Integrated Technologies for Efficient Recycling of Lithium-Ion Batteries

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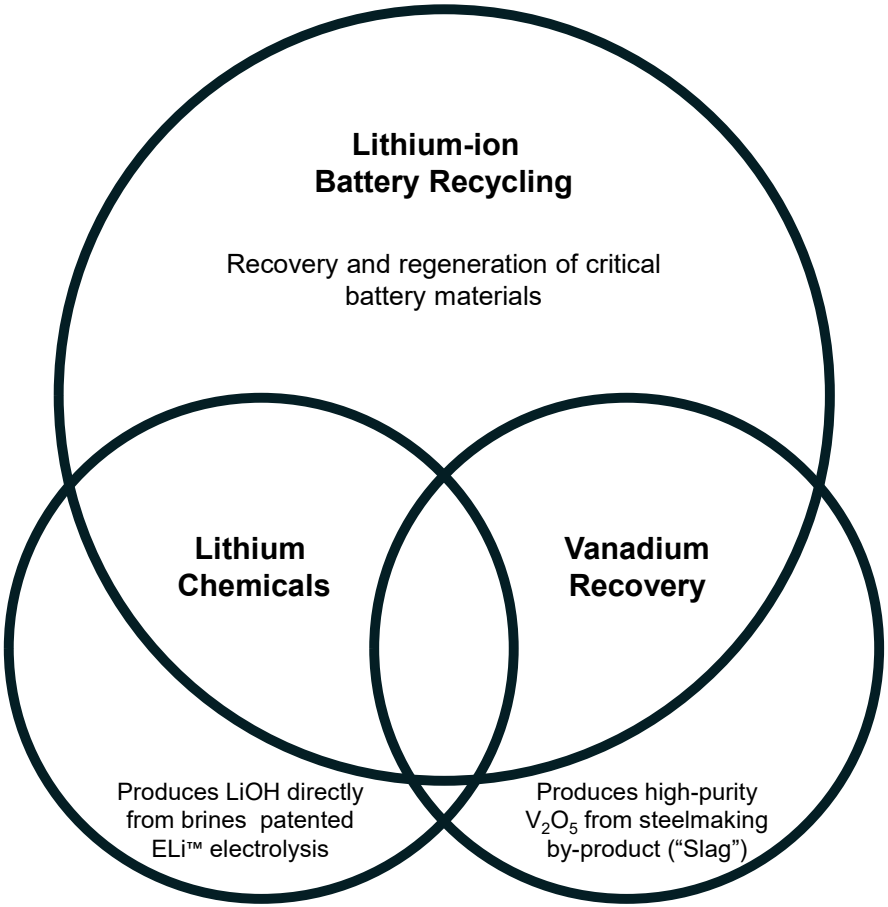
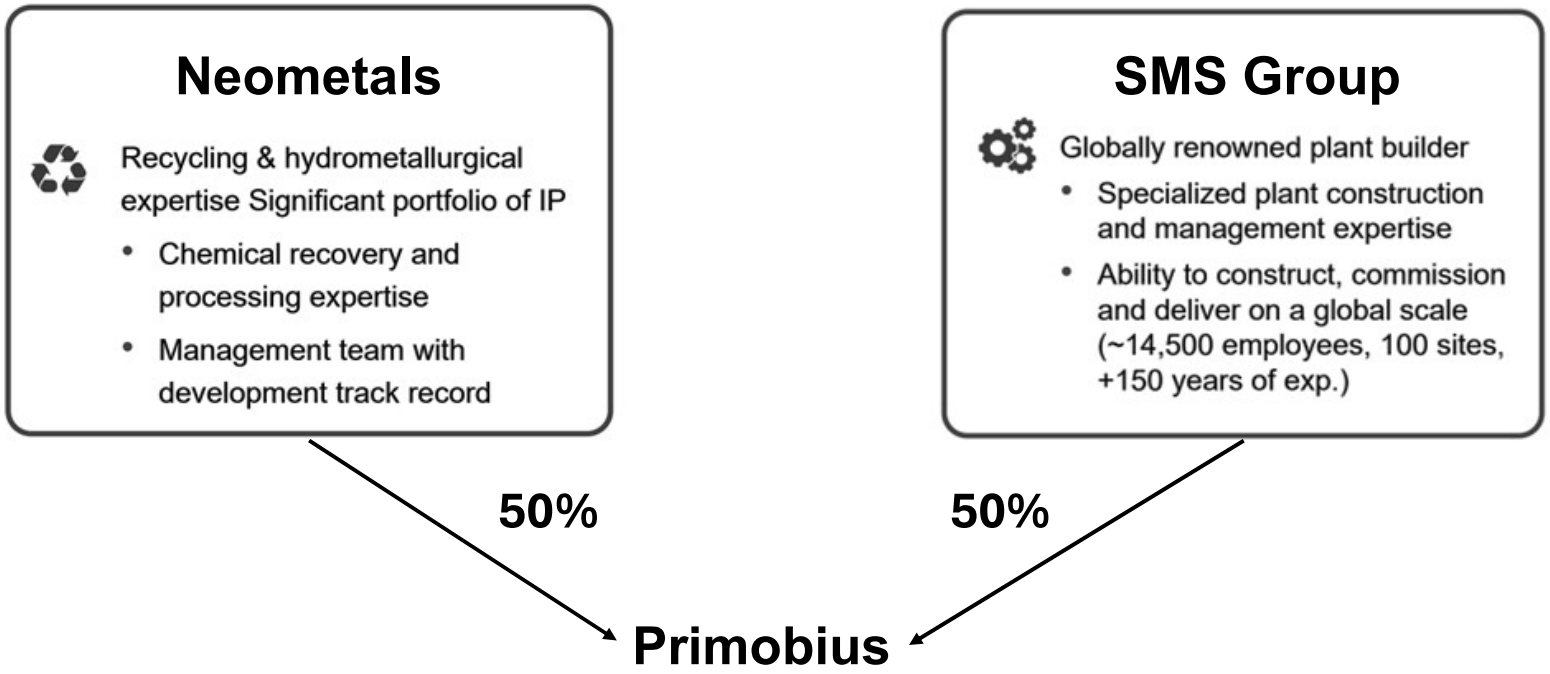
Focus


