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AACHEN KNOW-HOW CENTRE RESOURCE TECHNOLOGY

The BiRec Project
-*FactSage*™ supported process design-

B. Friedrich

IME Metallurgie Prozesstechnik Recycling
DIE METALLURGEN

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Proposal Overview

Innovative Technologien für Ressourceneffizienz
Bereitstellung wirtschafts-strategischer Rohstoffe

Bundesministerium für Bildung und Forschung

- **BMBF call r4 „Innovative Technologies for Resource Effiency“**
  - **Pupose: Secure raw materials basis for future technologies**
  - **Materials Focus: High tech metals with major economic leverage**
  - **Research Focus:**
    - **Economic use of complex ore deposits**
    - **Exploration of primary resources**
    - **Closed loop development for used products**
    - **Increase of accepatance for raw materials production**
    - **Processing of production residues**

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BiRec Summary

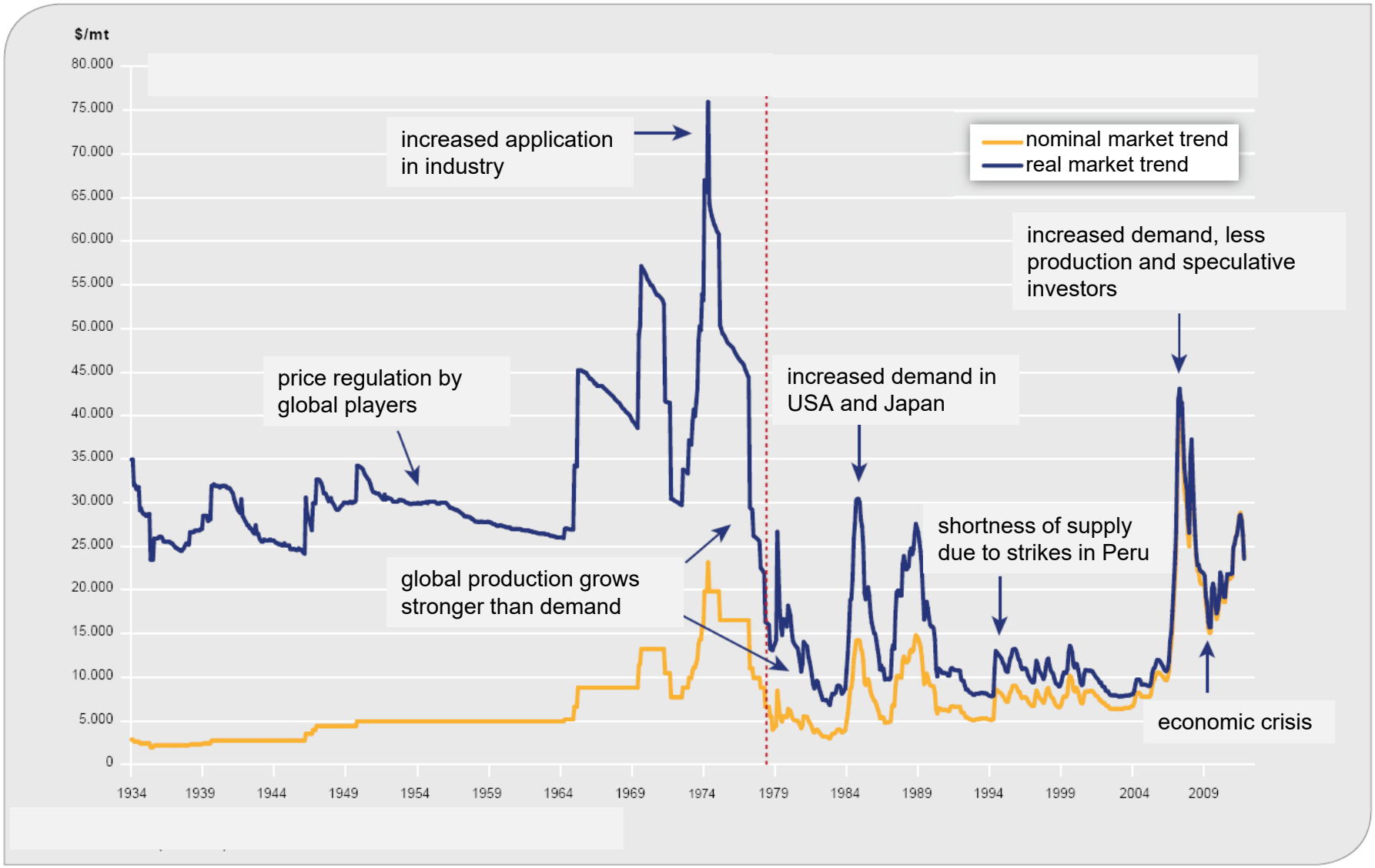
- **Purpose:** Development of a sustainable route for inner European processing of Bismut drosses through innovative refining technologies
- **Project duration:** 36 months (start: Sept. 2016)
- **Consortium:** 2 x Industry, 1 x SME , 1 x University
- **Total funding:** ~ 1.200.000 €
- **Internet:** http://www.r4-innovation.de/

