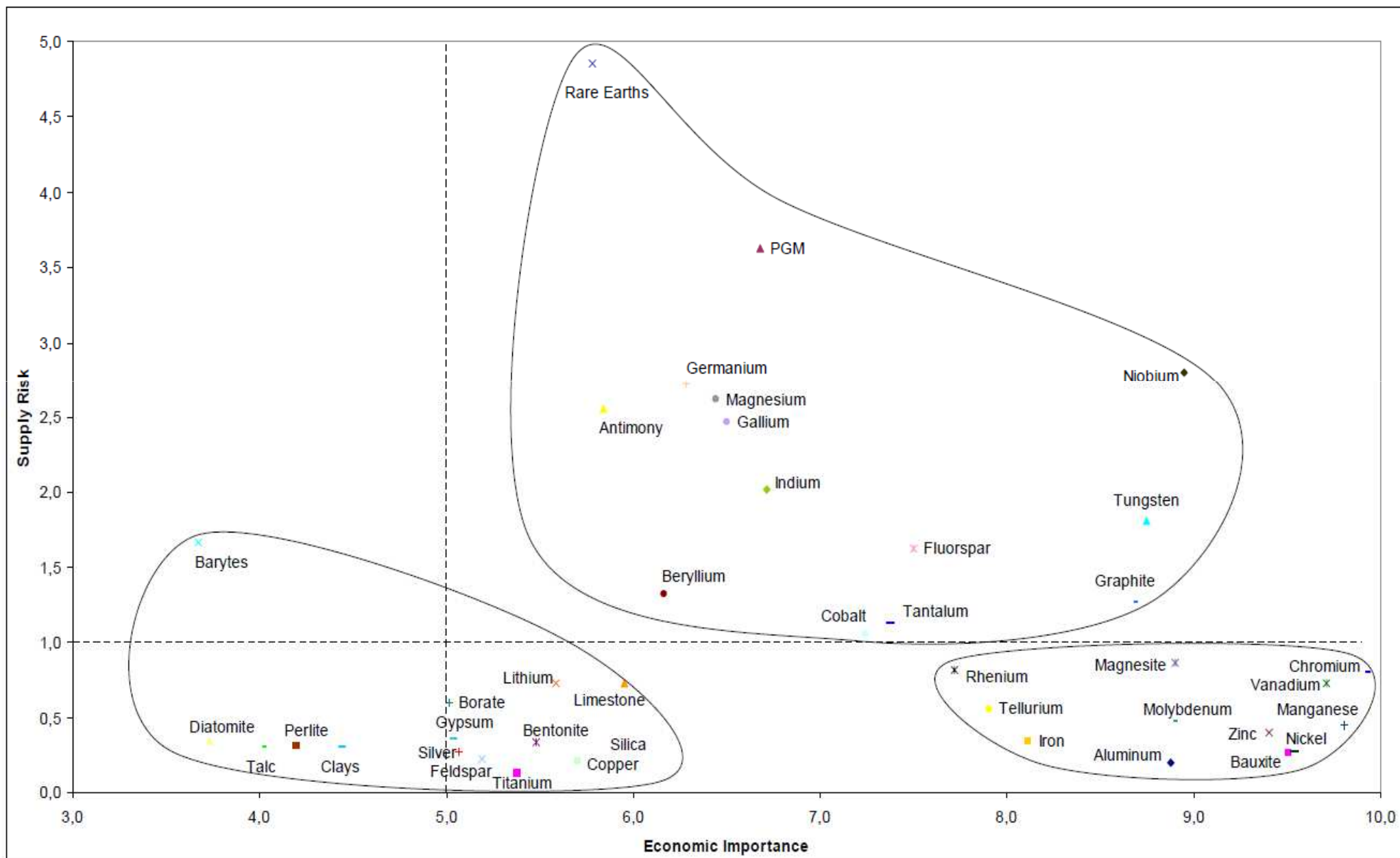


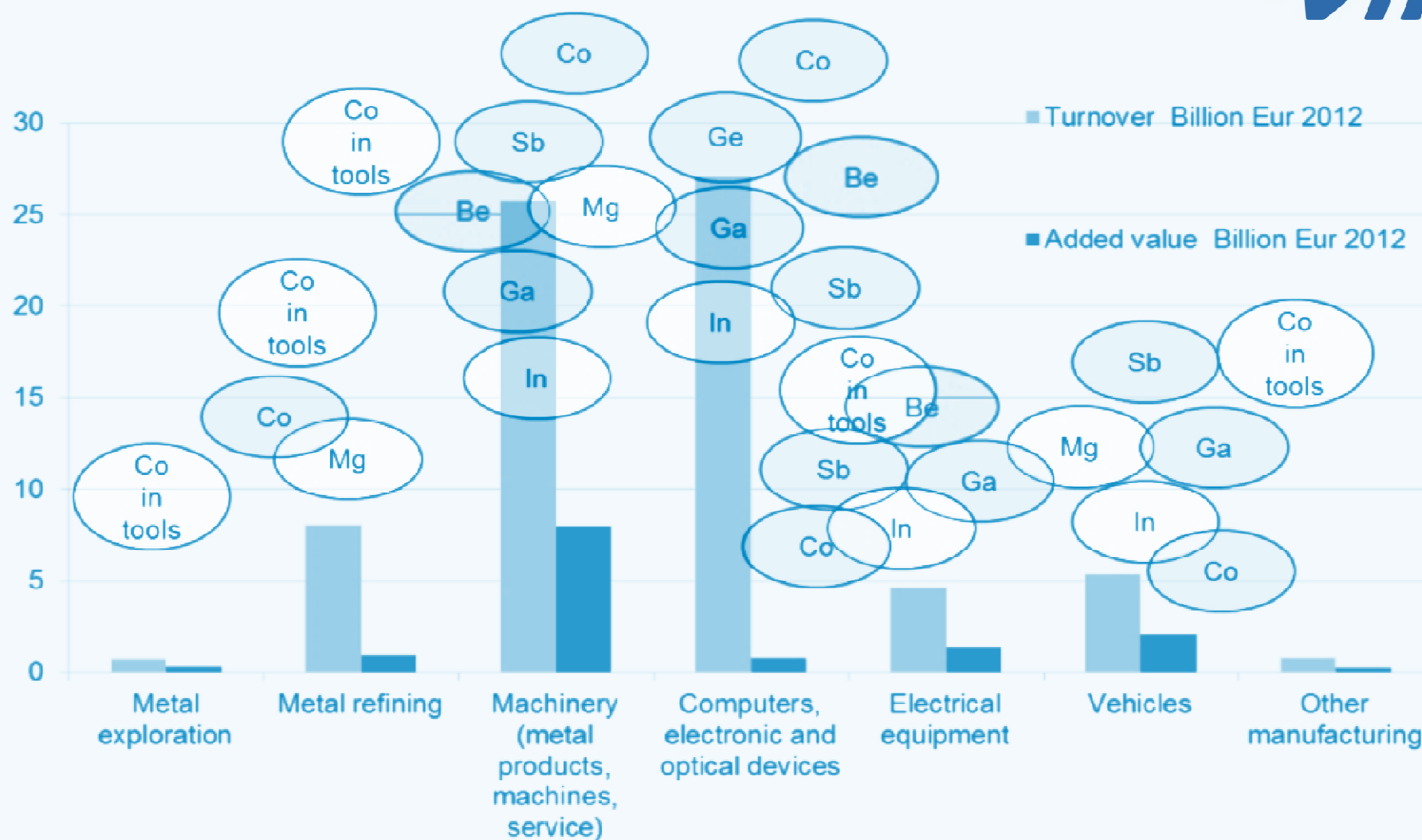
Mineral Criticality vs Finnish Economy

The size of the "mineral economy"

