Recycling

Stephan Csoma
Executive Vice-President, Recycling
Agenda

1. Business group profile
2. Short loop and long loop recycling
3. Asian presence
4. Growth and profitability drivers
5. Key takeaways
Business group profile

- Technical Materials (TM)
  - Ag, Mn, P
  - Sb, In, Zn
  - Cu, Sn

- Jewellery and Industrial Metals (JIM)
  - Ag, Au, Pt

- Precious Metals Refining (PMR)
  - Ag, Te, Sb
  - Ir, Pt, Bi
  - Pb, Au, Sn
  - In, Sn, In
  - Se, Ru, Pd
  - Rh, Cu

- Platinum Engineered Materials (PEM)
  - Pt, Pd, Rh

- Precious Metals Management (PMM)
  - Ag, Pt, Au
  - Ir, Ru, Pd
  - Rh

Recycling
Closing the loop in Recycling

**SHORT LOOP**
Customers’ industrial residues, spent equipment and production scrap

**LONG LOOP**
Mining / smelting and refining by-products, industrial residues and end-of-life products

**JIM, TM and PEM**
High precious metals concentrations, sampling easier, simpler technology, integrated with product offering

**PMR**
Complex (lower precious metals concentrations, numerous metals), sampling more complex, sophisticated technology
Short closed loop in Recycling

Precious Metals Management (PMM) sources precious metals for industrial business units
Asian presence becoming increasingly important

<table>
<thead>
<tr>
<th>Jewellery and Industrial Metals</th>
<th>Expanding base in S.E. Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platinum Engineered Materials</td>
<td>Production in Yokohama, Japan</td>
</tr>
<tr>
<td>Technical Materials</td>
<td>Production in Suzhou, China</td>
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## Growth and profitability drivers

<table>
<thead>
<tr>
<th>Business unit</th>
<th>Main growth drivers</th>
<th>Profitability drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Jewellery and Industrial Metals</strong></td>
<td>Global demand for jewellery and industries eg. mint or decorative</td>
<td>Integration of products and recycling services</td>
</tr>
<tr>
<td><strong>Platinum Engineered Materials</strong></td>
<td>Evolution in the high-purity glass market and fertilizer industry</td>
<td>Product design / innovation and applied technology and closed loop offering</td>
</tr>
<tr>
<td><strong>Technical Materials</strong></td>
<td>Demand in electrical, automotive and HVAC industry</td>
<td>Product innovation, operational excellence and closed loop offering</td>
</tr>
<tr>
<td><strong>Precious Metals Management</strong></td>
<td>Demand in Umicore business units and demand for physical delivery of metals</td>
<td>Metal services and trading</td>
</tr>
</tbody>
</table>
Key takeaways

Integration of short loop offering enhances competitiveness of product activities

Umicore to grow in line with the market and maintain strong performance

Continue the focus on cost competitiveness and regional positioning
Precious Metals Refining

Speaker
Luc Gellens
Senior Vice-President, Umicore Precious Metals Refining
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1. Business model and competition
2. Business drivers
3. Growth strategy
4. Key takeaways
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Precious Metals Refining today

Largest and most complex precious metals recycling operation in the world

Processes more than 200 different types of raw materials

World leading refiner of 20 different metals

World class environmental and quality standards
The value chain of metals
200+ materials to close the loop

MINES
Ores & concentrates
- Complex mining by-products

SMELTERS & REFINERS
Refined metals
- Smelting & refining residues

INDUSTRY
New products
- Complex production scrap

CONSUMERS
Complex end-of-life materials

Industrial by-products
- 86% volume
- 75% revenues

Recyclables
- 14% volume
- 25% revenues
Precious Metals Refining today

- By-products
- Recyclables

- 6,400 lots
- >500 customers
How PMR generates revenues

Main revenue drivers

Treatment & refining charges
Treatment charges are determined, among other criteria, by the complexity of the materials.

