Precious Metals Refining
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Precious Metals Refining

Largest and most complex precious metals recycling operation in the world

- Proprietary processes mastering a complex feed with the highest degree of flexibility
- Global customer base

Processes around 350,000 tonnes/year of more than 200 different types of raw materials

- Wide range of complex precious metals bearing materials
- Efficient recovery of 17 different metals
- Focus on high added value processes (throughput time, efficiency)

Applying world class environmental and quality standards
Agenda

- Business model & competitive position
- Supply streams
- Metals market
- Environmental & ethical aspects
- Conclusion
Business model & competitive position
Business strategy

Umicore Precious Metals Refining aims to be recognized as the international reference in the sustainable refining of complex precious metals materials

UHT-technology platform

- Technological innovation
- Leadership
- Operational excellence
- Business excellence
- Process robustness
- Process optimization
- Competence management

Opportunity driven approach based on our PM intermediates

• Focus on partnerships
• Master the supply chain

PM = Precious Metals
Complex mining concentrates & residues

Ores & concentrates

Smelting & refining residues

Smelting & refining

Refined metals

Production scrap

End-of-life materials

Complex production scrap

Recycled metals

Recycled metals

Complex end-of-life materials

Products e.g. computers

Industry

MINES

SMELTERS & REFINERS

CONSUMERS

End-of-life materials

Production scrap

Recycled metals

Recycled metals

UMICORE

Precious Metals Refining

Position in the market

materials for a better life
Positive value recycling

Umicore Precious Metals Refining is mainly a positive value recycler

⇒ Customers are incentivised to come to Umicore through the return they get
   There is no direct need for regulation or incentives

In case of negative value recycling, government incentives or legislation is needed
   E.g.: Battery recycling business
Umicore offers a treatment and refining service to the raw material supplier, returning the metal (value) to the supplier → **Toll refining or purchase contracts**
- Umicore charges the supplier a charge for this service → **Treatment/refining charge (TC/RC)**
- Umicore returns metal to the supplier according to a contractually agreed recovery rate per metal (or returns the metal value) → **Pass-through metal**
- Umicore assumes the risk of recovery under or above the contractually agreed recovery rate → **Metal yield**
- Umicore also recovers non-metallic **by-products**, which are sold

Return split between TC/RC and metal yield (vs contractual recovery rate) varies per contract and per metal in the contract, depending on commercial negotiation
Supply contracts

Contract determines
- Period: spot, long term (0.5 – 2 years), evergreens (with notice period)
- Quality of raw material: metal concentrations, ...
- TC/RCs, including recovery rates
- Volumes, within certain margins

B to B business, with mostly industrial counterparts
- Either directly with industrial residue producer or consumer (e.g. industrial catalysts)
  These tend to be longer term
- Or through collectors (e.g. e-scrap or automotive catalysts)
  These tend to be somewhat shorter term

Umicore offers toll refining services or purchases the raw material, at the customer’s discretion
- Purchase price is based on toll refining mechanism
- Main difference is that raw materials have to be financed in working capital
Metal price impact

Umicore Precious Metals Refining has a metal price exposure
- Directly through metal yield component
- Indirectly on availability of raw materials
  - Certain materials are only worth recycling when the metal price crosses a certain threshold (i.e. value of metal contained becomes higher than the cost of the recycling)
  - Changing metal prices thereby impact the supply environment

Securing metal price exposure on earnings
- Systematic hedging of transactional exposure to eliminate residual risk on pass-through metal
- Metal price sensitivity is mitigated by securing the metal price component over a longer time period, through contractual arrangements

Managing metal price impact on working capital
- Certain contracts are toll refining → Metals remain the property of the supplier
- In case of purchase contracts payables/receivables terms are optimised vs throughput time to limit impact on net working capital
Core competitive strengths

Umicore Precious Metals Recycling creates value through

- High recovery yields for metals
- Short throughput times
- Recovery of 17 different metals

Supply of raw materials therefore focused on

- High value metals contained: precious & specialty metals
- Complexity (multiple metals contained)

Operational flexibility in supply is key to optimise and sustain profitability

- Short term: to continuously optimise profitability depending on market circumstances
- Long term: to be able to treat new types of recyclable materials

The recycling plant works continuously at maximum capacity optimising its returns by selecting the best feed
Competitive position