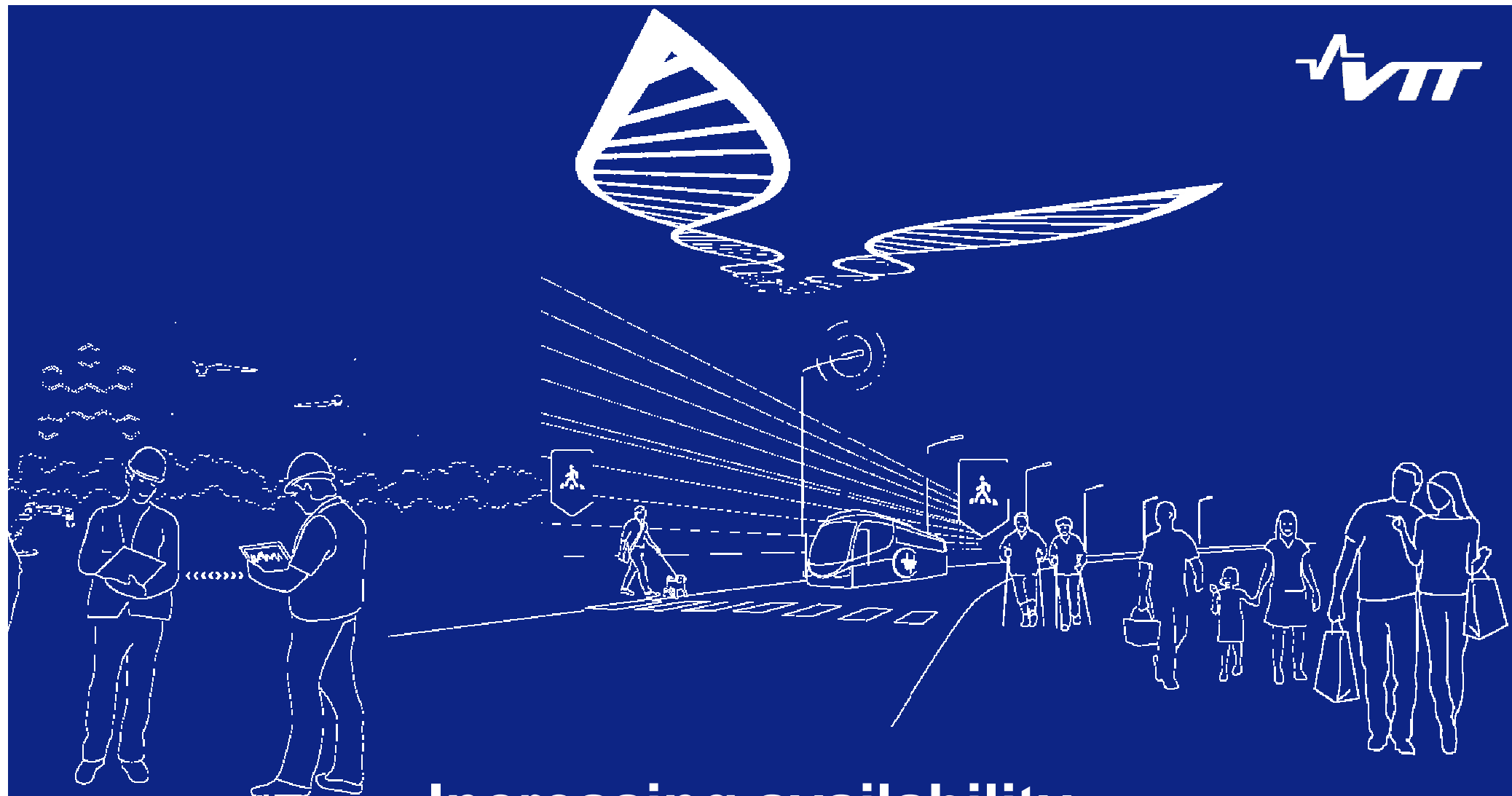


European critical materials



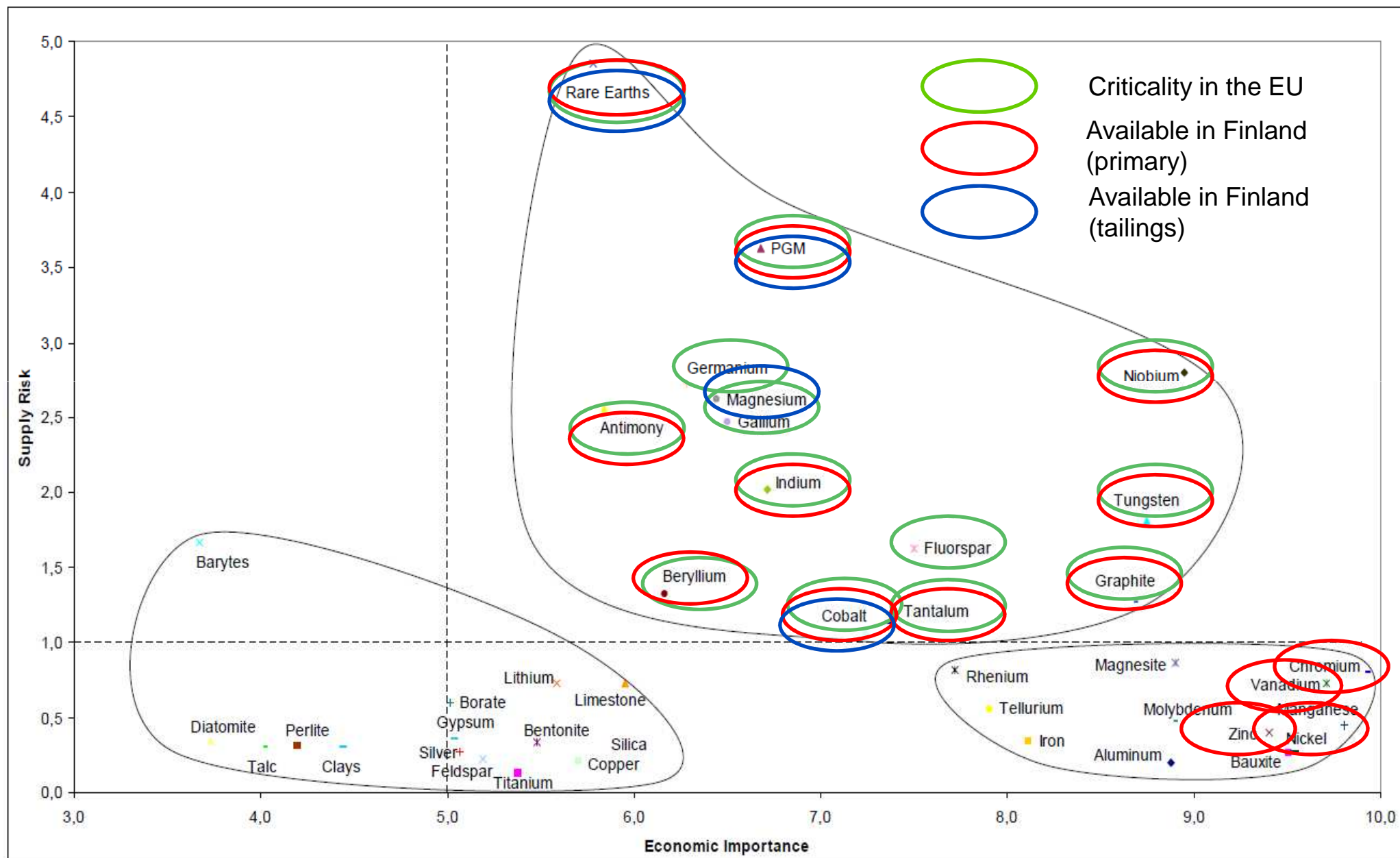


Metal industry in Finland 2012, Source Metallin toimialakatsaus 2013



**Increasing availability:
domestic streams in Finland**

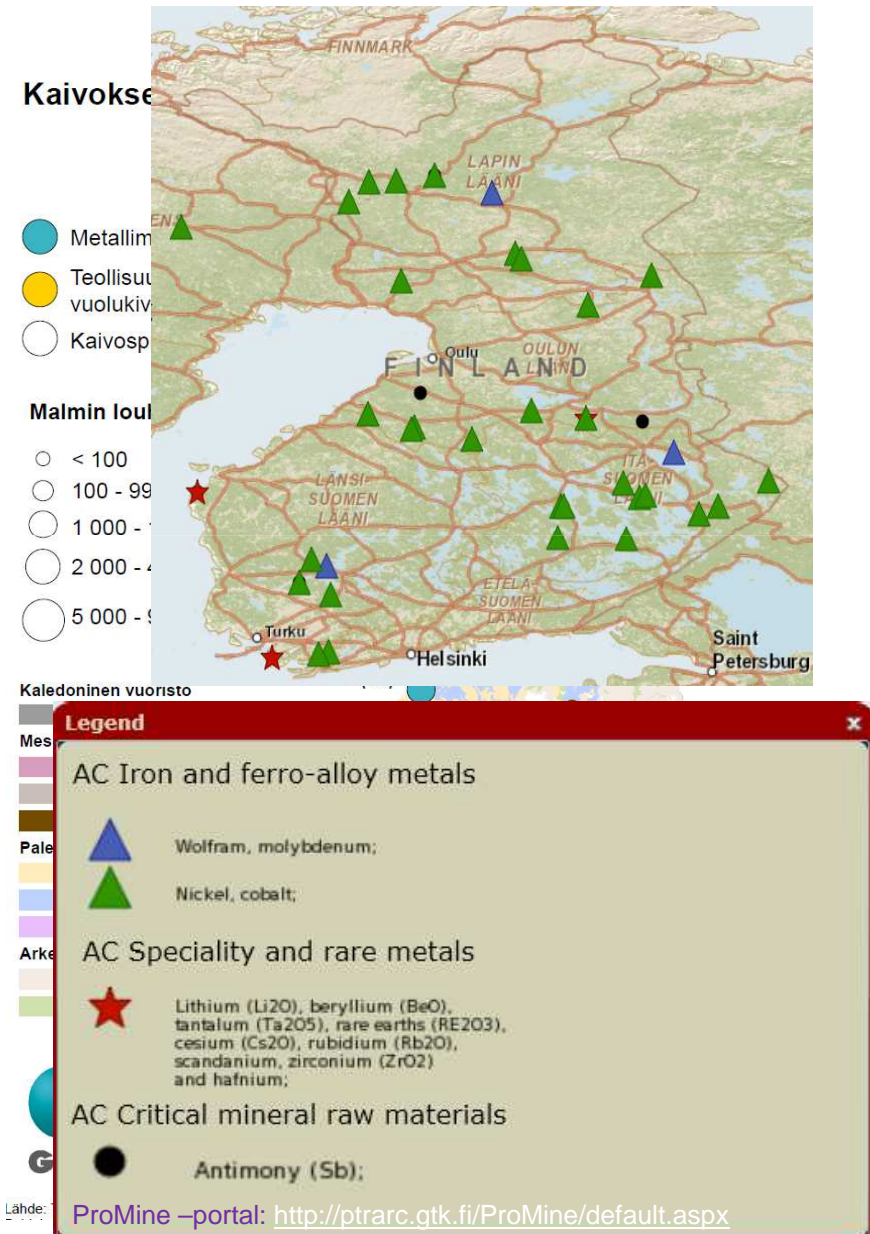
European critical materials



Good potential for primary and secondary flows



- Key primary reserves
 - Cu, Zn, Ni, Co, FeCr, Au
- Key critical metals reserves
 - Kevitsa (PGM), Suhanko (Pd-Pt-Ni), Sodankylä (Cu-Ni-PGM), Siilinjärvi (REE), Sokli (REE, Nb)
- Tailings as secondary source
 - Ferro-alloy, specialty and rare metals, critical RM



Difference between waste and primary raw material?



