# Metallurgy – Key to Recycling

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Most Sustainable Corporations in the World GLOBAL100

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Sustainable use of Earth's natural resources

# Outotec in Brief

- **Sales EUR 2,078 million (2012)**
  - Over 5,745 national patents or applications, 630 patent families and 70 trademarks
- **Ranked Globally 12th most sustainable corporation**
  - http://corporateknights.com/report/9th-annual-global-100
  - **Knowledge in the processing of >60 elements**
- **>130 Non-ferrous smelters (58 Flash, 56 TSLs, 17 Kaldo)**
  - 2013 Flash Milestones (Tongling>400,000tpa & Fanchenguang>400,000tpa)
  - ca. 50% Cu , >30% Sn in TSL , close to 40% PGM matte converting
  - Ca. 70% Cu in China through Outotec
- **650 sulfuric acid plants**
  - World's largest metallurgical based, Zambia and largest in Ma'aden
- **Minerals Processing / Hydrometallurgy**
  - 1100 grinding mills (28MW worlds' largest saving around 15% energy)
  - >10000 flotation units (reaching 500m$^3$)
  - 1800 thickeners / >3500 filters
- **Ironmaking and Ferroalloys**
  - 20 pelletizing and sintering plants for chromites (ferroalloys),
  - 13 ferroalloy smelters
  - 340 iron ore sintering plants / 93 iron ore pelletizing plants
- **Light metals / Roasting / Waste to Energy**
  - 290 fluidized bed roasting plants / alumina calcining

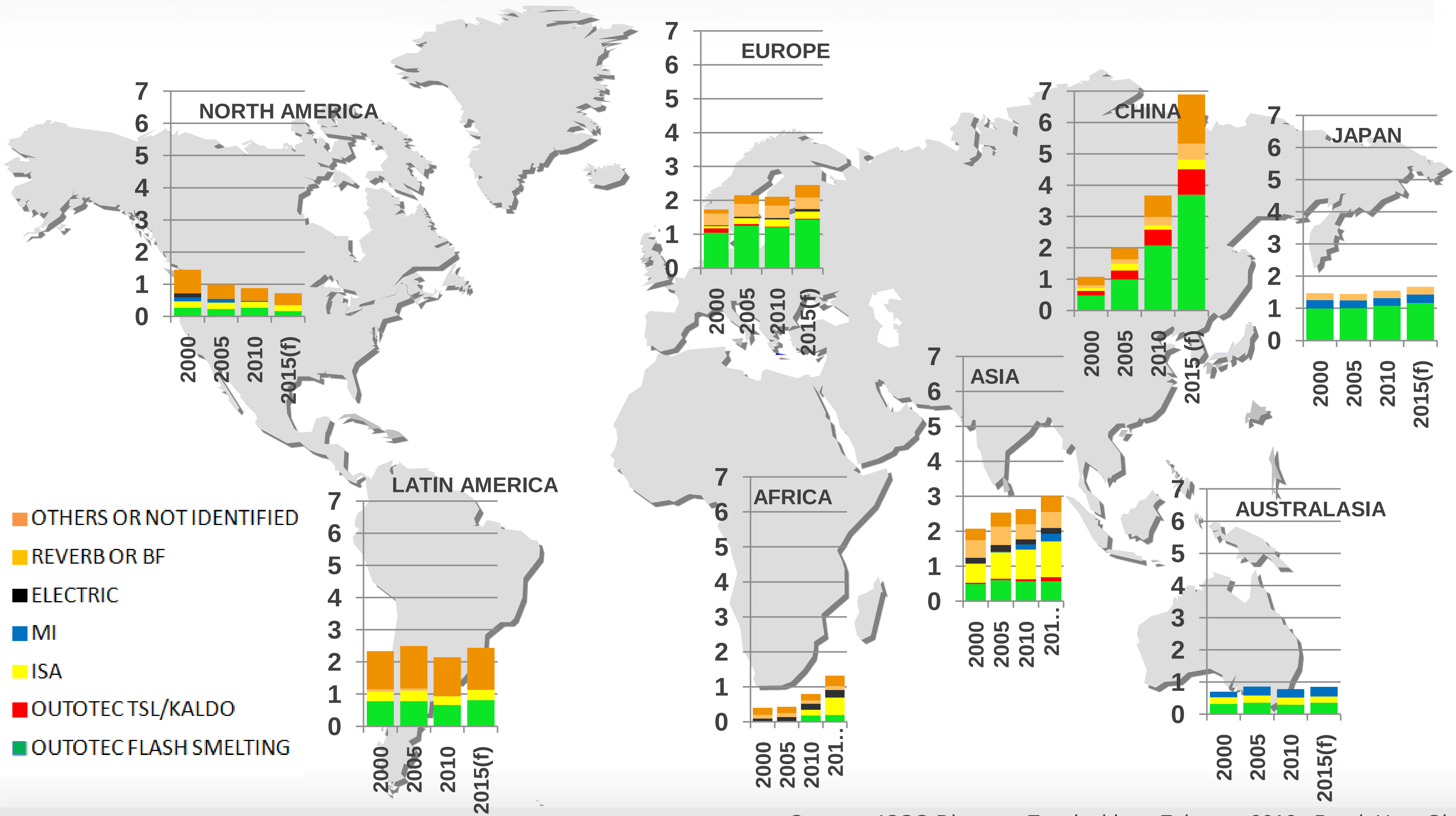
Grinding mills
LKAB Sweden

World's largest
pellet plant
(7.5 million tpy)
Samarco; Brazil

Xiangguang Copper highest
environmental award
Chinese Government.

