Innovative Technologies and Concepts for the Intelligent Deep Mine of the Future

Near-to-Face Processing

An Approach towards improved Primary Resource Efficiency

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Content

- Introduction
- Basic Aspects of Underground Processing
- Semi-mobile sensor-based Sorting Unit
- Case Study: Room-and-Pillar Potash Mining
- Conclusion and Outlook

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Task: Mine-to-Mill Integration

- **Objective:**
  - To integrate underground processing (near-to-face processing) associated with backfill into the entire mining process
  - and to model the effects on economy and resource efficiency.

→ **Integrated Underground Processing (IUP)**
"Leave Waste Underground"

- RWTH Aachen in co-operation with Tomra Sorting Solutions

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- Introduction
- **Basic Aspects of Underground Processing**
  - Differences, Synergies and Potentials
- Semi-mobile sensor-based Sorting Unit
- Case Study: Room-and-Pillar Potash Mining
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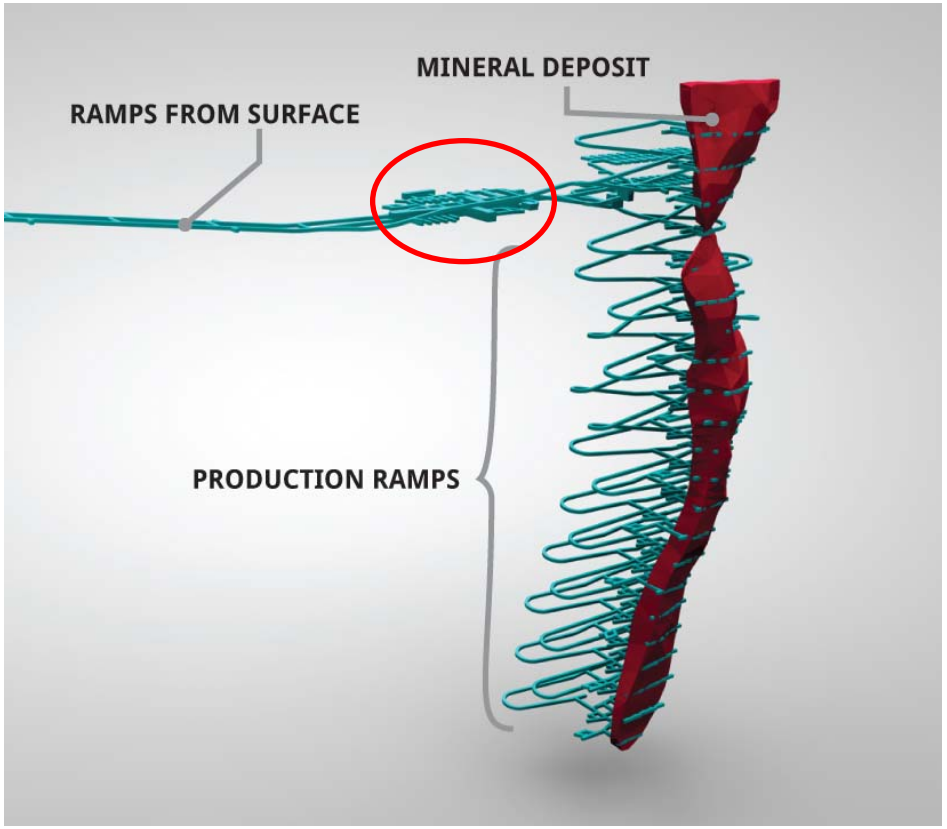
Definitions

- **Underground Processing (central):**
  - Full-scale processing plant; stationary
  - Long term installation for whole life of mine or life of main level

- **Near-to-Face Processing (semi-mobile):**
  - Small-scale; semi-mobile processing unit
  - Waste rejection close to the workings

Examples for central Underground Processing

- **Noront Resources Ltd. (Canada) feasibility study "The Eagles Nest"**
  - Underground processing plant for nickel-copper-platinum
  - Crushing, grinding, flotation and dewatering
  - Daily production 3,000 tons



Source: Noront Resources Ltd.