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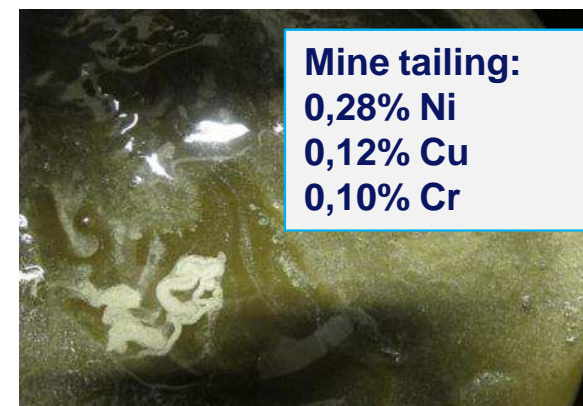
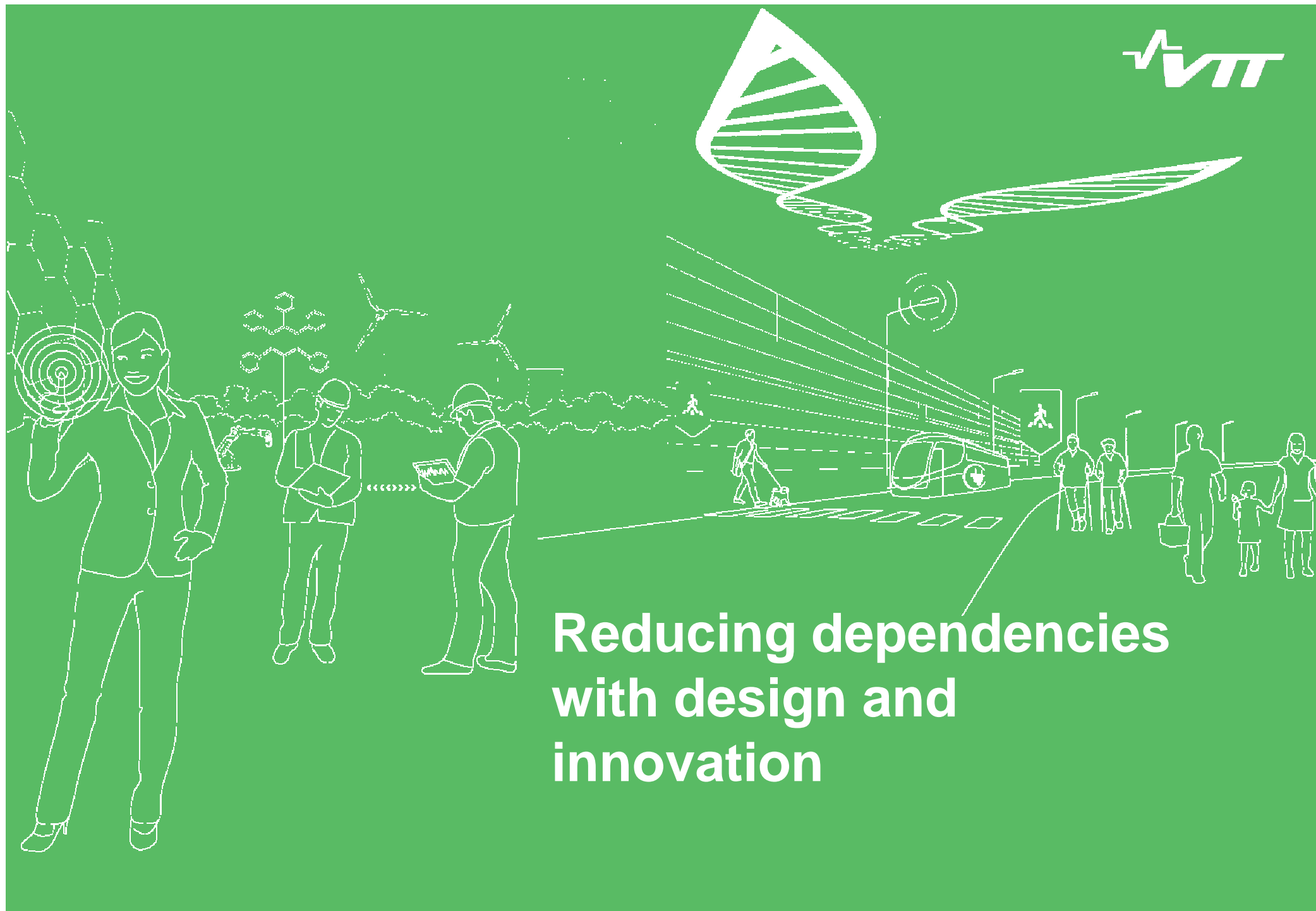
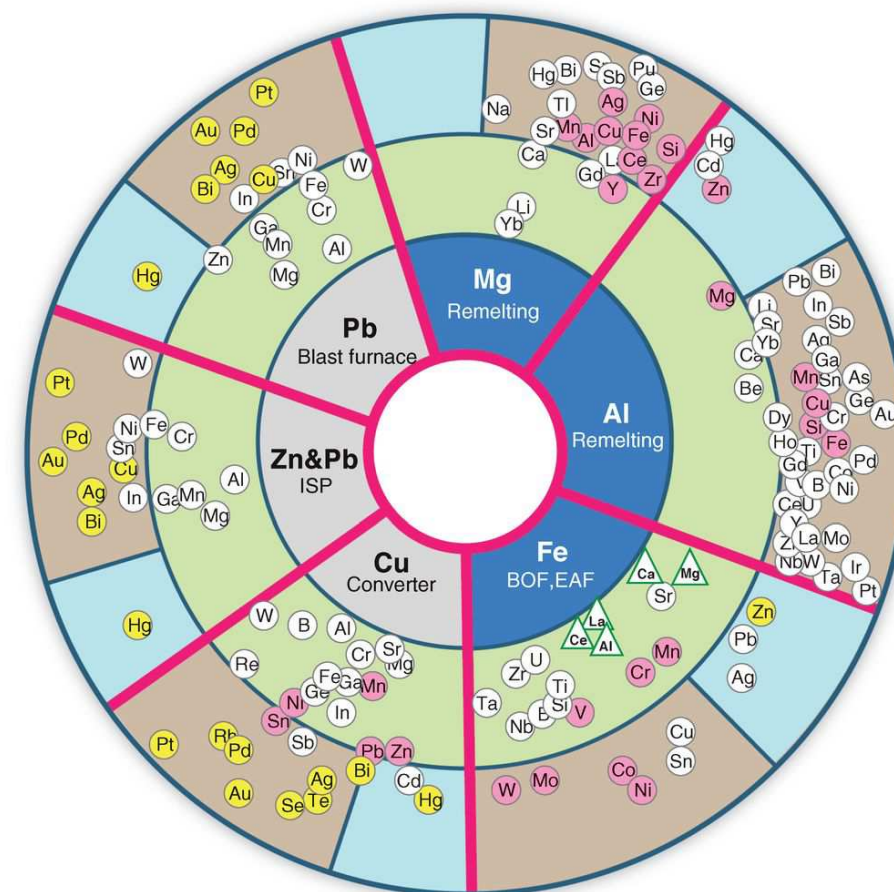