Lithium-ion
Battery Recycling
Recovery and regeneration of critical battery materials
Lithium Chemicals
Vanadium Recovery
Produces LiOH directly from brines patented ELi™ electrolysis
Produces high-purity V_2O_5 from steelmaking by-product (“Slag”)

Lithium-ion Battery (LiB) Recycling Project



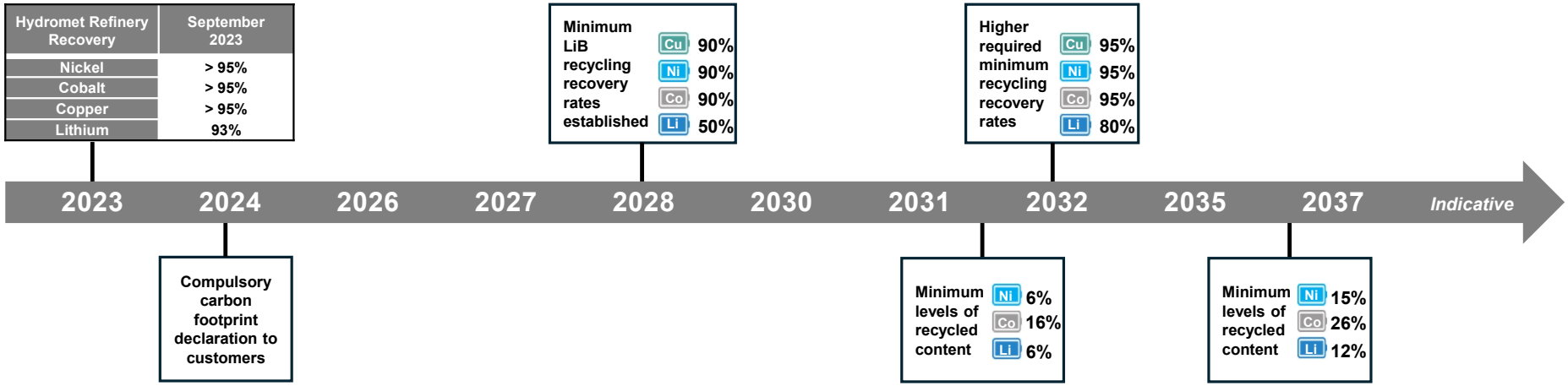
Overview of Presentation

1. Background/Challenges of Battery Recycling
2. Introduction of our Integrated Battery Recycling Technologies
3. Role of Thermodynamic Modelling in Process Development
4. Key Milestones – Mercedes Plant