# Copper production (million tonnes/a)

## Outotec world leading technology provider for copper production




Sources. ICSG Directory Excel tables - February 2013., Brook Hunt Global Copper production Dec. 2012

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# Geological *vis-à-vis* Urban Mine “Minerals”

“Mineral Centric” from classical mining equivalent to “Product Centric” in Urban Mining

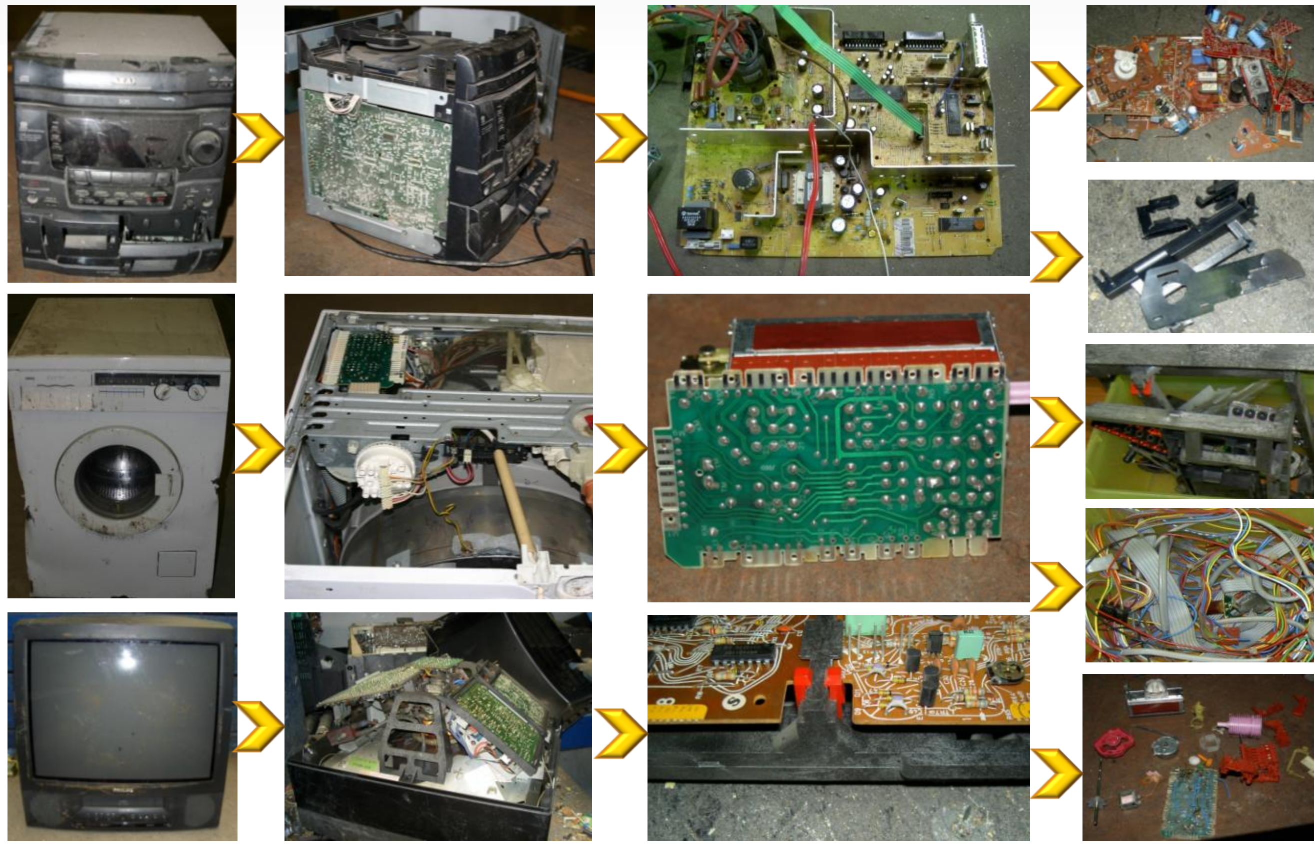
Geological Minerals

Chalcopyrite $CuFeS_2$

and

>15 minors

e.g. Au, Ag, PGMs, Se etc.