Photo: Tuulikki Nousiainen



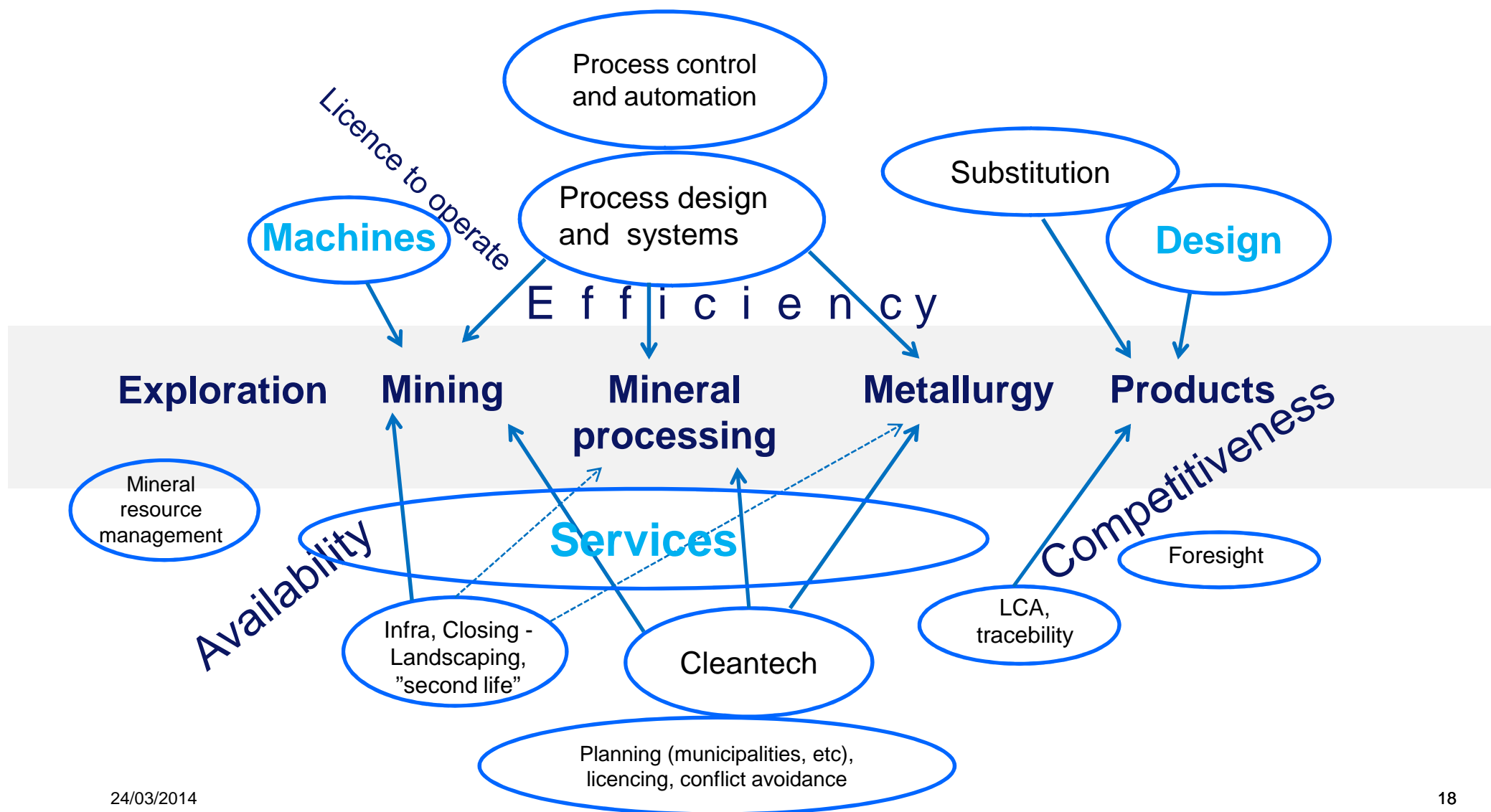


**Reducing dependencies
with design and
innovation**



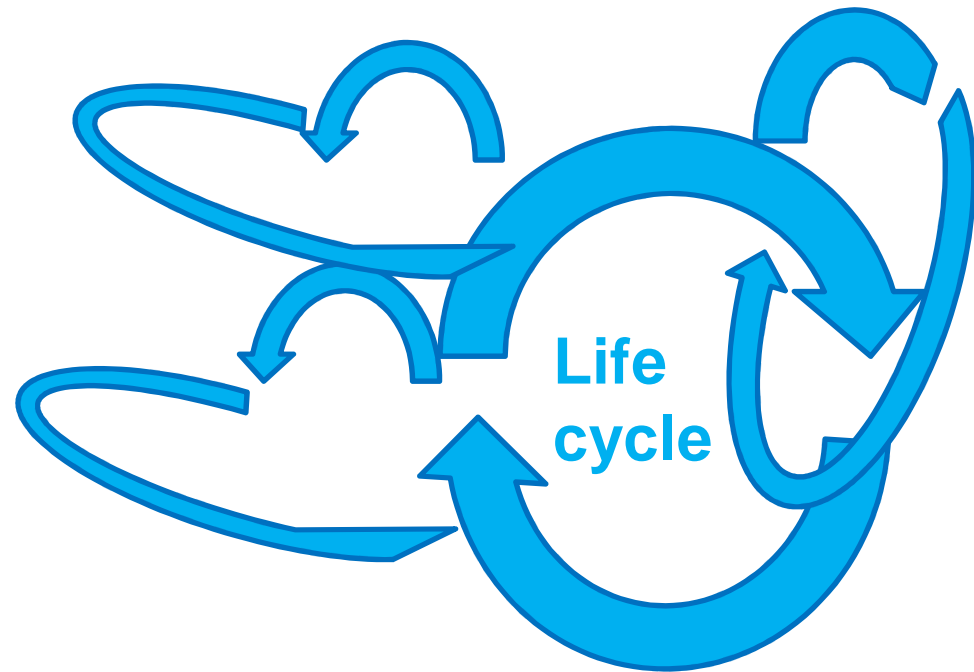
To metal phase	To slag phase	To gas phase
Elements that have distributed among the metal phase as a solid or liquid metal	Elements that have distributed among the slag phase as oxide	