Background/Challenges of Battery Recycling

Primobius

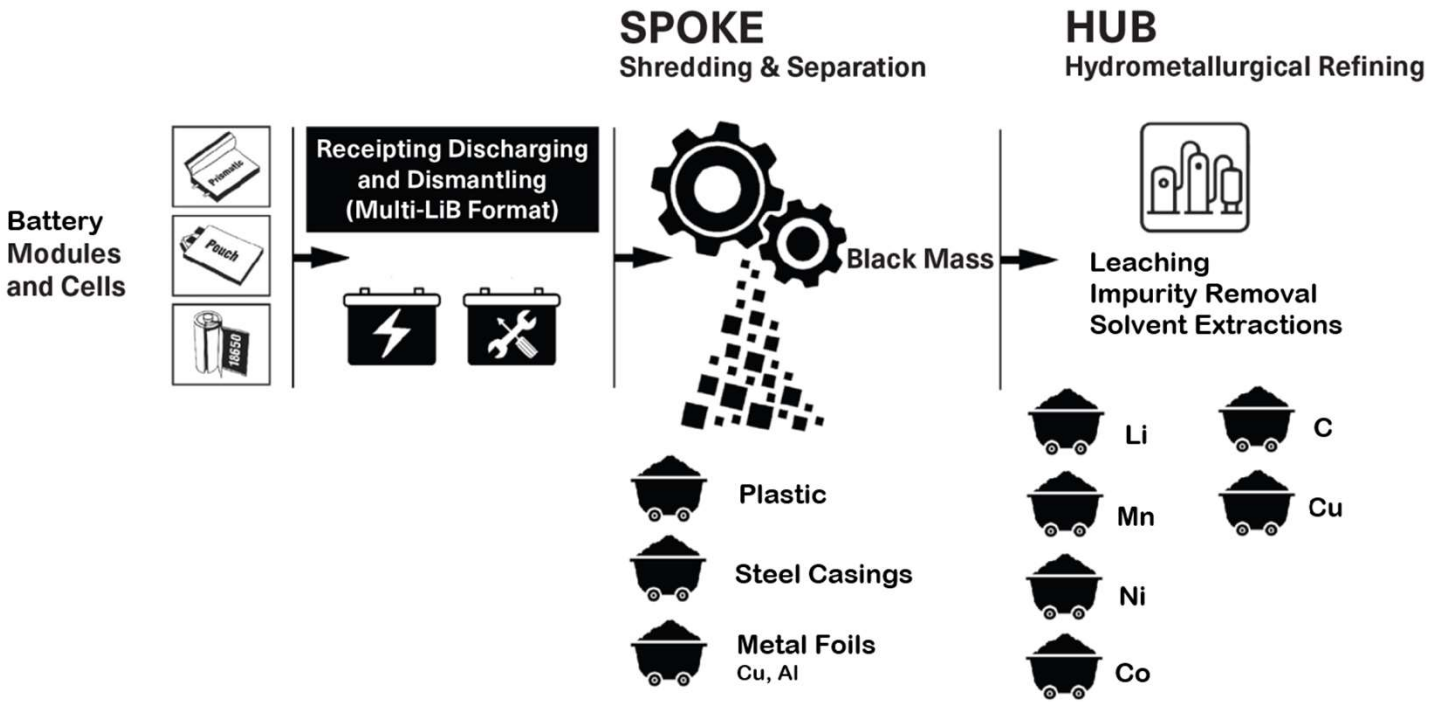
Hydromet Refinery Recovery	September 2023
Nickel	> 95%
Cobalt	> 95%
Copper	> 95%
Lithium	93%



European regulations are pushing the responsibility to "close the loop" to the OEMs