**Material combinations and Designed Consumer “Minerals”**

**Material connections**

**Joined Materials**

## Designer “Minerals”

>40 elements complexly linked

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# Outotec Secondary Smelting Processes

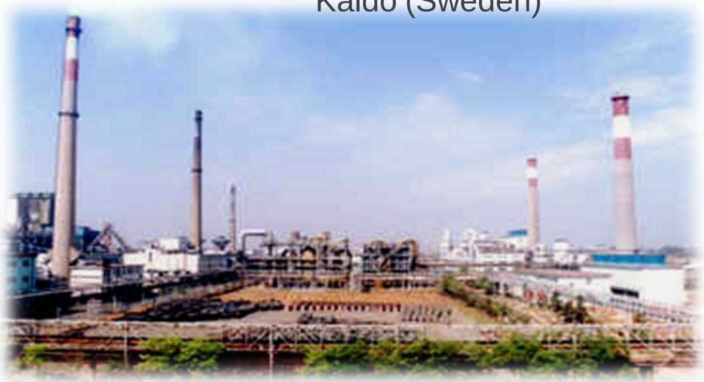
| Company | Location | Technology | Feed Capacity |
|---|---|---|---|
| Dowa Mining | Kosaka, Japan | Ausmelt TSL | 150,000 |
| Korea Zinc | Onsan, ROK | Ausmelt TSL | 70,000 |
| Global Resources & Materials | Danyang, ROK | Ausmelt TSL | 120,000 |


E-Waste and Copper Recycling Dowa TSL (Japan)


Boliden – Rönnskår Smelter Kaldo (Sweden)


Lead Battery Recycling Recylex TSL (Germany)


Copper Recycling GRM Danyang Smelter TSL (S. Korea)


Xiangguang Yanggu Smelter Kaldo (China)