Elements that have evaporated and distributed among the gas phase
● Recoverable element (as pure metal)	● Alloying element	▲ Deoxidation agents

Mineral value chain – mind map

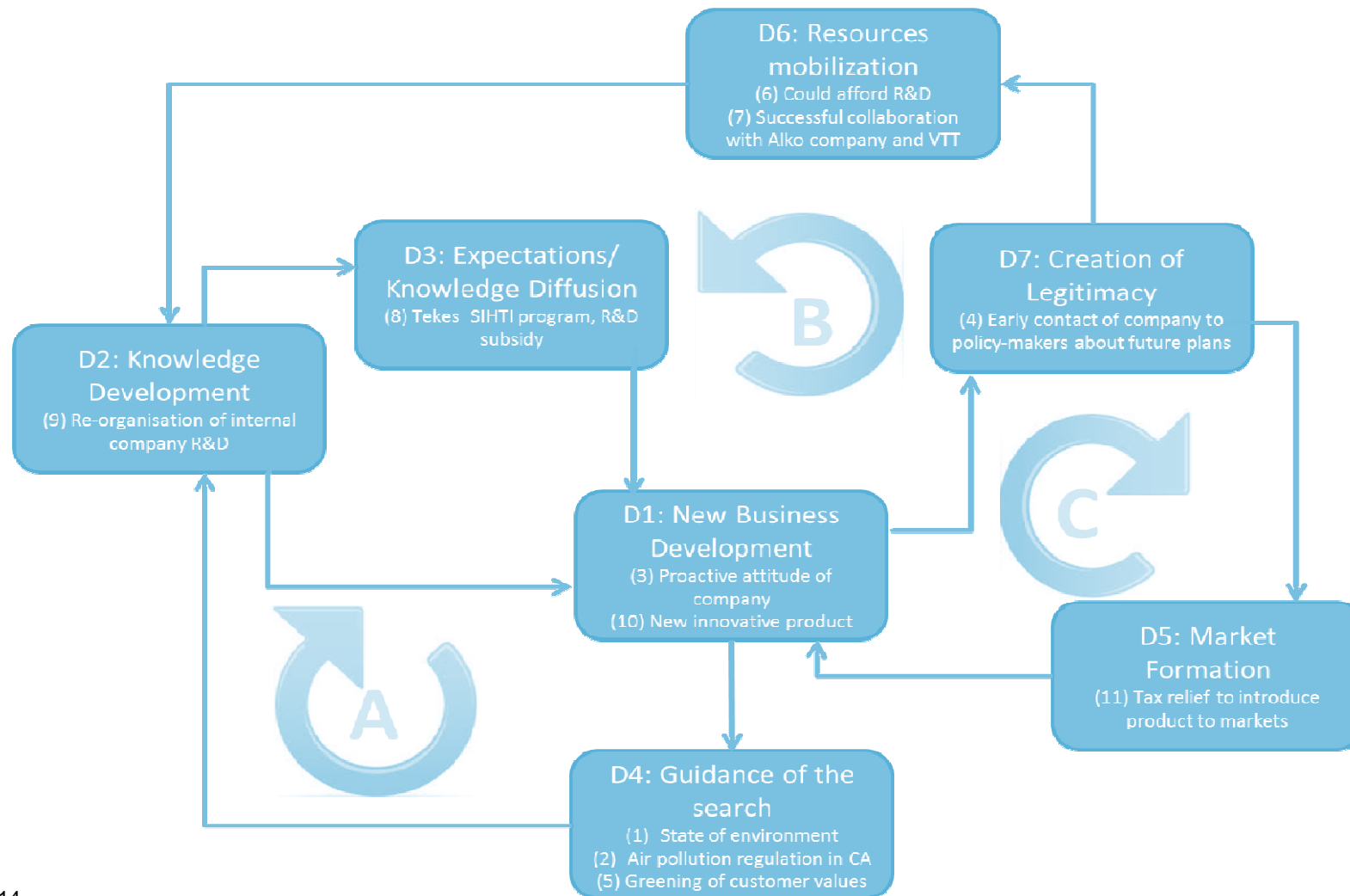


There is a need for new Design approach

- Design for lifetime
- Design for manufacturing
- Design for substitution
- Design for recycling