Definitions

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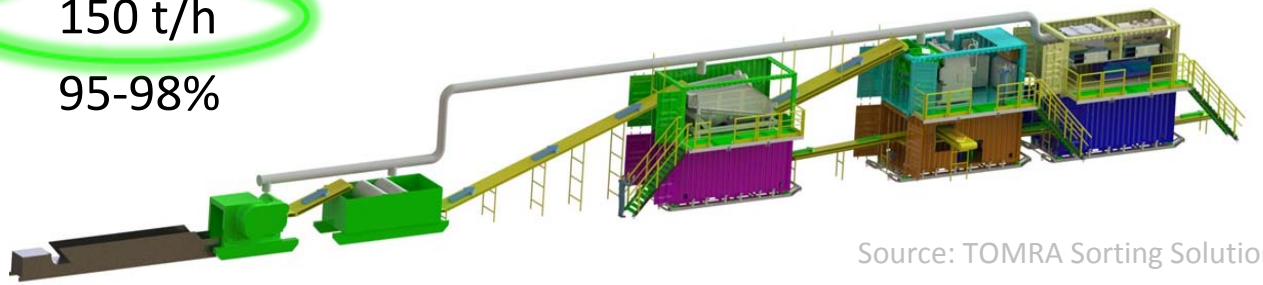
Examples for near-to-face Underground Processing

- **Python semi-mobile processing unit developed by GekkoSystems**
  - Throughput: 10-30 t/h
  - Modular system for gold ore processing

Source: Gekko Systems

- **Semi-mobile sensor-based sorting unit by TOMRA**
  - Throughput: 150 t/h
  - Recoveries: 95-98%



Source: TOMRA Sorting Solutions

Near-to-Face Processing Effects on **Sustainability**

Resource Efficiency:

- **Less environmental impact** by less waste material to be stored at surface

- **Less energy consumption** for mass transport to surface and for grinding

- **Less water consumption** in the processing step by early waste rejection in combination with dry processing technologies

- **Less surface subsidence** via backfilling the mining voids

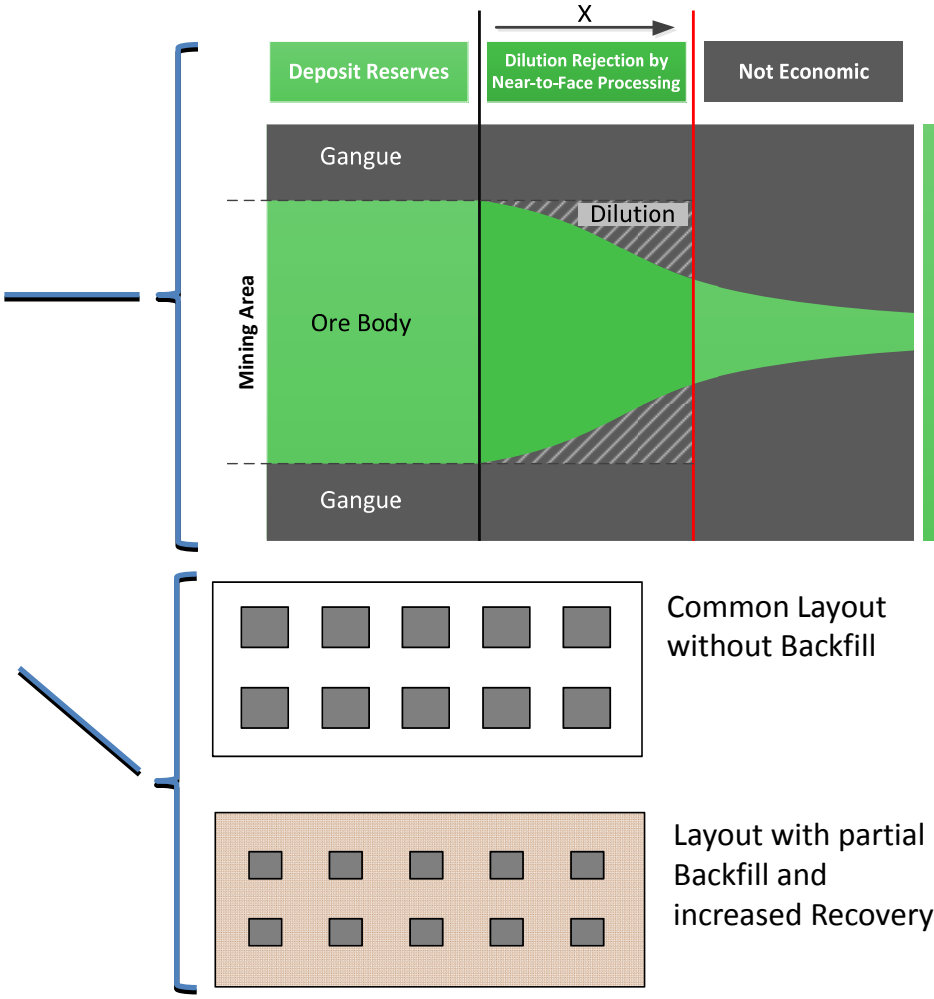
Near-to-Face Processing Effects on **Sustainability**