Criticality of Bismut

- Primary Bi mainly produced in China (84 %)
- Worldwide Bi-demand doubled since 1990
- Current demand growth 10-15 %/a
- Future growth progonosis ~ 25 %/a
- Driver for increasing demand: hightech applications in medicine and electrotechnology (e.g. semiconductors)

Chinese market dominance in combination with growing demand and difficult substitution leads to volatile pricing

Price Fluctuations for Bismut on a Long Term View



Bi-supply through lead production

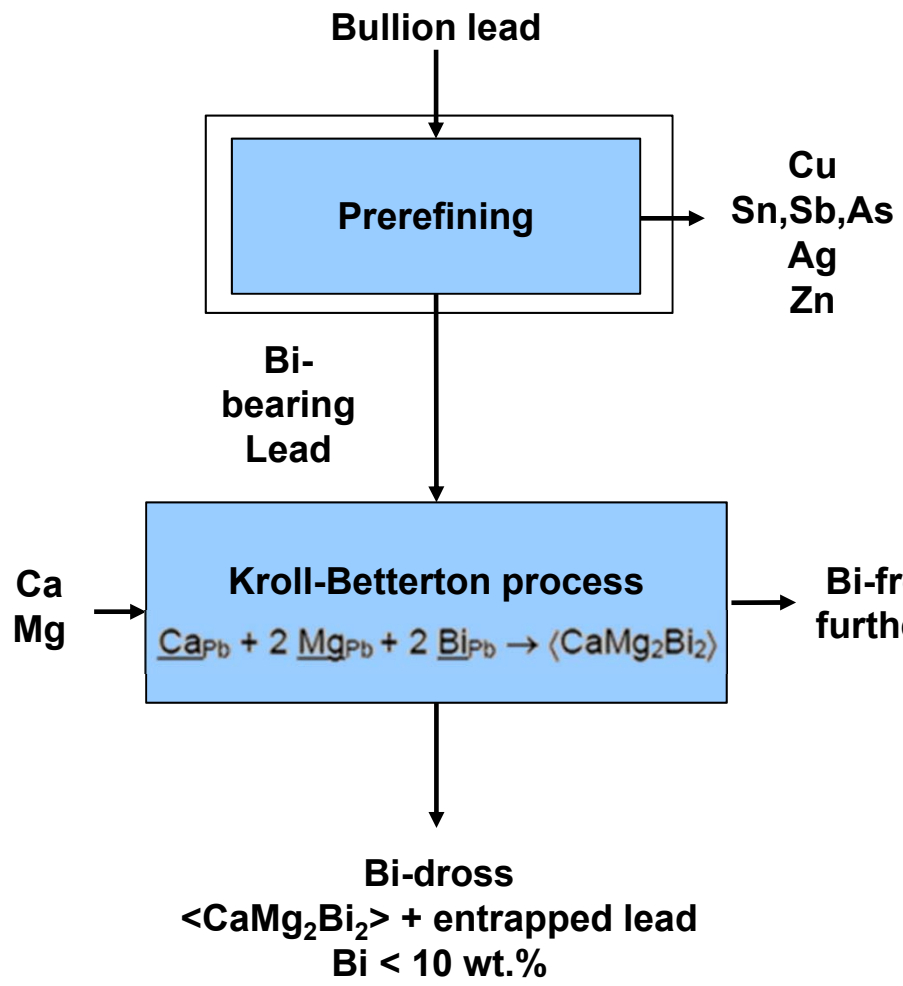
- Bi-rich ores are rare
- Main Bi-supply as byproduct of tungsten, copper, tin, zinc, gold, silver and lead production
- Lead industry originates ~ 90-95 % of byproduct bismut