Umicore is a dedicated recycler with focus on higher value supply streams
- Competitors typically are dedicated smelters with focus on high volume base metals
- Umicore’s complex flowsheet allows higher recovery yield on highest added value metals in a shorter throughput time

Umicore’s operation is highly competitive due to its operational excellence which enables higher returns and the sharing of these with suppliers

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Core enablers

State-of-the-art technology
- Combination of pyro- and hydrometallurgy
- Knowledge management is essential (knowhow, IP)

Market intelligence
- Supply market
- Metals market

Integrity, reliability & risk management
- Sampling and assaying essential to determine return distribution
- Credit worthiness important in business where high (metal) values are in the loop

Environmental management excellence
- Resource efficiency
- Eco-efficiency
- Ethical supply
Supply market
Production configuration

Maxton
USA # 7
- Autocat collection & pre-processing

Guarulhos
Brazil # 113
- Smelting & pre-processing of Au, Ag & PGM containing materials
- Au refining
- Sampling & assaying
- Autocat collection & pre-processing

Hoboken
Belgium # 1294
- Headquarters
- R&D centre
- All metals refining
- Sampling & assaying
- Autocat collection & pre-processing

Bangkok
Thailand
- Autocat collection & pre-processing

Total headcount end of June 2010: 1469 people
International supply base

North America
- E-scrap
- Automotive catalysts
- Industrial catalysts
- Residues from non-ferrous metals industry
- Residues from non-ferrous metals mining

Europe
- E-scrap
- Automotive catalysts
- Industrial catalysts
- Residues from non-ferrous metals industry

Asia
- E-scrap
- Automotive catalysts
- Industrial catalysts
- Residues from non-ferrous metals industry

South America
- E-scrap
- Automotive catalysts
- Industrial catalysts
- Residues from non-ferrous metals industry
- Residues from non-ferrous metals mining

Africa
- E-scrap
- Automotive catalysts
- Industrial catalysts
- Residues from PGM industry

Oceania
- Automotive catalysts
- Residues from non-ferrous metals industry
- Residues from non-ferrous metals mining
Supply market

Umicore is supplied from a wide range of sources of two main categories

- Secondaries: Waste/residues from industry/refining/mining
- End-of-life materials

Environmental aspects

- The more complex the raw material, the more environmental “hazards” involved
- Some competitors have trouble operating seen the environmental impact and the strengthening of the legislation worldwide
- Customers are looking for transparent supply streams
Residues from the non-ferrous metals industry

Umicore focuses on complex residues containing different metallic substances

- Residues from non-ferrous metal smelters and refiners mainly containing lead, nickel, copper, zinc and precious metals
- Certain complex primary materials which are difficult to treat by conventional smelters and refiners

Often in partnership to create win-win situation

- Residue treatment is optimized using Umicore’s technical expertise and tailor-made treatment
- Umicore provides economies of scale and flexible processing capacity
- Umicore’s dedicated business model supports development of partnerships
- Partnerships are built on Umicore values: commitment, openness, innovation, team work and respect, thus takes time to develop.

Global supply base directly with non-ferrous metal industrial players
Residues from the non-ferrous metals industry

Non-ferrous metal residues supply driven by

- Growing demand and production of primary refining for base metals, precious metals and specialty metals
- Increasing complexity of feed, leading to more complex residues to treat

Evolution of global production level 1980-2009

<table>
<thead>
<tr>
<th>Metal</th>
<th>Pb</th>
<th>Zn</th>
<th>Cu</th>
<th>Pt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>5</td>
<td>4</td>
<td>9</td>
<td>100</td>
</tr>
<tr>
<td>2009</td>
<td>15</td>
<td>12</td>
<td>20</td>
<td>500</td>
</tr>
</tbody>
</table>

(in million metric tons) (in million tonnes) (in million metric tons) (in metric tons)
Electronic Scrap

Umicore focuses on complex, high-end scrap, containing multiple metals/elements

- Mobile phones
- Printed circuit boards
- Shredded e-scrap fractions

Supply through professional collector organisations

- Collection of electrical equipment
- Dismantling (and pre-processing) the material
- Supplying the high-end fractions to Umicore

Main competitors are copper smelters that have adapted their flowsheet to be able to handle e-scrap to fill up their capacity. Their focus remains on simple, high copper fractions.
Electronic Scrap

E-scrap supply driven by
- Growing use of electronic products
- Increasing complexity of electronic products
- Legislation

E-scrap recycling situation in EU today
- ± 40% of total e-waste is recycled
- < 10% of mobile phones are recycled
- Non recycled part is either dumped, not collected or exported as “re-use”
  ⇒ Hardly any recycling or “backyard” recycling

Worldwide availability of high-end e-scrap (printed circuit boards)
(in tonnes)

Source: Umicore
Spent automotive catalysts

Spent automotive catalysts primarily contain platinum, palladium and rhodium.

