



Enabling effective  
gypsum recovery management  
by using the  
UN Framework Classification for Resources

Ulrich Kral, Technische Universität Wien  
Soraya Heuss-Aßbichler, Ludwig-Maximilians-Universität München  
Mohamed Osmani, Loughborough University

# Context and aim



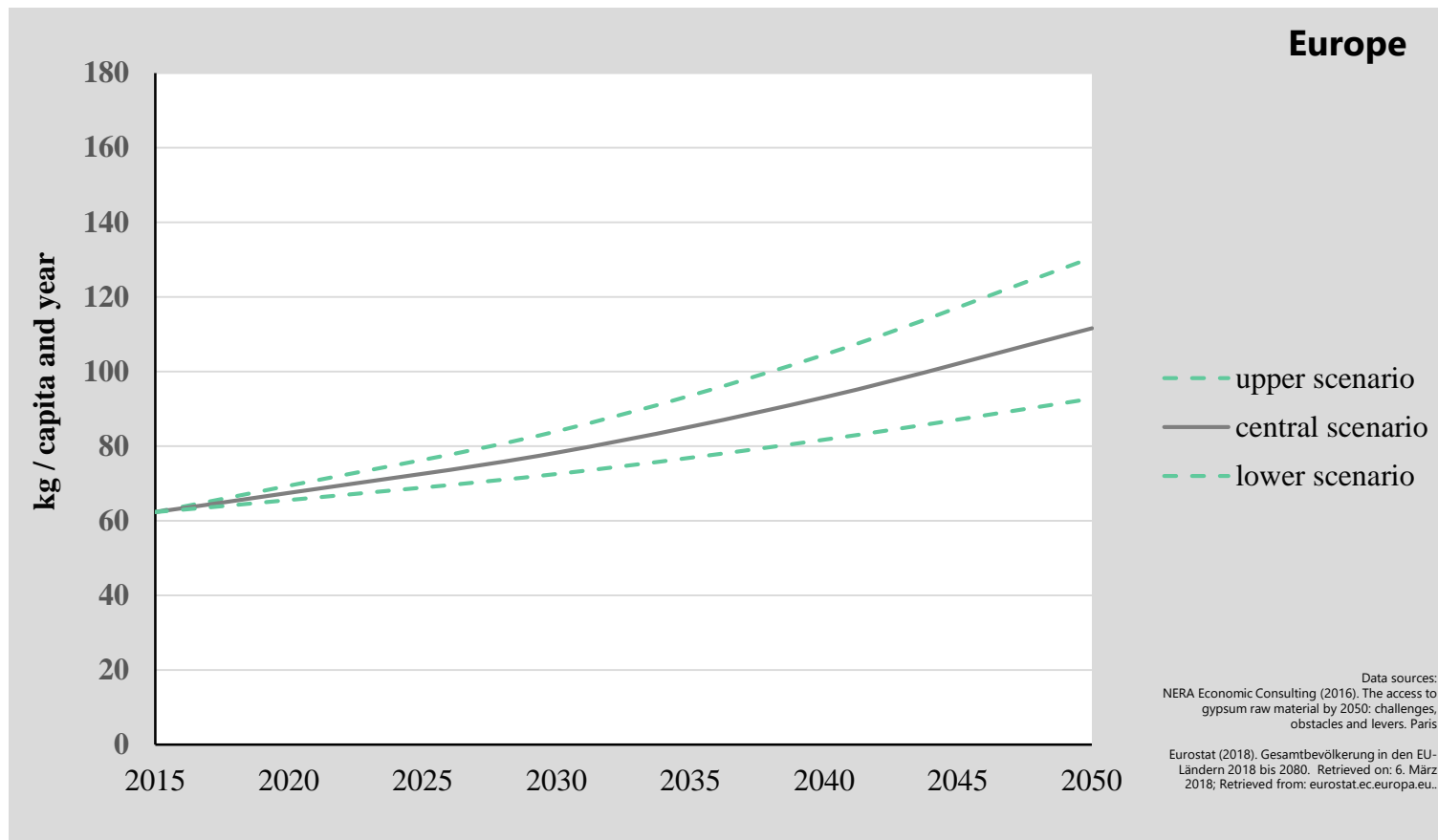
Today, recycling plays a minor role for gypsum supply.