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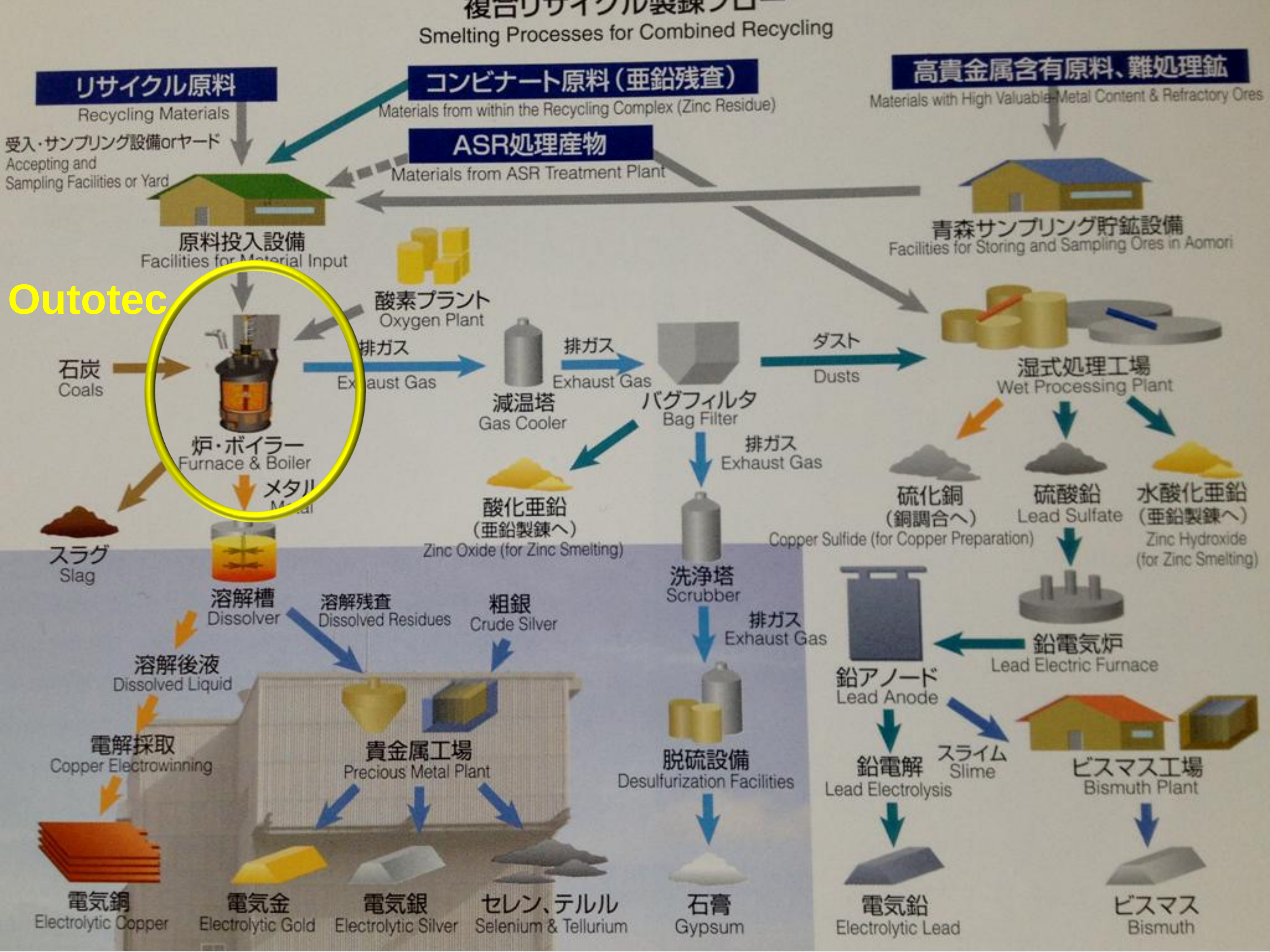
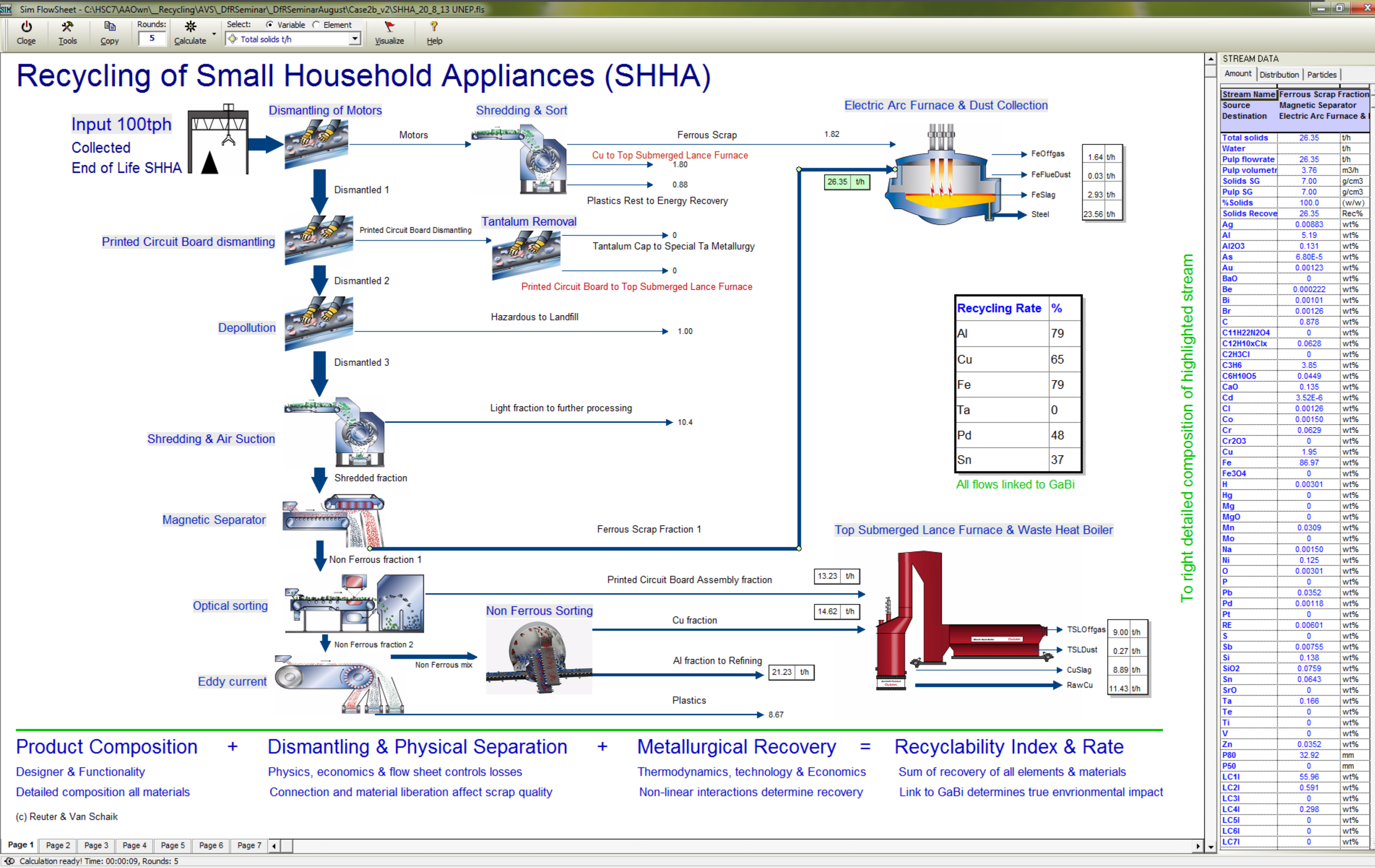