Supply comes from collectors and through own collection network:
- It is the only supply stream where Umicore is partially vertically integrated for the whole recycling process:
  - Collecting → Pre-processing → Concentration → Refining

Most of the competition covers only part of the flowsheet:
- A1 (US): Collection - Pre-processing
- Multimetco (US), Nippon PGM (Japan): Collection – Pre-processing - Concentration
- Inco (Ca), Impala (SA): Concentration - Refining
- Johnson Matthey (UK), Heraeus (De), Tanaka (Ja): Refining
Spent automotive catalysts

Autocat supply driven by
- Growing automotive production
- Larger and more complex engines
- Tightening legislation increases metal loading per car

Only some 50% of spent car catalysts are recycled today, with significant regional variances

Gross demand in PGMs for autocats
(in tonnes/year)

Source: Based on Johnson Matthey data
Spent industrial catalysts

Spent industrial catalysts can contain different metals; Umicore targets the ones containing platinum, palladium and rhodium.

Current recycling rate above 90%

- Industrial loops are very efficiently organized
- Close cooperation between catalyst manufacturers, catalyst users and spent catalyst reclaimers.

Umicore’s original sampling capabilities are unique in the market, assuring accurate and reliable assaying of metal contents.

Different competitors in the different sub-segments of this market, such as Johnson-Matthey (UK), Heraeus (De), Sabin (US), local Chinese refiners, ...
## Overview competitive landscape

<table>
<thead>
<tr>
<th>Supply market</th>
<th>Competitive landscape</th>
<th>Base metal refiners</th>
<th>Manufacturers with PM/PGM refinery</th>
<th>Specialised recycling companies</th>
<th>Umicore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residues from non ferrous metals industry</td>
<td>ex Pb</td>
<td>Pb</td>
<td>Purple</td>
<td></td>
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<tr>
<td></td>
<td>ex Zn</td>
<td>Zn</td>
<td>Yellow</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>ex Cu</td>
<td>Cu</td>
<td>Red</td>
<td></td>
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<tr>
<td></td>
<td>ex PGM</td>
<td>PGM</td>
<td>Orange</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Various</td>
<td>Various</td>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mining</td>
<td>Various</td>
<td>Various</td>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End-of-life materials</td>
<td>E-scrap</td>
<td>E-scrap</td>
<td>Green</td>
<td></td>
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<td></td>
<td>Ind. cats</td>
<td>Ind. cats</td>
<td>Orange</td>
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<tr>
<td></td>
<td>Autocats</td>
<td>Autocats</td>
<td>Red</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Various</td>
<td>Various</td>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examples of competitors</td>
<td>Stolberg, Penoles, Xstrata Zn, Glencore, Korea Zn, Teck Cominco</td>
<td>Stolberg, Penoles, Xstrata Zn, Glencore, Korea Zn, Teck Cominco</td>
<td>Yellow</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>LS Nikko, Xstrata Cu, MC, Brixlegg</td>
<td>LS Nikko, Xstrata Cu, MC, Brixlegg</td>
<td>Green</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Angle Platinum, Stillwater, Vale Inco, Xstrata Ni, Amplat, Lonmin, Norilsk</td>
<td>Angle Platinum, Stillwater, Vale Inco, Xstrata Ni, Amplat, Lonmin, Norilsk</td>
<td>Red</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Aurubis, Dowa, Boliden</td>
<td>Aurubis, Dowa, Boliden</td>
<td>Purple</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Johnson Matthey, BASF, Heraeus, Chimet, Saxonia, Tanaka-Nippon PGM</td>
<td>Johnson Matthey, BASF, Heraeus, Chimet, Saxonia, Tanaka-Nippon PGM</td>
<td>Orange</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Techemet, Multimetco, Sabin, JBR, Gemini</td>
<td>Techemet, Multimetco, Sabin, JBR, Gemini</td>
<td>Blue</td>
<td></td>
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Metals market
Umicore’s metal portfolio well aligned with “critical” technology metals

<table>
<thead>
<tr>
<th>Technology metals</th>
<th>EU critical materials (RMI)</th>
<th>Metals recovered by Umicore</th>
<th>Precious metals</th>
<th>Specialty metals</th>
</tr>
</thead>
</table>

- **Metals recovered by Umicore**
  - **Base metals**
  - **Precious metals**
  - **Specialty metals**
  - **Metals recovered in other BUs**
Precious metals

Flexible capacity for precious metals allows flexibility in the feed composition and volume.