Primary Resource Efficiency:

- **Compensation of ore dilution** at an early stage which enables mining of areas with **narrowing deposit** parts or **low ore grades**.

- **Increased extraction rate** by reducing pillar volume by means of backfill.

- Reducing costs along the mining process chain leads to **lower effective cut-off grades**.



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- **Semi-mobile sensor-based Sorting Unit**
  - A conceptual study of Tomra Sorting Solutions |Mining
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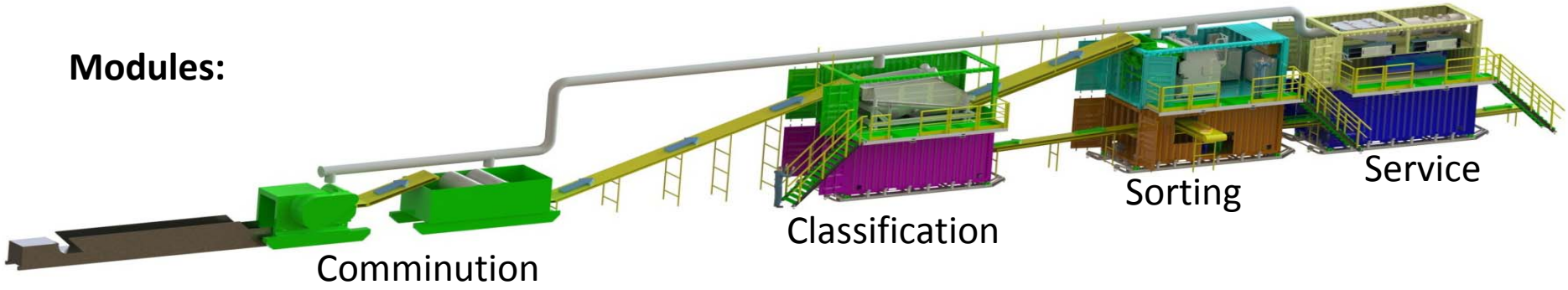
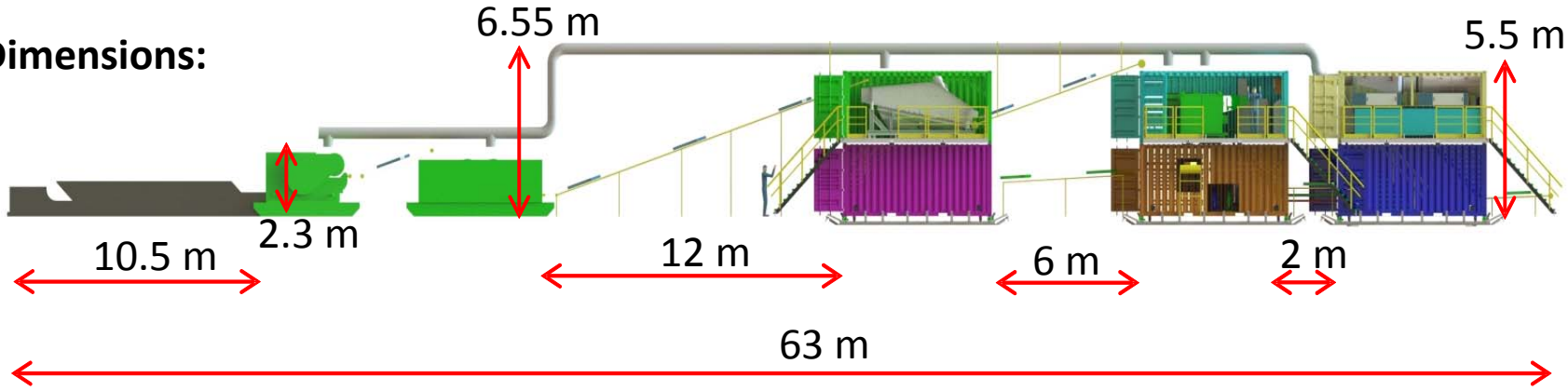
Final CAD Model
Tomra Sorting Solutions