Source: BBH

Sustainable production techniques for technical bismut from lead streams are needed to ensure independent supply for high tech industries

Origin of Bi-rich drosses

Lead refining process



Source: BBH

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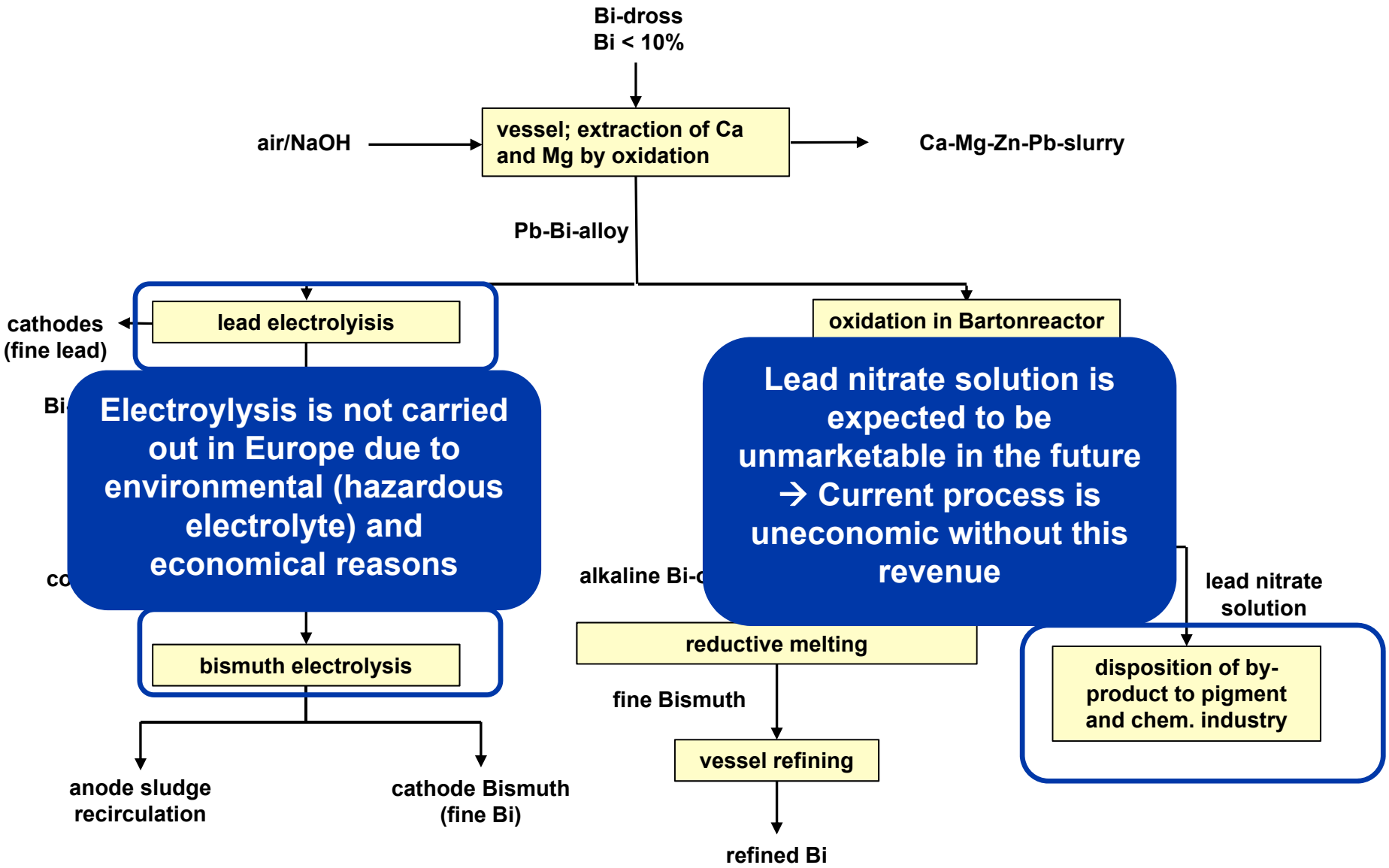