複合リサイクル製錬フロー
Smelting Processes for Combined Recycling
リサイクル原料
Recycling Materials
コンビナート原料（亜鉛残査）
Materials from within the Recycling Complex (Zinc Residue)
高貴金属含有原料、難処理鉱
Materials with High Valuable Metal Content & Refractory Ores
受入・サンプリング設備orヤード
Accepting and Sampling Facilities or Yard
ASR処理産物
Materials from ASR Treatment Plant
青森サンプリング貯鉱設備
Facilities for Storing and Sampling Ores in Aomori
原料投入設備
Facilities for Material Input
Outotec
酸素プラント
Oxygen Plant
石炭
Coals
排ガス
Exhaust Gas
減温塔
Gas Cooler
排ガス
Exhaust Gas
バグフィルタ
Bag Filter
ダスト
Dusts
湿式処理工場
Wet Processing Plant
炉・ボイラー
Furnace & Boiler
メタル
Metal
排ガス
Exhaust Gas
酸化亜鉛
（亜鉛製錬へ）
Zinc Oxide (for Zinc Smelting)
硫化銅
（銅調合へ）
Copper Sulfide (for Copper Preparation)
硫酸鉛
Lead Sulfate
水酸化亜鉛
（亜鉛製錬へ）
Zinc Hydroxide
(for Zinc Smelting)
スラグ
Slag
溶解槽
Dissolver
溶解残査
Dissolved Residues
粗銀
Crude Silver
洗浄塔
Scrubber
排ガス
Exhaust Gas
鉛電気炉
Lead Electric Furnace
鉛アノード
Lead Anode
溶解後液
Dissolved Liquid
電解採取
Copper Electrowinning
貴金属工場
Precious Metal Plant
脱硫設備
Desulfurization Facilities
鉛電解
Lead Electrolysis
スライム
Slime
ビスマス工場
Bismuth Plant
電気銅
Electrolytic Copper
電気金
Electrolytic Gold
電気銀
Electrolytic Silver
セレン、テルル
Selenium & Tellurium
石膏
Gypsum
電気鉛
Electrolytic Lead
ビスマス
Bismuth

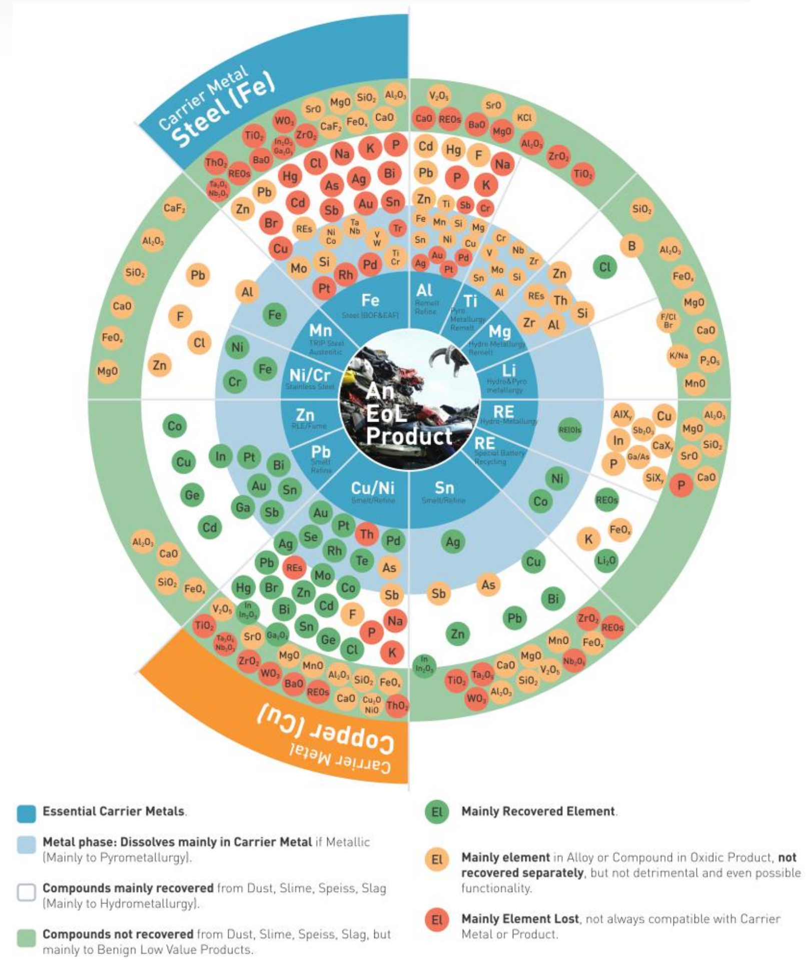
# Product Centric - Processing Infrastructure




| Recycling Rate | % |
|---|---|
| Al | 79 |
| Cu | 65 |
| Fe | 79 |
| Ta | 0 |
| Pd | 48 |
| Sn | 37 |