Source: Regulation (EU) 2023/1542 of the European Parliament and of the Council

Integrated Battery Recycling Technologies



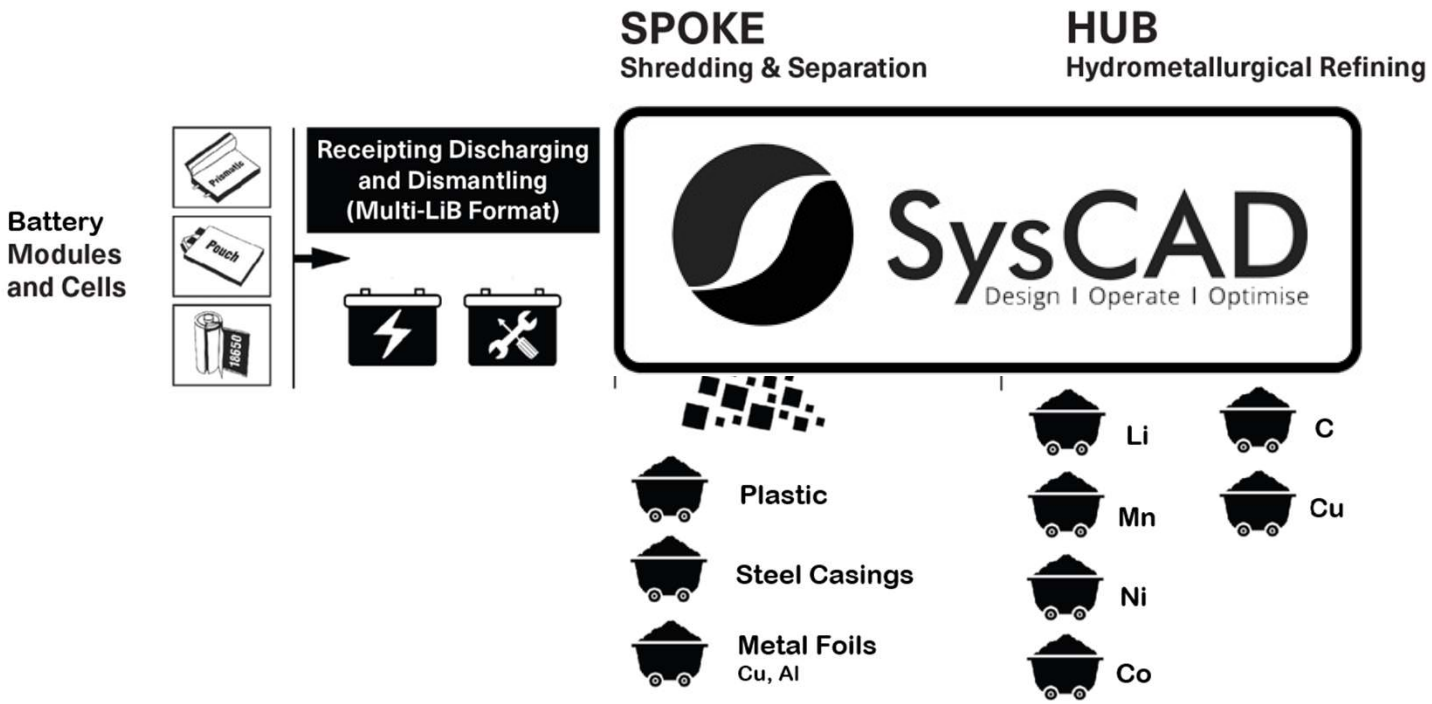
Process Development Challenges

1. Inconsistent battery feed composition
2. Co-precipitation of battery materials in impurity removal

How do we overcome?

On top of leveraging our demo plant in Hilchenbach for testworks and campaigns, SysCAD simulation and thermodynamic modelling also played a very important role to narrow down the testwork matrix.