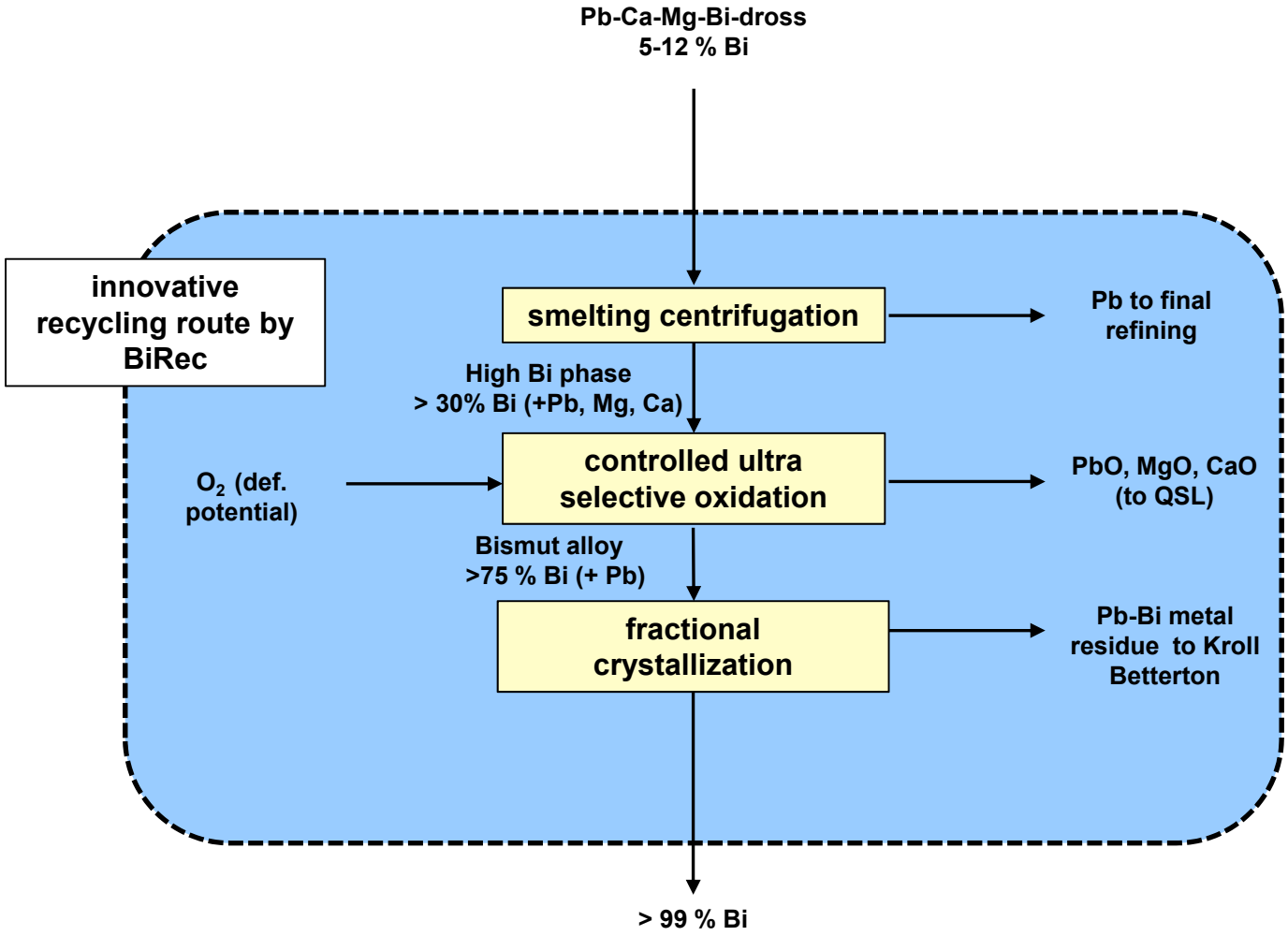
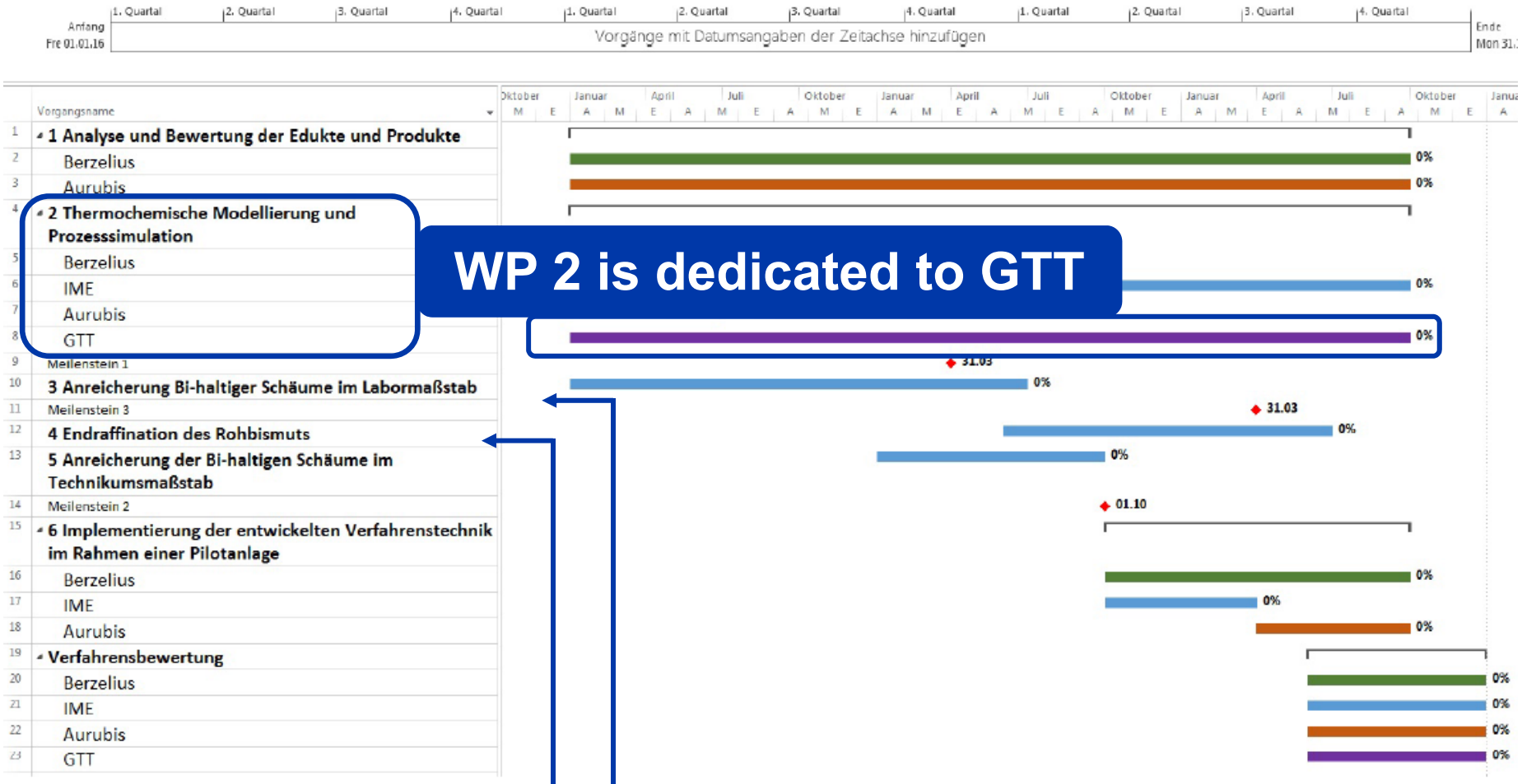
State of the art processing of Bi-drosses