| Stream Name | Ferrous Scrap Fraction | |
|---|---|---|
| Source | Magnetic Separator | |
| Destination | Electric Arc Furnace & | |
| Total solids | 26.35 | t/h |
| Water | | t/h |
| Pulp flowrate | 26.35 | t/h |
| Pulp volumetr | 3.76 | m3/h |
| Solids SG | 7.00 | g/cm3 |
| Pulp SG | 7.00 | g/cm3 |
| %Solids | 100.0 | (w/w) |
| Solids Recove | 26.35 | Rec% |
| Ag | 0.00883 | wt% |
| Al | 5.19 | wt% |
| Al2O3 | 0.131 | wt% |
| As | 6.80E-5 | wt% |
| Au | 0.00123 | wt% |
| BaO | 0 | wt% |
| Be | 0.000222 | wt% |
| Bi | 0.00101 | wt% |
| Br | 0.00126 | wt% |
| C | 0.878 | wt% |
| C11H22N2O4 | 0 | wt% |
| C12H10xClx | 0.0628 | wt% |
| C2H3Cl | 0 | wt% |
| C3H6 | 3.85 | wt% |
| C6H10O5 | 0.0449 | wt% |
| CaO | 0.135 | wt% |
| Cd | 3.52E-6 | wt% |
| Cl | 0.00126 | wt% |
| Co | 0.00150 | wt% |
| Cr | 0.0629 | wt% |
| Cr2O3 | 0 | wt% |
| Cu | 1.95 | wt% |
| Fe | 86.97 | wt% |
| Fe3O4 | 0 | wt% |
| H | 0.00301 | wt% |
| Hg | 0 | wt% |
| Mg | 0 | wt% |
| MgO | 0 | wt% |
| Mn | 0.0309 | wt% |
| Mo | 0 | wt% |
| Na | 0.00150 | wt% |
| Ni | 0.125 | wt% |
| O | 0.00301 | wt% |
| P | 0 | wt% |
| Pb | 0.0352 | wt% |
| Pd | 0.00118 | wt% |
| Pt | 0 | wt% |
| RE | 0.00601 | wt% |
| S | 0 | wt% |
| Sb | 0.00755 | wt% |
| Si | 0.138 | wt% |
| SiO2 | 0.0759 | wt% |
| Sn | 0.0643 | wt% |
| SrO | 0 | wt% |
| Ta | 0.166 | wt% |
| Te | 0 | wt% |
| Ti | 0 | wt% |
| V | 0 | wt% |
| Zn | 0.0352 | wt% |
| P80 | 32.92 | mm |
| P50 | 0 | mm |
| LC1l | 55.96 | wt% |
| LC2l | 0.591 | wt% |
| LC3l | 0 | wt% |
| LC4l | 0.298 | wt% |
| LC5l | 0 | wt% |
| LC6l | 0 | wt% |
| LC7l | 0 | wt% |

# Outotec understands the metals business


M.A. Reuter et al., *“UNEP Metal Recycling: Opportunities, Limits, Infrastructure”*, United Nations Environmental Programme 2013
http://www.unep.org/resourcepanel/Publications/MetalRecycling/tabid/106143/Default.aspx.