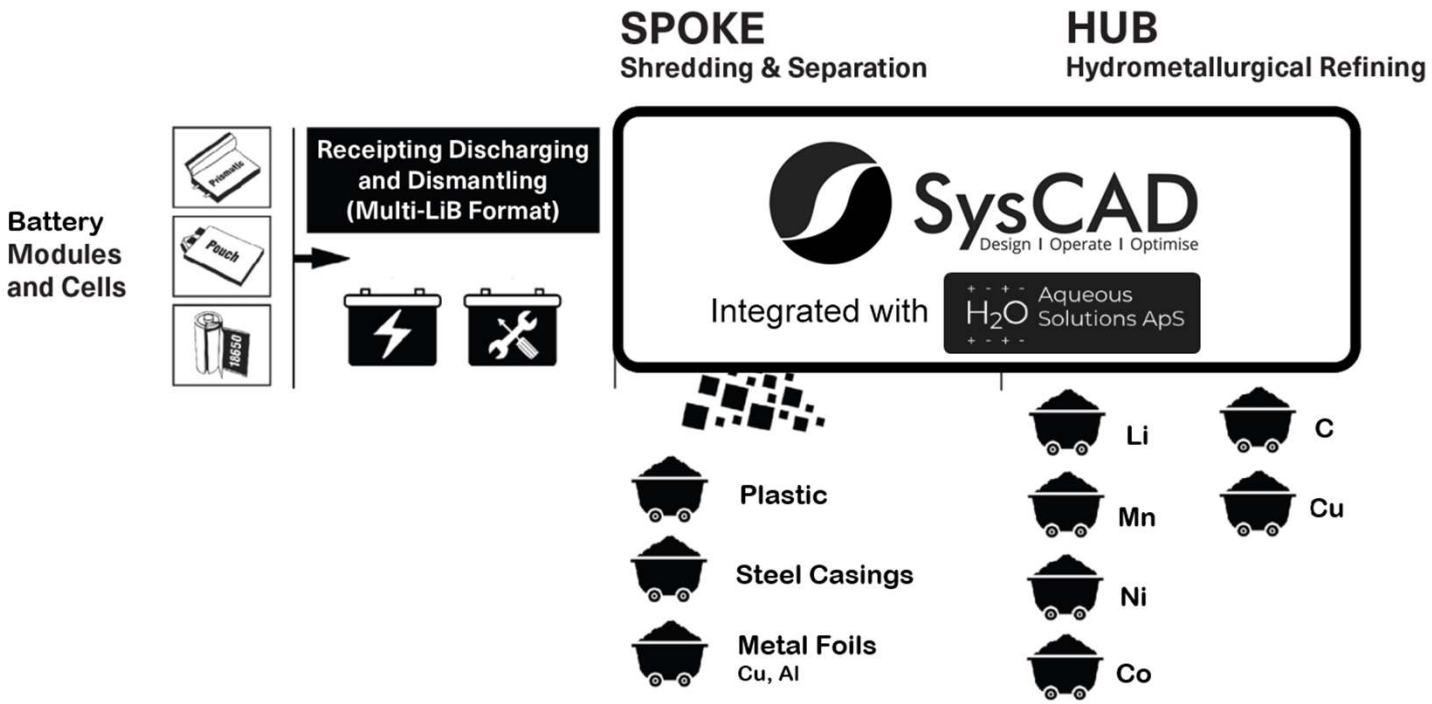
SysCAD Simulation



Inconsistent feed:

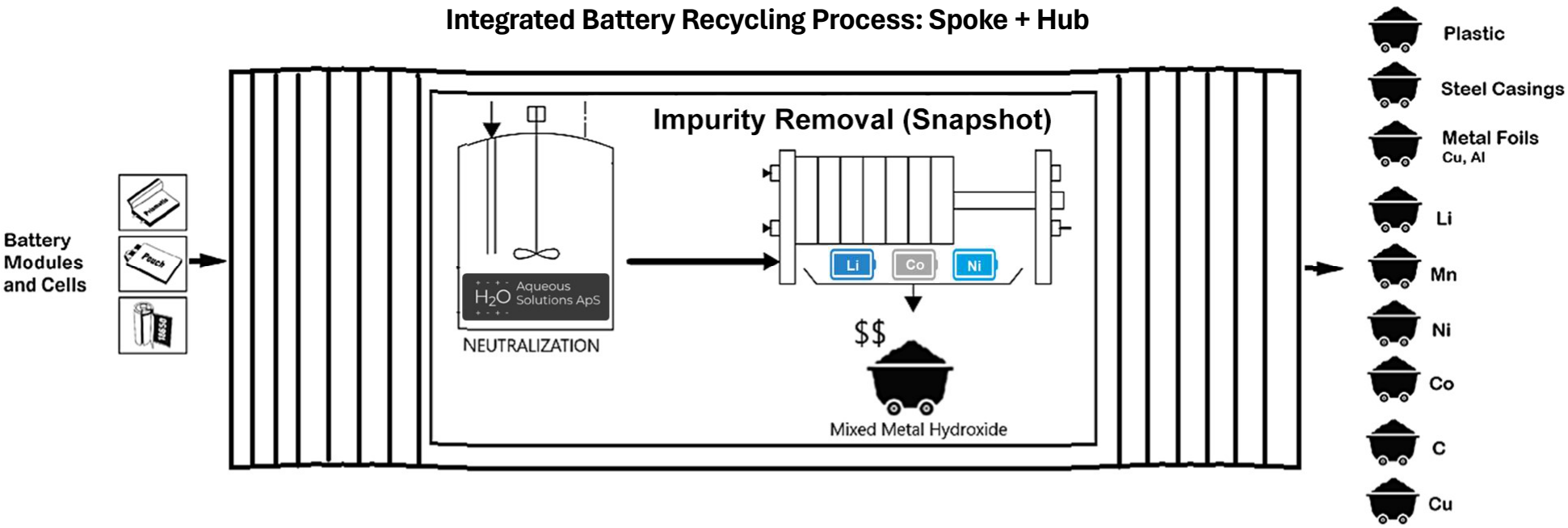
- **Too many mass balance scenarios**
- **Too many testwork matrix**

SysCAD Simulation & Thermodynamic Modelling



Example: Impurity Removal

SysCAD Simulation & Thermodynamic Modelling In Impurity Removal



Key Milestones

1. **Integrated Battery Recycling Plant for Mercedes-Benz under construction.**
2. **2500tpa EOL battery feed nameplate.**
3. **Commissioning start in 2nd half of 2024.**

Conclusion

We enable customers to:

1. **Own their recycling plant.**
2. **Produce their own recycled battery material.**
3. **Meet compliance with EU Regulation in 2031 for minimum recycled content in new batteries.**