Modules:



Dimensions:



Source: TOMRA Sorting

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  - Approach for Integrated Underground Processing
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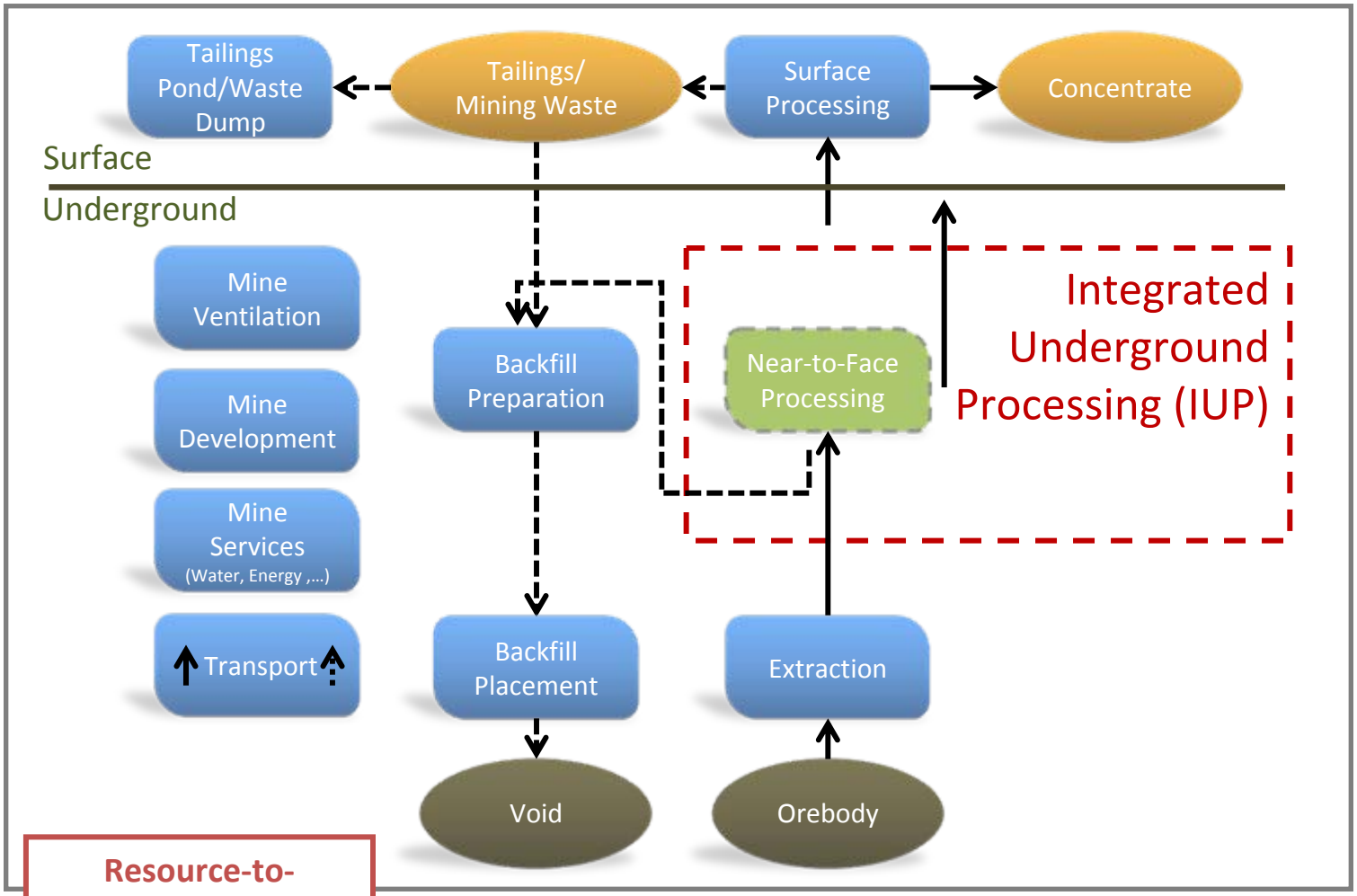
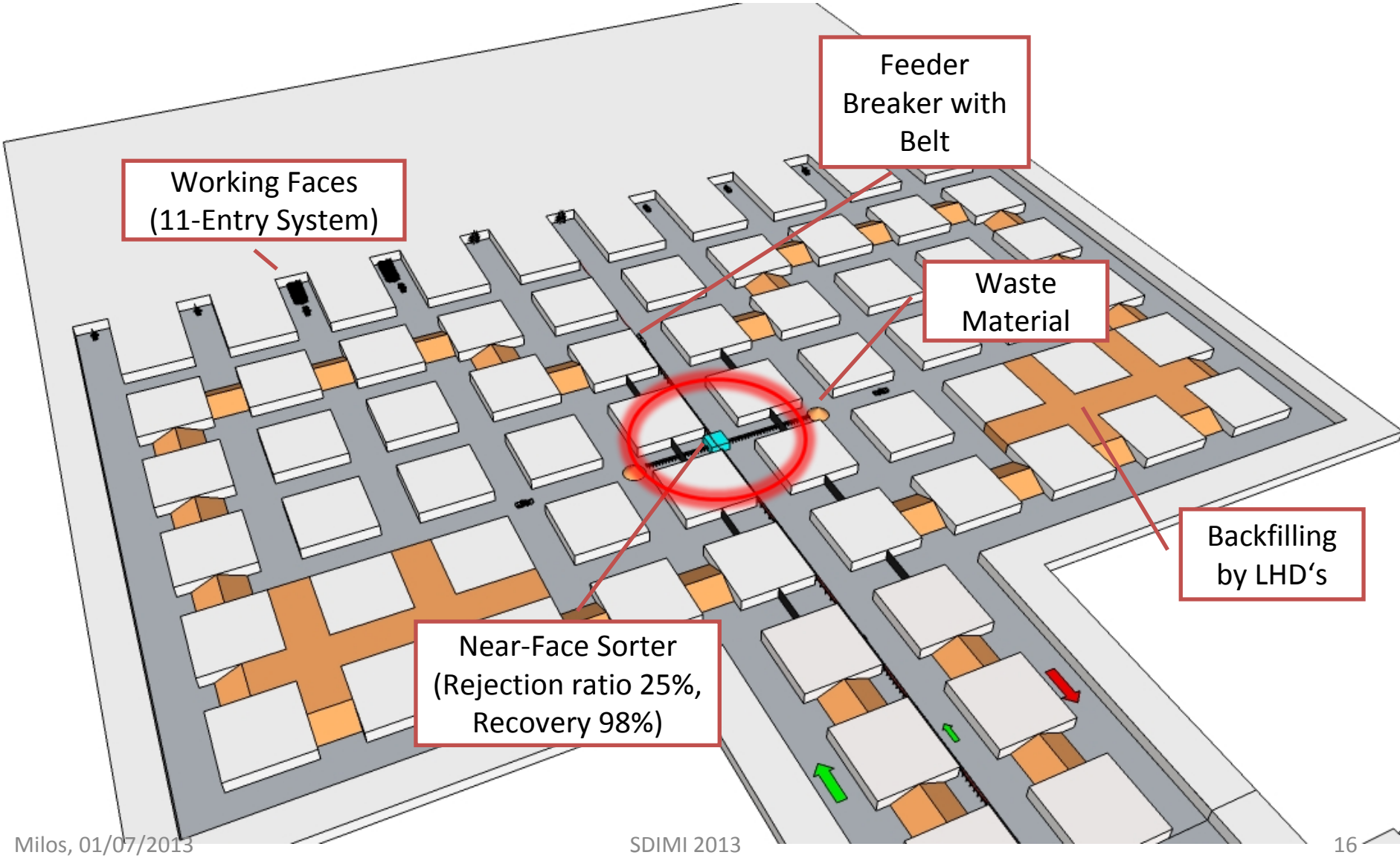
IUP Model: Interaction of Sub-processes