Metal yield
Umicore assumes the risk of recovery above or under the contractually agreed recovery rate.
Metal price exposure

Direct:
- through metal yield

Indirect:
- through raw material availability

Managing the effects of metal price movements on earnings

Systematic hedging of transactional exposure (pass through metal)

Depending on market conditions hedging of (part of) structural metal price exposure through contractual arrangement

Impact on working capital is mitigated by toll-refining – metals remain property of the supplier during treatment
Umicore has unique technology

Umicore is unique due to its proprietary complex flowsheet that combines three metallurgical streams

This enables

- Flexibility to treat a broad range of input materials
- Recovery & valorization of the most metals
- Ability to optimize feed and therefore profitability
- Scope to broaden to new types of materials in future
Umicore has unique technology

- Umicore technology guarantees **environmentally friendly** processing, a high yield and a more competitive cost.
- PMR has invested heavily in **new and advanced processes**
- PMR introduced its unique UHT technology for Battery Recycling four years ago.
## Competitive landscape
None can take in the wide span of materials and metals

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
<th>Products</th>
<th>Degree of overlap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base metal Refiners</td>
<td>Stolberg, Penoles, Glencore, Tech Cominco, LS Nikko, Brixlegg</td>
<td>Cu, Pb, Zn by-products containing precious metals (PM)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some e-scrap</td>
<td></td>
</tr>
<tr>
<td>Primary PGM Refiners</td>
<td>Stillwater, Amplats</td>
<td>Recyclables: automotive catalysts</td>
<td></td>
</tr>
<tr>
<td>Specialty PM/PGM Refiners</td>
<td>Vale, Impala, Norilsk</td>
<td>By-products rich in PM</td>
<td></td>
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<tr>
<td></td>
<td>JMI, BASF, Heraeus, Chimet, Tanaka, Nippon PGM, Sabin, Gemini</td>
<td>Recyclables: industrial or automotive catalysts</td>
<td></td>
</tr>
<tr>
<td>Specialized Refining Companies</td>
<td>Dowa, Boliden, Aurubis, Korea Zinc</td>
<td>Cu, Pb, Zn, Ni by-products containing PM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recyclables: electronic scrap and industrial catalysts</td>
<td></td>
</tr>
</tbody>
</table>

- **Most competitors are customers**
- **They usually focus on niches**
- **No other company can process as wide a scope of materials as Umicore**
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Long-term business drivers

- Resource scarcity
- Increased complexity of materials
- Eco-efficiency

Capture more value through capacity expansion, unique technologies and new streams of recycling
Resource scarcity
Opportunity for PMR to process more materials

Increase of production of metals leads to more by-products from the base metals and PGM industry

Processing end of life products is necessary for a sustainable supply of metals

Evolution of global production level 1980-2014

- **Pb (m tonnes)**
- **Zn (m tonnes)**
- **Cu (m tonnes)**
- **Pt (tonnes)**
Increased complexity of materials
Availability to increase for Umicore

- Availability of complex concentrates on the rise which means higher complexity of by-products from primary refiners

- Diversity and complexity in the recyclables market limits processing of these materials by base metals smelters

- Increased pressure on non-ferrous smelters to comply with stricter EHS guidelines
Eco-efficiency
Trend towards higher recycling rates

• Base metal smelters are increasingly obliged to find an outlet for their by-products

• Recycling markets of end-of-life products to increase

• Processing complex materials in an environmentally friendly way will become the norm

Umicore Precious Metals Refining’s outstanding environmental performance and ethical sourcing practices provide an additional competitive edge

E-waste
generated in 2014

41.8 million tonnes

Only 4 billion people are covered by national legislation

That’s approximately 4 out of every 7 people

From The Global e-waste monitor 2014, United Nations University, 2015
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Growth strategy 2015-2020

- Increase in capacity
- Continuous upgrade of fixed assets base
- R&D to maintain technology leadership
- Recycling development
Capacity increase is key to growth

Projected volume evolution

- Investment to increase capacity at Hoboken by 40%
- Execution 2014-2015; ramp-up 2016-2017
- Further improvement of competitiveness through economy of scale
- Refining charges will initially not follow the same pace as volume growth due to material mix
Continuous upgrade of fixed asset base

- **Continuous improvement** through investments in fixed assets will continue.

- **Innovation remains critical** in guaranteeing strong performance (environment, metal yield, cost).

- Debottlenecking **never stops**.
R&D to maintain technology leadership

- PMR continues to **invest heavily in R&D**
- Innovative process technology ensures PMR remains the **leader in complex metallurgy**
- Battery recycling technology, introduced in 2011, is offering **options for future process improvements**
Recycling development
Battery recycling

• The demo plant is operational since 2011. Processing of spent rechargeable batteries optimized and validated

• The market is set to develop strongly in the coming years

• By 2020, Umicore will be ready for scaling-up to a real industrial footprint
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Key takeaways

Unique position in complex recycling

Increasing availability of complex materials


Active pursuit of growth avenues post 2020, including battery recycling