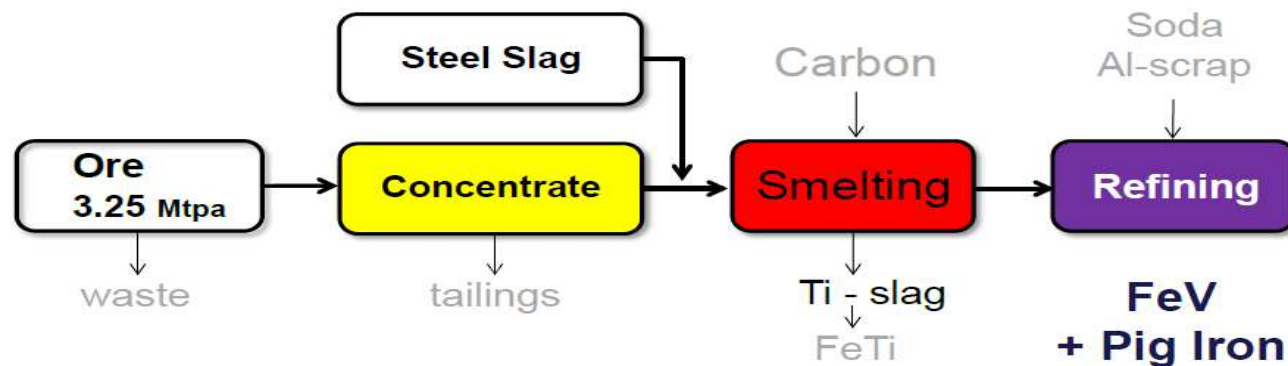
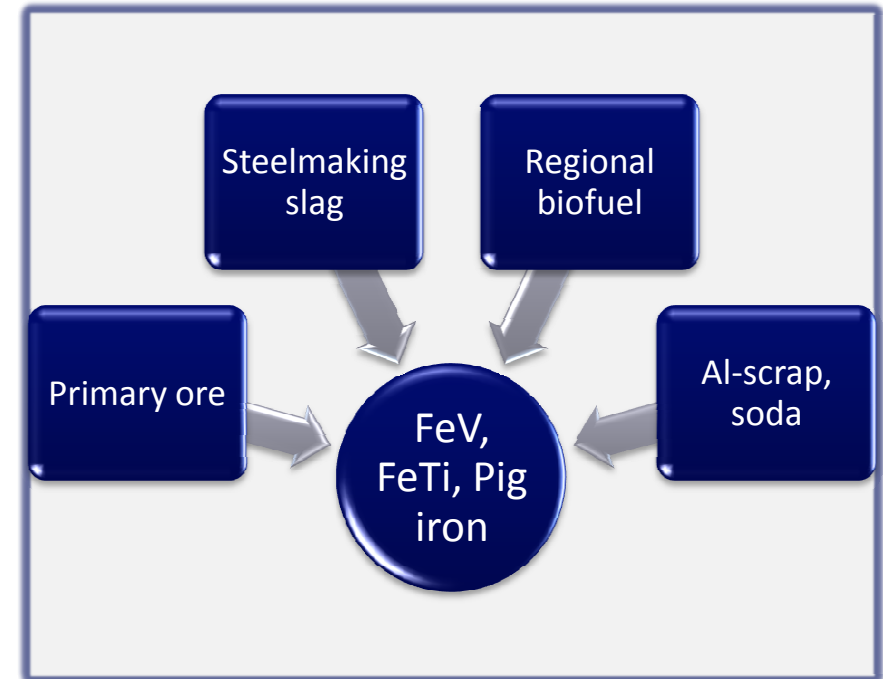
Virtuous cycles in innovation – what is missing in the mineral sector?



Systemic innovations

- **Systems planning and engineering in all levels**
 - Long term land-use planning
 - Resource flow management across the value network
 - Knowledge management upstream and downstream
 - Design driven approach
- **Cultural change from traditional throughput industry towards networked, cross sectorial clusters**

Location Map, Infrastructure



Transfer knowledge to innovations: Knowledge and Innovation Communities (KIC)



- KICs are long-term (min. 10 years) networks gathering world-class partners from industry, research and universities
- KICs aim at implementing results from classic R&D projects and bring them to market readiness
- KICs receive a funding from the European Institute of Innovation and Technology (EIT) to leverage ongoing projects towards market implementation

From lab to
market

Development, testing and market transfer
of new technologies

From student to
entrepreneur

Design of industry oriented,
interdisciplinary education schemes

From idea to
product

New ways of collaboration between
industry and research

Conclusions

- Highest potential if we look through value chain or network
- Systematic approach is a tool for new innovations and new ecosystems
- Radical thinking is needed. What is raw material? What is product?
- We should be alert also towards new regulations and possibilities with international co-operation



TECHNOLOGY «» FOR BUSINESS