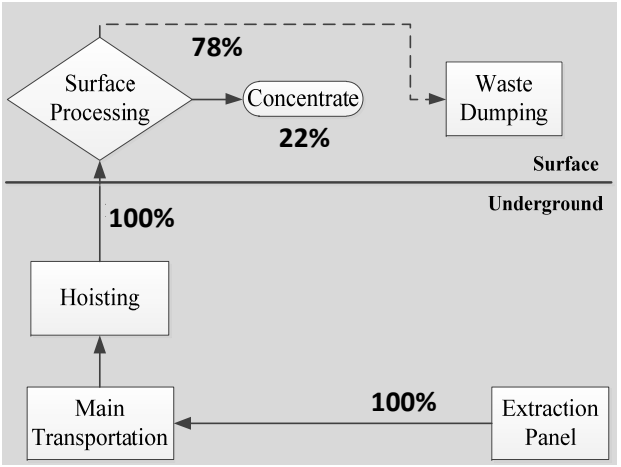
Panel Layout with Near-to-Face Processing



Model Scenarios

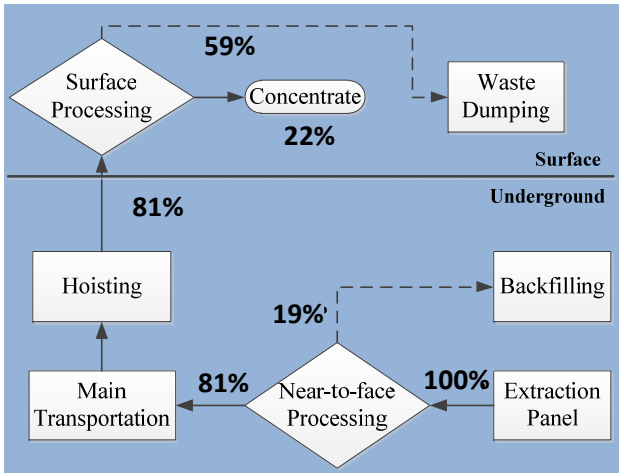
Base Case

- Common mining system
- All extracted material is transported to the surface processing plant



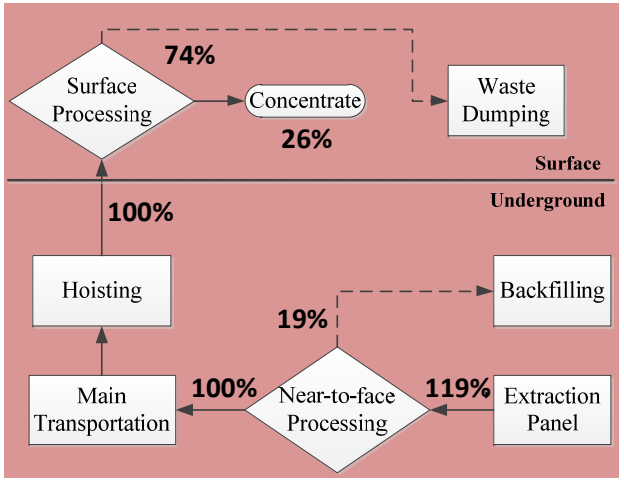
Near-to-Face Processing

- IUP near-to-face
- **Decreased mass movement** to surface
- Same production rate
- → **Savings** in downstream processes



Near-to-Face Processing with higher production

- IUP near-to-face
- Same mass movement to surface, but higher ore grade
- → **Higher production rate**
- → Shorter mine life



Preliminary Results

Successful implementation of near-to-face processing in underground room-and-pillar potash mining.

Rate of Underground Processing: **23%**

Reduction of mining waste movement to surface: **24%**

Other key figures to be modeled:

- Land use
- Energy/water consumption
- Economic feasibility (cost analysis, cash flow, NPV/IRR)
- Extraction rate

Results are in validation.

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Conclusion

- **Integrated mining and waste rejection processes near to face** have high potentials for deep underground mining.
  - Current developments to realize **near-to-face processing by modular semi-mobile sorting units**.

- **Potential for improved (primary) resource efficiency**:
  - Less mass movement to surface
  - Less land use
  - Less energy and water consumption
  - …

- **IUP effects gain impact with increasing depth.**

Outlook

- **More scenarios and case studies** (cut-and-fill mining, sublevel stoping) with different commodities are part of the project plan!

- IUP mining systems can increase the production rate of a mine:
  - → Deposits can be mined faster and thus shorten the project time / mine life.
  - → This can significantly increase the NPV of a project.
  - → **Increase of the NPV** in the range of **15-20%** is possible.

Thank you for your attention!