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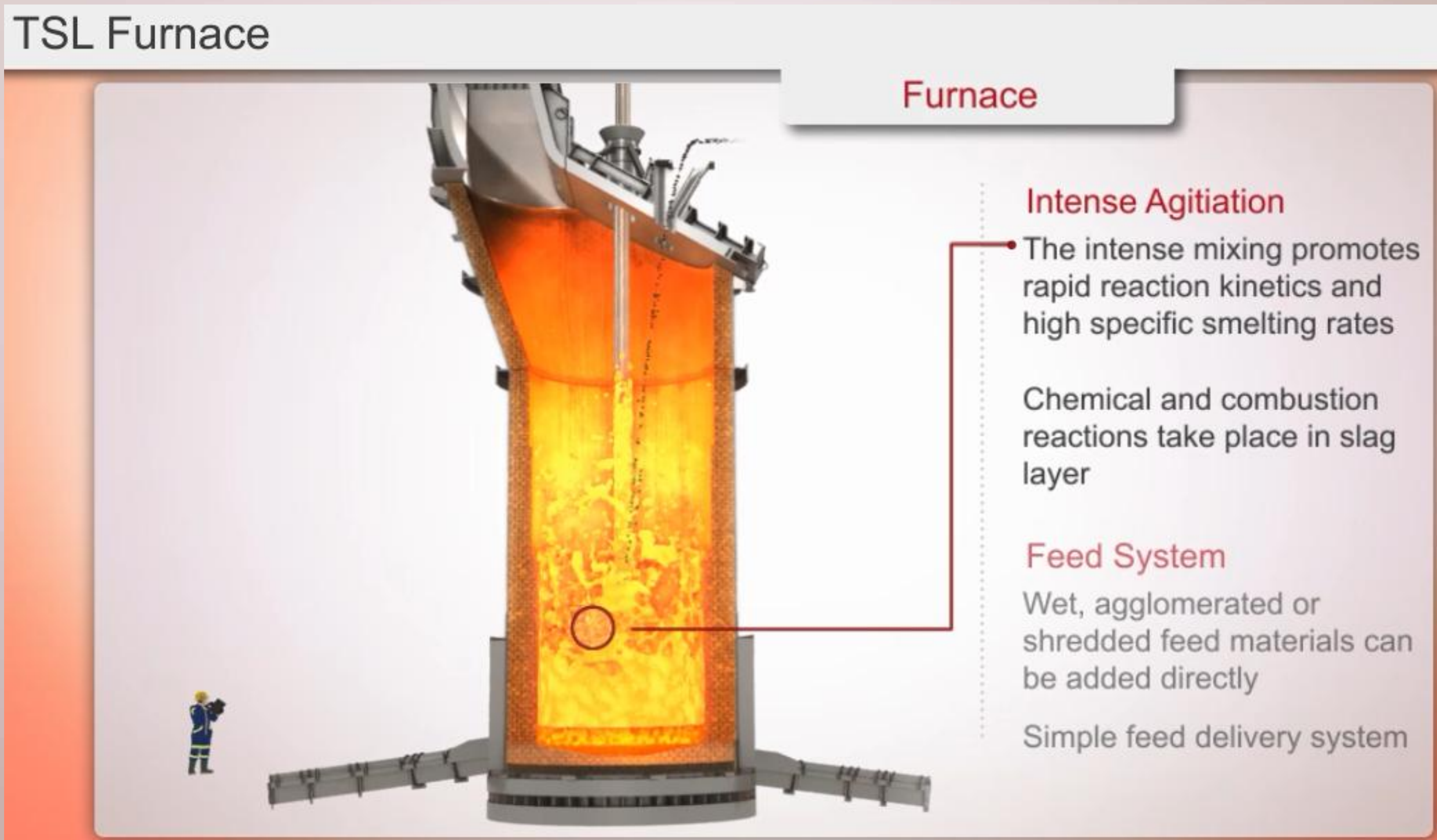
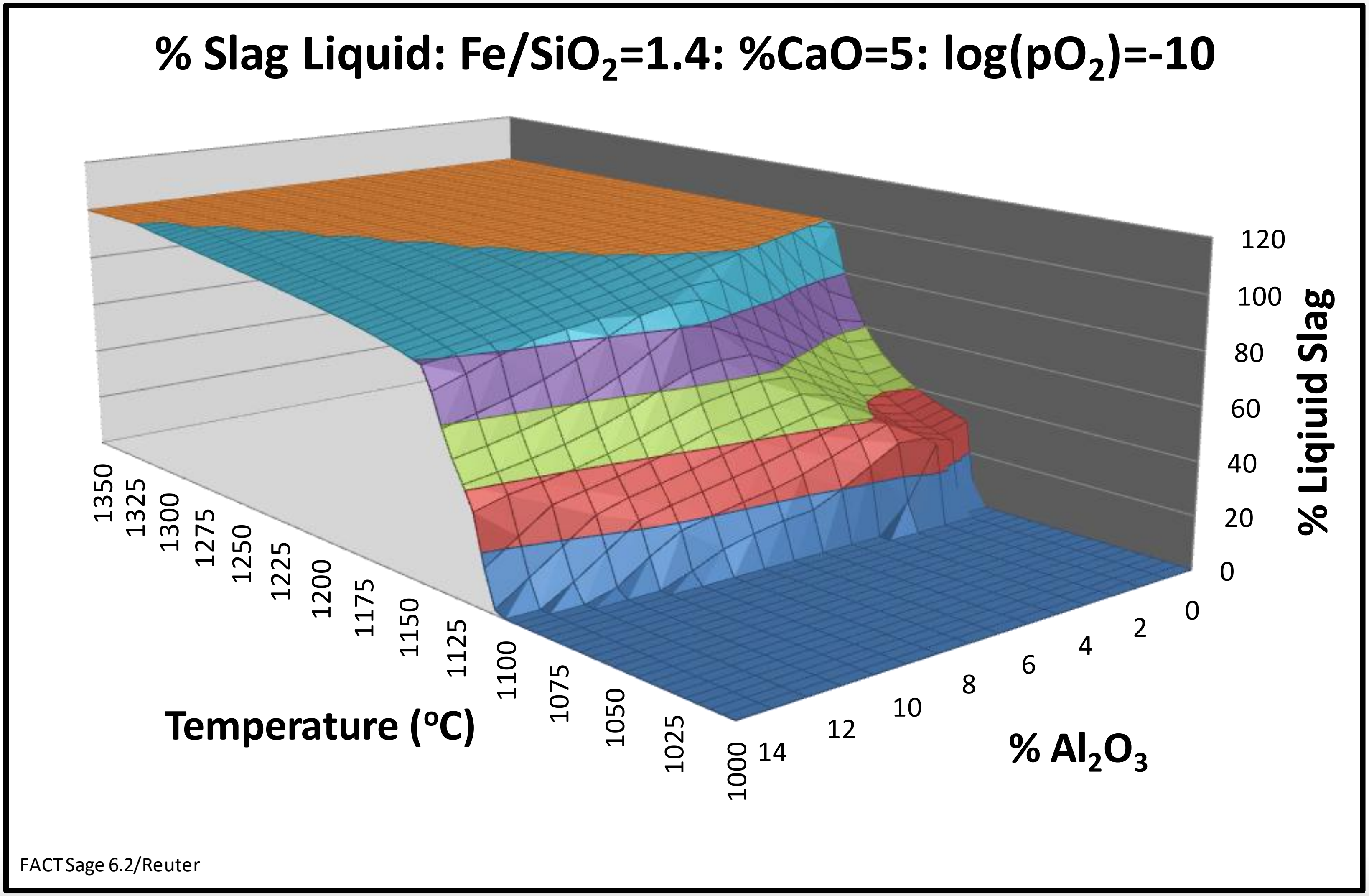
# Top Submerged Lance (TSL)