Developing and promoting a framework for managing anthropogenic resources on its pathway to market access.

**Introducing  
the United Nations Framework Classification for Resources  
for managing gypsum recovery projects.**

# Forecasting gypsum demand



# Forecasting gypsum availability

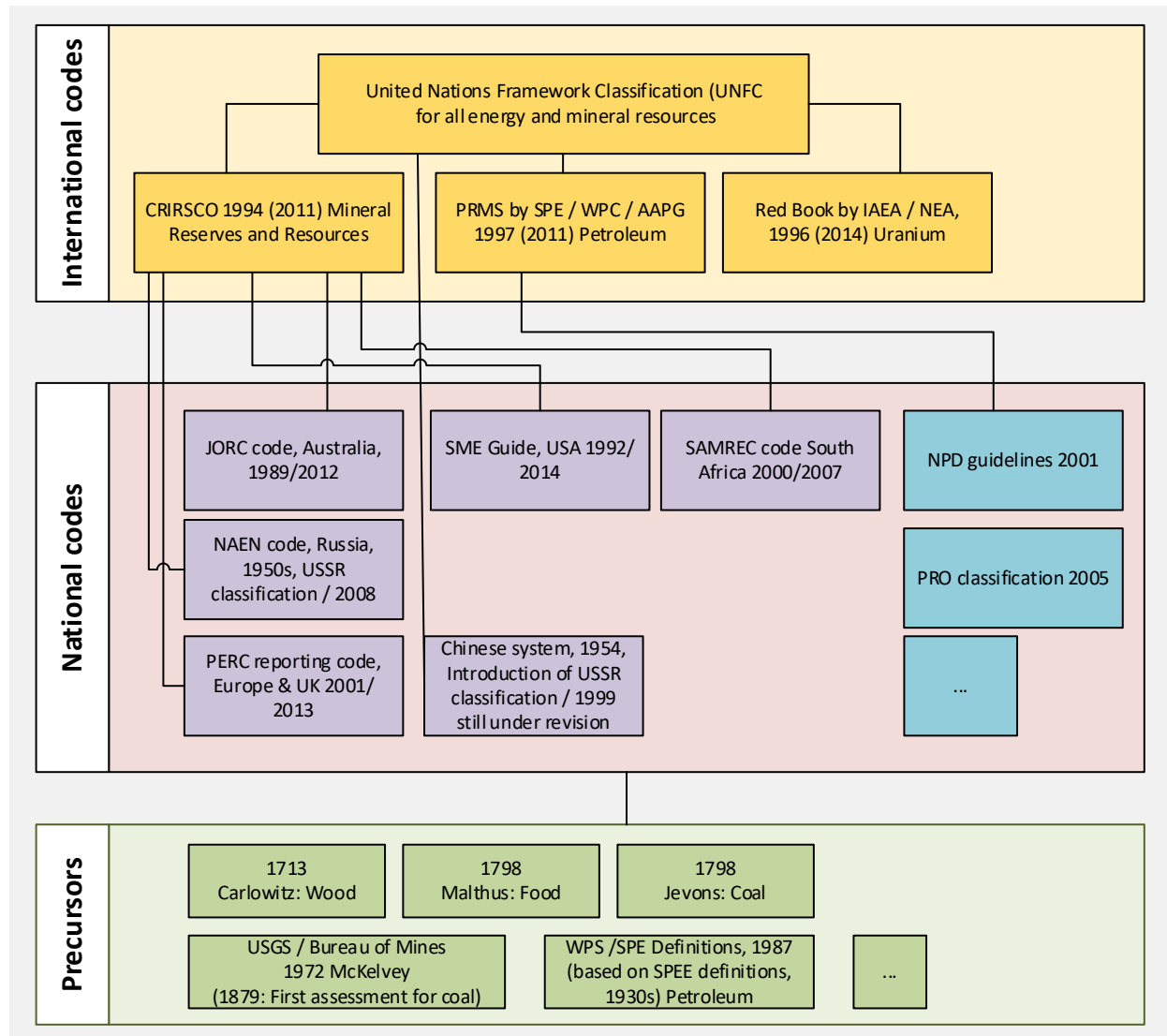
$$\mathbf{RPR \text{ [yr]} = \frac{\text{Reserves [t]}}{\text{Production } [\frac{t}{yr}]}}$$

# Natural gypsum deposits



Picture retrieved from <https://www.slavorum.org/>, Ilya Varmalov, zyalt.livejournal.com.