Innovative BiRec Processing Concept



Workpackages supported by FactSage™



WP 2 is dedicated to GTT

Modelling of two process steps in other WPs is carried out

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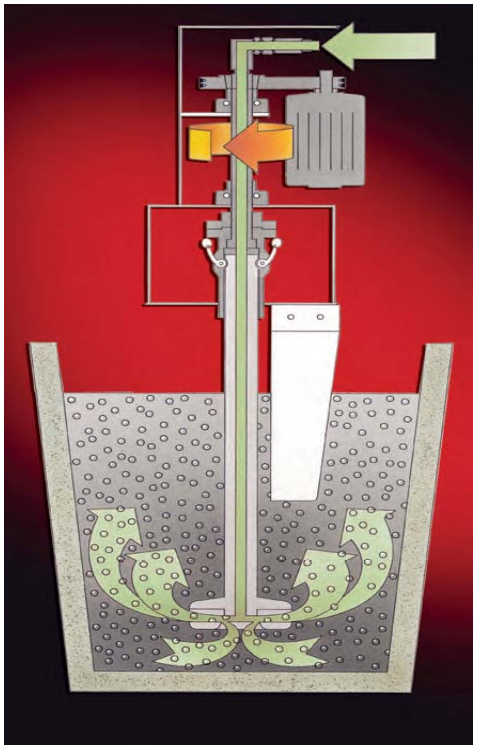
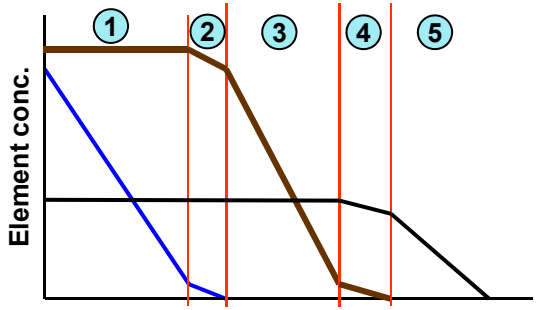
Oxidation of Bi-drosses

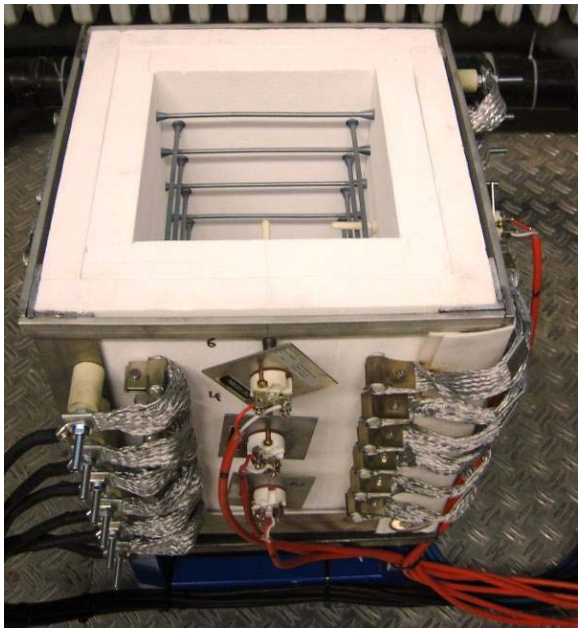
- Goal: further Bi-enrichment > 75 wt.% of centrifuged drosses prior to fractional cristallization
- Principle: Selective oxidation of Mg, Ca, and Pb
- Involved FactSage™ tools: Equilib, Predom, Reaction
- Preliminary work is required to establish a suitable database in FactSage™ for the Pb-Bi-Ca-Mg-O system
- Outcome: Optimal temperature, Oxygen content, achievable enrichment