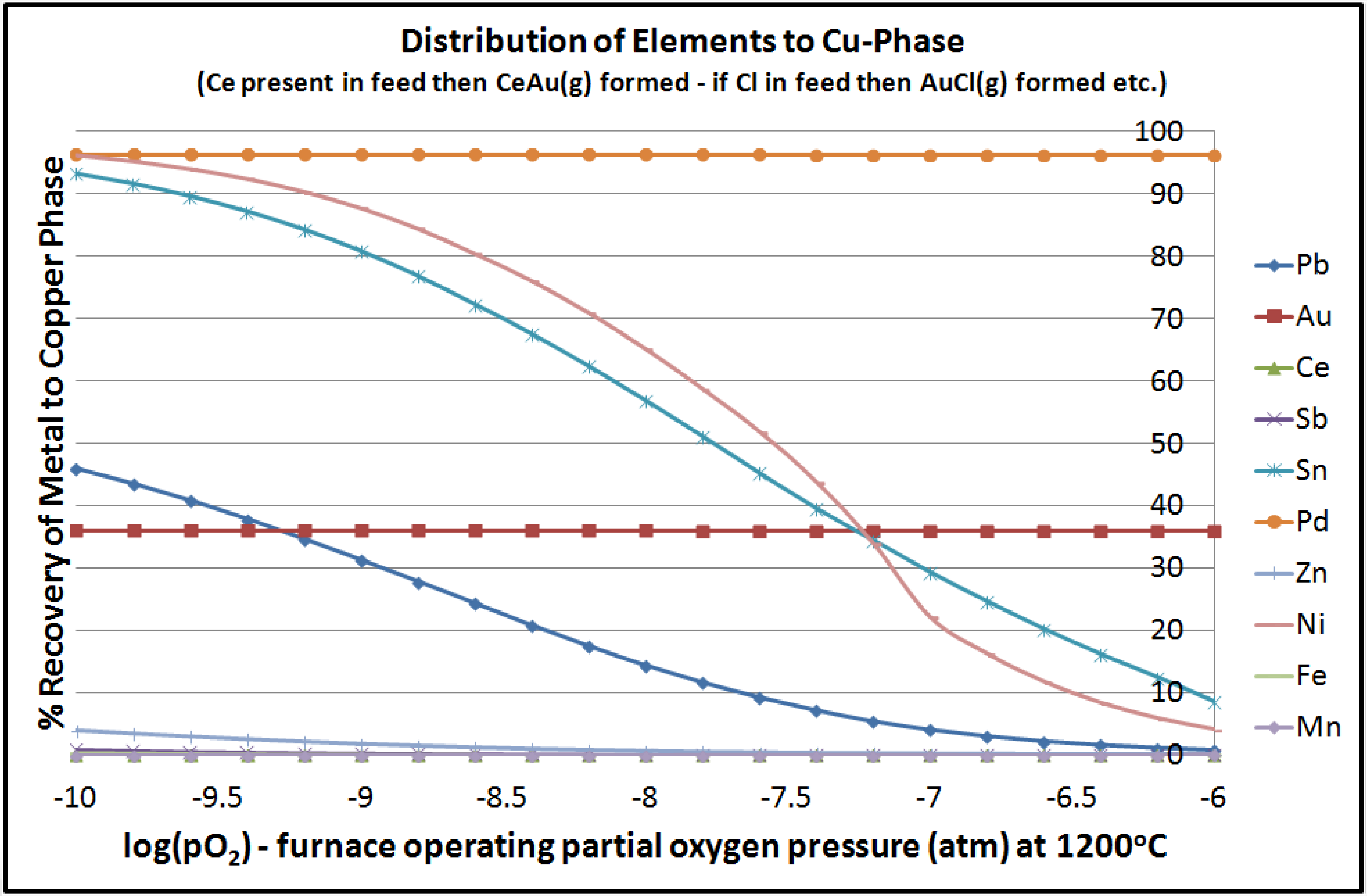


# Controlling the Furnace
## Controlling the slag…



# Simulation results for 1% & 8% Al on PCB

At 1150, 1200 and 1250ºC



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# Metal Recycling UNEP


Launched April 24th 2013 by UNEP via Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) in Berlin in the presence of the German Federal Minister of Environment.

Lead Author: Markus A. Reuter



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# Sustainable use of Earth's natural resources

www.outotec.com

www.outotec.com/sustainability

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