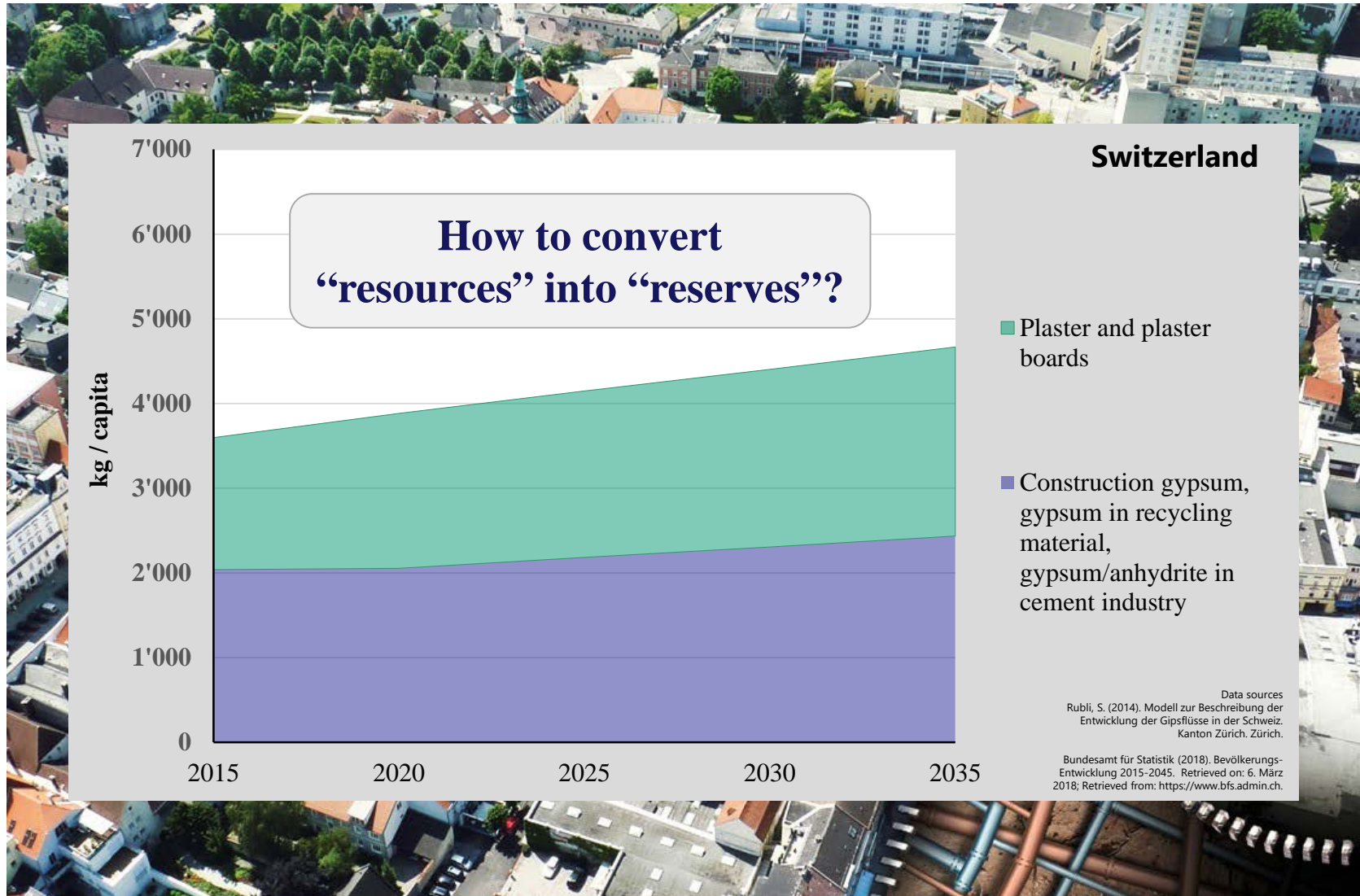
# Resource assessment frameworks



Adopted from Winterstetter, A., D. Laner, H. Rechberger and J. Fellner (2016). Integrating anthropogenic material stocks and flows into a modern resource classification framework: Challenges and potentials. *Journal of Cleaner Production* **133**: 1352-1362.