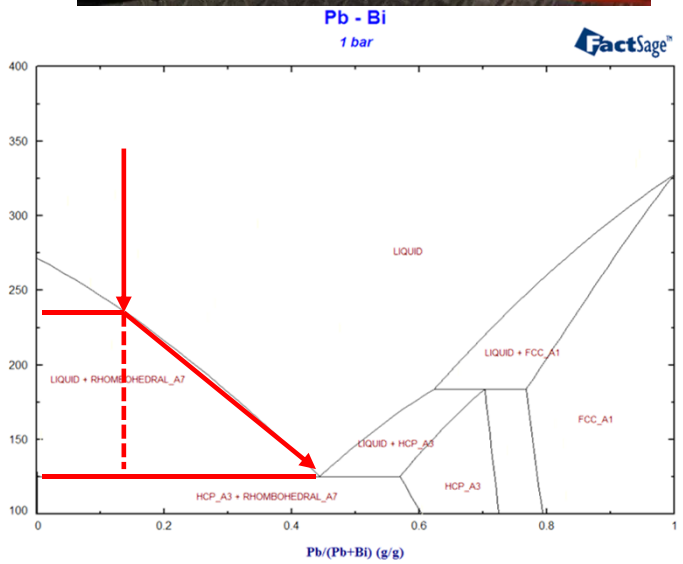




Fractional Cristallization

- Goal: Fractional cristallization of raw Bi up to a purity > 99 wt.%
- Principle: top to bottom controlled cooling
- Involved FactSage™ tools: Equilib (Scheill Cooling)
- Preliminary work is required to establish a suitable database in FactSage™ for the Pb-Bi-Ca-Mg-O system
- Outcome: Achievable degree of purity depending on feed material, behaviour of impurities





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Summary

- GTT as partner in the BiRec joint r4 project to adress criticality of Bismut supply in Germany
- Design of new sustainable Bismut recovery and refining processes from lead residues will involve two steps which can be simulated with FactSage™
  - Selective Oxidation of Bi-Ca-Mg-Pb melt
  - Fractional cristalization of Pb-Bi alloy
- Database development is needed in advance

GTT User-Meeting 2016; June 29th

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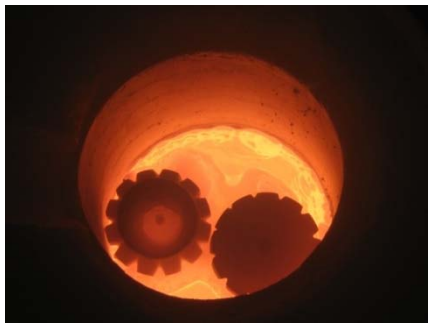
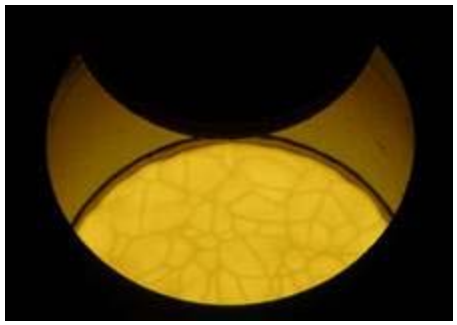
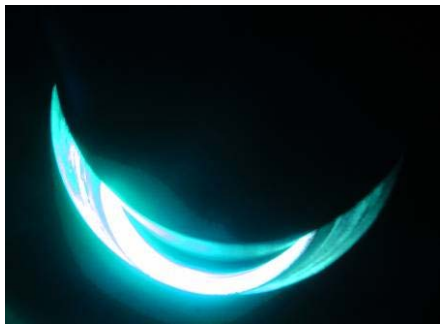
Thank you for your attention!

For further information please contact:

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