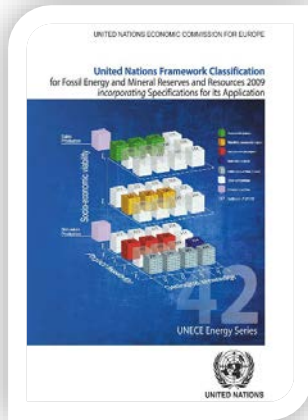


# Anthropogenic gypsum deposits



# UNFC as enabler for managing recovery projects

## United Nations Framework Classification (UNFC) for Resources



### **Communicating recoverable quantities based on the maturity level of recovery projects.**

- for all energy and mineral resources
- universally acceptable
- internationally applicable

since April 2017



### **Anthropogenic Resources**

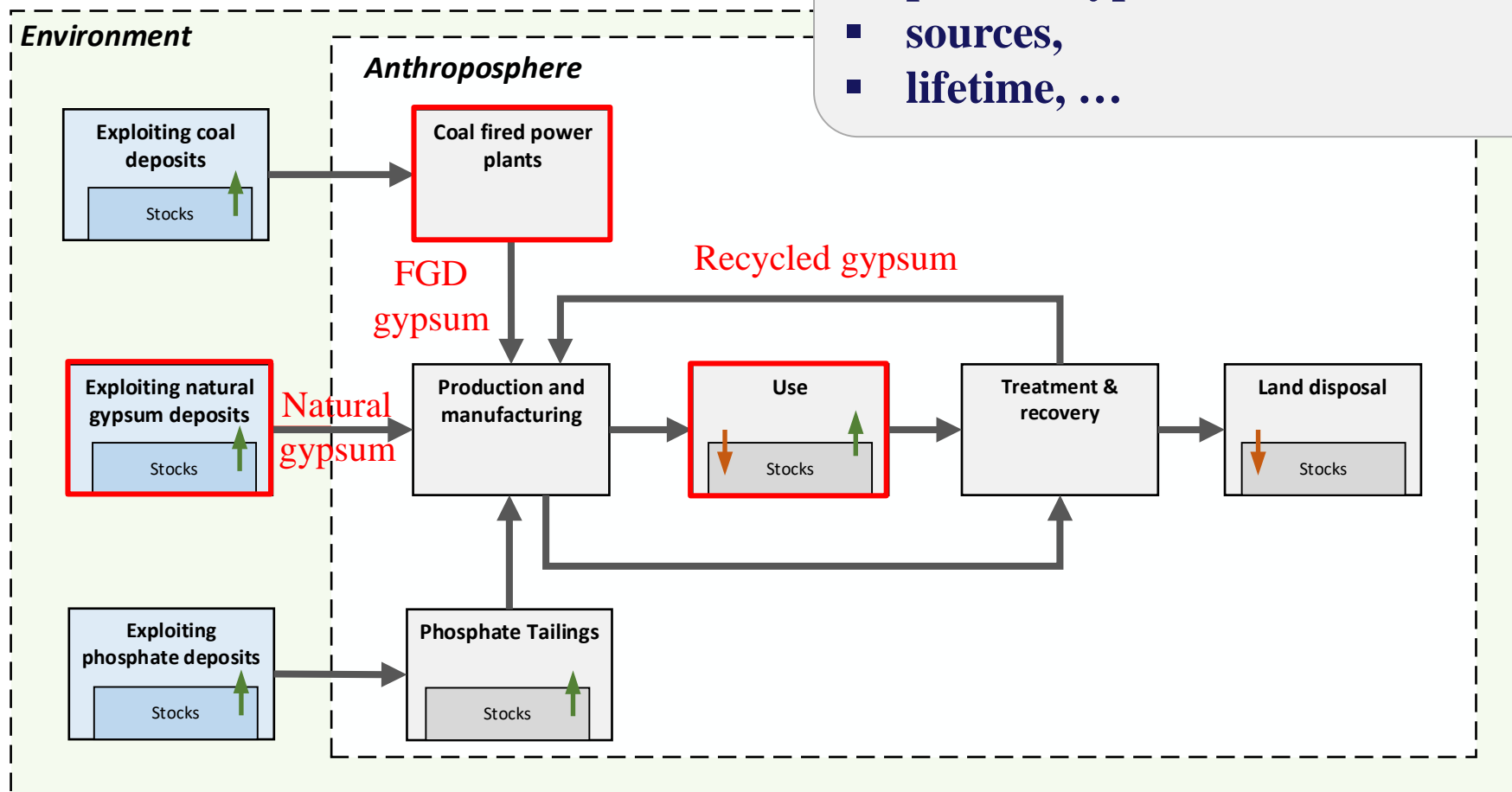
- Working Group
- Specifications to apply UNFC to anthropogenic resources
- Case studies



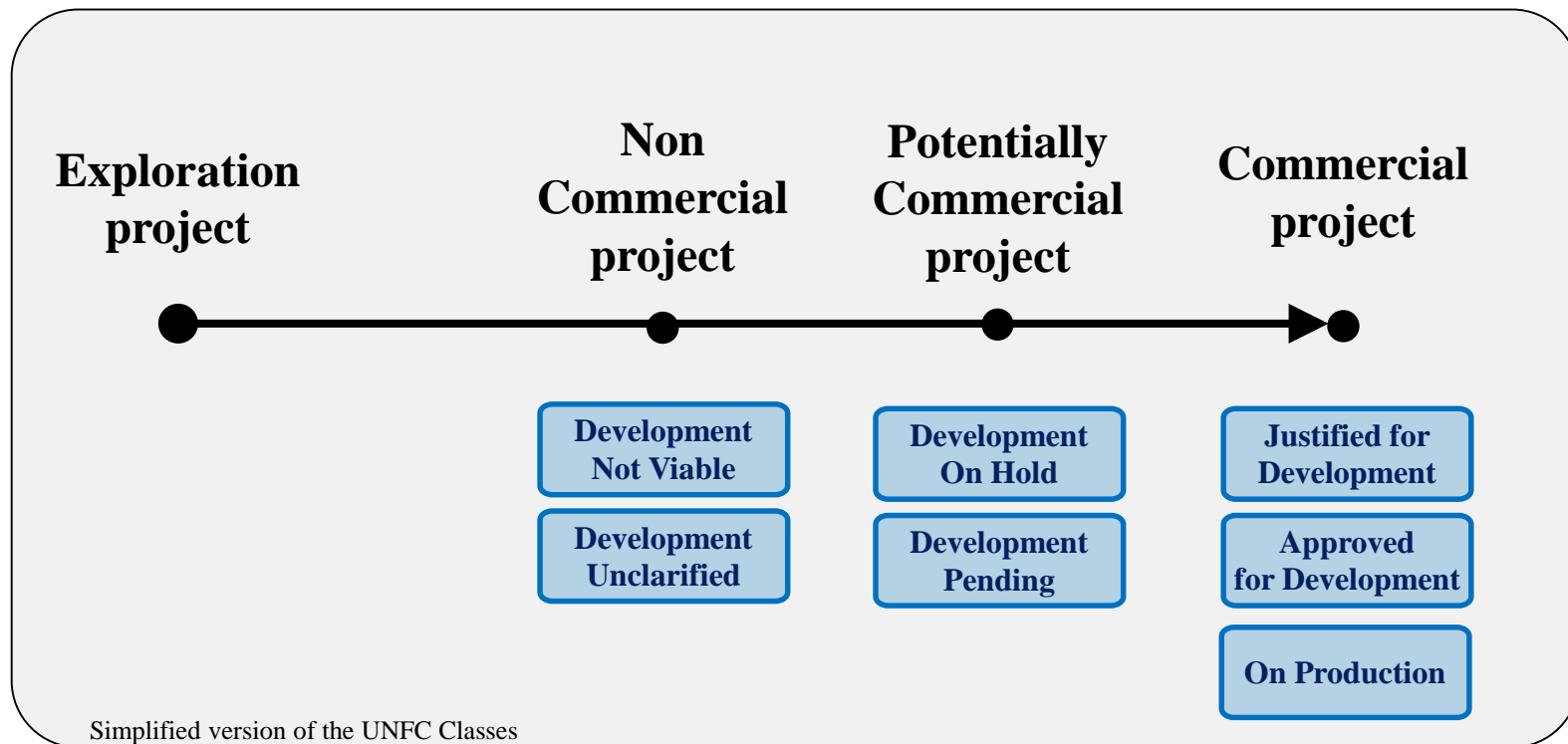
# Lifecycle of gypsum

## Defining gypsum recovery projects:

- product types
- sources,
- lifetime, ...



# Maturity levels for recovery projects



# Classifying the recovery projects

Criteria

Categories

Class

Quantity

Factors

Contingency factors:

- Political willingness
- Ecological benefits
- Net-present value
- Access to market, ...

Socio-economic viability

Commercial  
Project

E1 F1 G3

30 kt

Level of confidence in the potential  
recoverability of the quantities

Re-classifying projects through the  
satisfaction of contingency factors.

- high
- medium
- low

Project feasibility

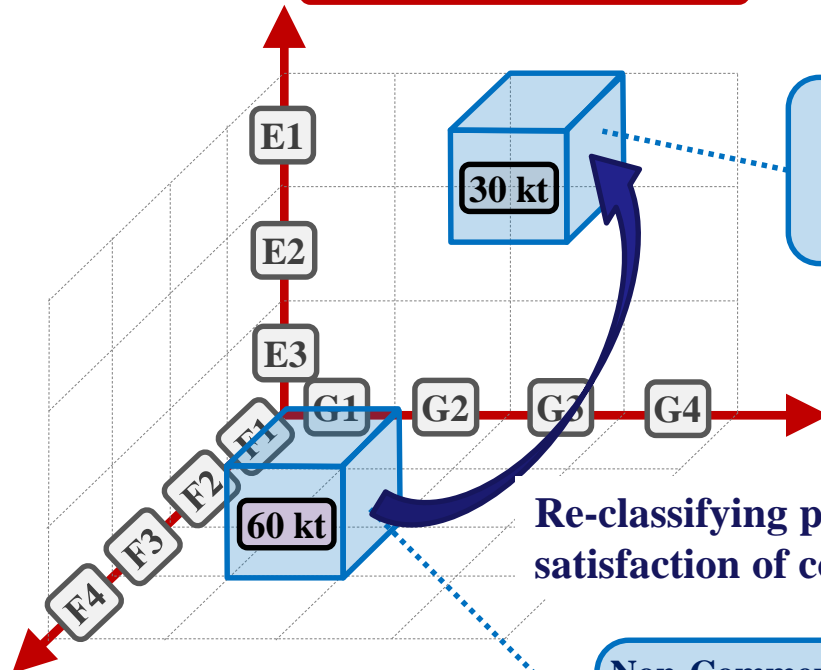
Contingency factors

- Readiness of technology
- Availability of transport infrastructure, ...

Non-Commercial  
Project

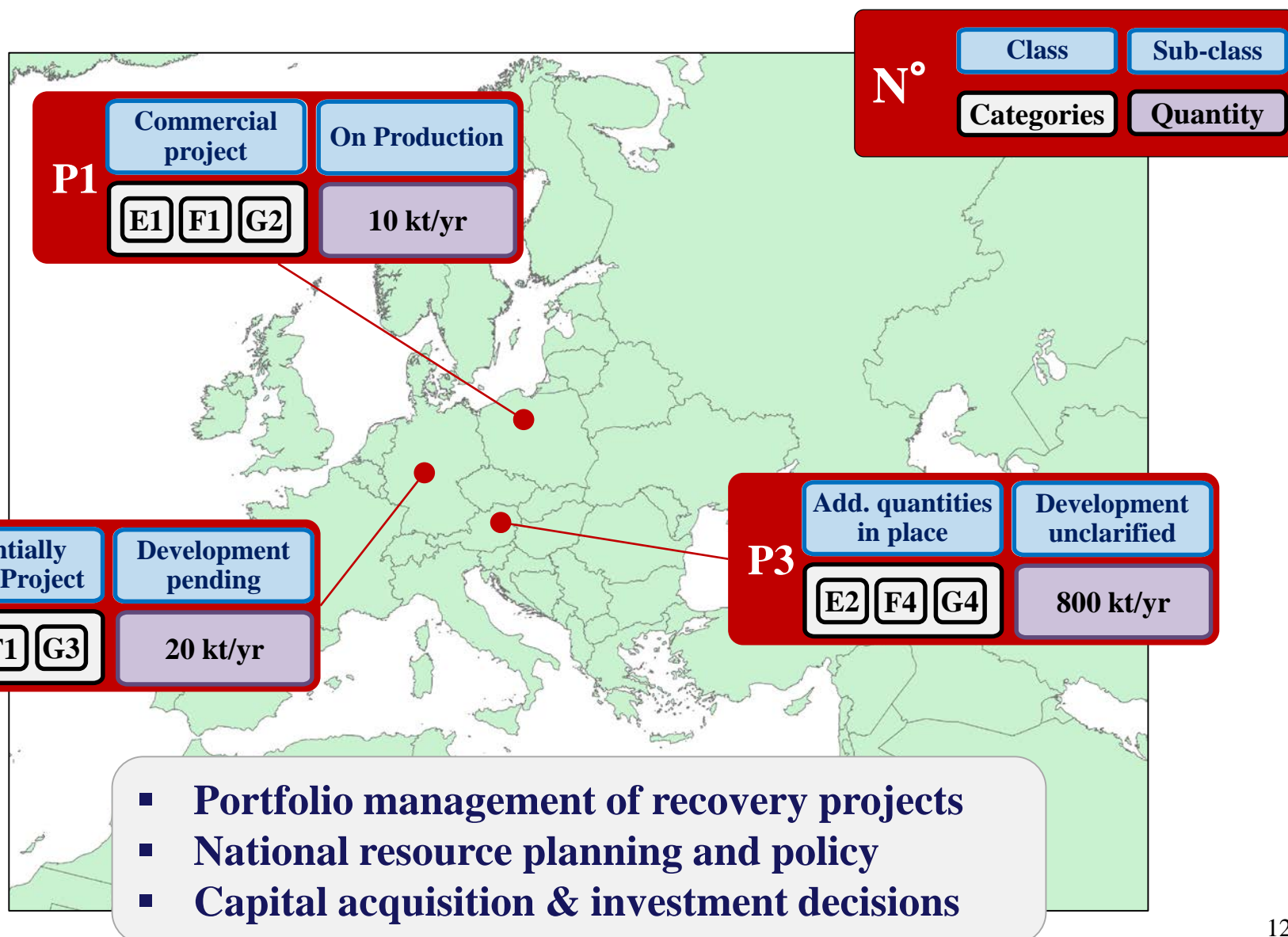
E3 F3 G2

60 kt



# UNFC Results: Snapshot

Example



# UNFC Results: over time

Example

Year <del>2010</del> 2011						
Class	Sub-class	Austria	Belgium	Germany	France	....
Commercial Project	On Production	3'000	20'000	2'000		
	Approved for Development				10'000	
	Justified for Development					
Potentially commercial project	Development Pending					
	Development On Hold					
Non-commercial project	Development Unclassified		180'000	80'000		
	Development Not Viable				300'000	
Additional quantities in place	-	100'000				

?

**Re-classifying projects through the satisfaction of contingency factors.**

# Take home messages

- 1. Recycling plays a minor role for gypsum supply.**
- 2. Managing gypsum on its pathway to market access requires consistent, reliable and transparent estimates on recoverable gypsum quantities.**
- 3. The UNFC helps to**
  - manage (gypsum) recovery projects from the exploration to the production phase.
  - communicate critical factors for the viability of recovery projects
  - carry out strategic resource planning and make sound judgements on the potential of material sourcing projects.





Thank you for listening

**Ulrich Kral**

Technische Universität Wien  
Research Center for Waste and Resource Management  
Karlsplatz 13/226  
A-1040 Vienna, Austria  
[ulrich.kral@tuwien.ac.at](mailto:ulrich.kral@tuwien.ac.at)  
[iwr.tuwien.ac.at/en/](http://iwr.tuwien.ac.at/en/)  
phone +43 1 58801 226 55

**COST Action MINEA**

[www.minea-network.eu](http://www.minea-network.eu)  
[http://www.cost.eu/COST\\_Actions/ca/CA15115](http://www.cost.eu/COST_Actions/ca/CA15115)

**UNECE Expert Group on Resource Classification**

<https://www.unece.org/energy/se/reserves.html>