Production volumes are determined by the supply of materials, not by demand from the metal markets.

End-of-life materials, particularly catalysts, are an important source of PGMs.

Recovered metal is used primarily in Umicore’s product businesses.
Specialty metals

The main source of these metals are the residues of the non-ferrous industry.

Specialty metals are key metals in the production of photovoltaic cells, electronics (such as LCD displays), and metallurgical applications (processes & alloys).

Primary supply is constrained, which can lead to high prices when demand increases.

Indium is used by the Thin Film Products business unit to make ITO targets, other metals are mainly sold to external customers.
Base metals

Base metals are important as they form the core of the technology for recovery of precious and specialty metals.

Base metals can, however, be considered as a by-products: Although high in volumes, they are less important for direct value creation.

Produced metal mainly sold on the market:

- A large part of the Umicore lead is sold to the battery industry
- Umicore sells its copper in the form of copper cathodes
- Nickel is further transformed in chemical compounds in the Cobalt & Specialty Materials business unit
By-products

Umicore’s valorises its waste products through the production of by-products

Sulphuric acid (\(H_2SO_4\))
- Sold in the region
- Share of voluntary production has decreased in past decade, as result of involuntary production increase (e.g. as by-product from Hoboken plant)

Slags are used in the concrete industry (certified product)
Environmental & ethical aspects
Eco efficiency
“Doing more with less”

Focus on efficient recovery of metals that have a high environmental footprint in primary production

- High metal recovery yields in the process
- The production of metals from by-products and recyclables at Umicore avoided emissions of 80% of primary footprint.

Precious Metals Refining operates best in class environmental facility (ISO 14001, ...)

Highly efficient on-site resource management

- Organic compounds in feed materials partially replace fossil fuel and reducing agents
- Waste heat management system to use heat produced in smelters in other parts of the plant
- Extensive water and gas emission management (& recycling) limits river water use

Minimising metal emissions to air and water is a win/win situation as metals not lost to the environment are found back in the output
Umicore’s role in business ethics

Recycling (sourcing from the urban mine) can provide materials from a resource with better known origin, mitigating the issues around conflict minerals, provided that the recycling chain is transparent.

Umicore actively participates and supports initiatives for more transparency and ‘sustainability’ in the recycling chain, among others

- Audits from OEMs
- Dialogue with OEMs, policy makers and other stakeholders
- Contribution of expertise to projects in developing countries relating to e-waste recycling

Umicore green procurement and business partner screening

- Practical implementation of Umicore’s commitment to promote honest and ethical business conduct.
- to avoid hidden risks such as treatment of materials of doubtful origin, conflict of interest, money laundering schemes, or waste treatment in breach of legislation etc.

Active member in security committees of industry associations
Stakeholder cooperation

Umicore proactively impacts the market via participation in different organisations

- **Industry associations**
  - IPA
  - IPMI
  - Minor Metals Trade Association
  - European Electronics Recyclers Association
  - Eurometaux
  - EPIA
  - ...

- **Workgroups and initiatives**
  - StEP initiative (Solving the e-waste partners)
  - Partnership on Computing Equipment (PACE)
  - Mobile Phone Partnership Initiative (MPPI)
  - World Business Council for Sustainable Development

- **EU & government workgroups**
  - Member of Raw Materials Initiative (RMI) expert group
  - Expert in working groups of the OECD-UNEP Resource Panel.

- **Projects with research institutes and other companies/stakeholders in the life cycle**
  - Study on fate of precious metals in pre-processing of e-scrap with TU Berlin & pre-processor
  - Study on informal e-scrap processing sector in India with EMPA
  - Project on closed life cycle of LCD/LED TV with Philips, Van Gansewinkel and KU Leuven, VITO
  - Study on e-waste recycling practices in Africa by Oko Institute & EMPA
Conclusion
Business drivers and impact on Umicore

- **Resource scarcity**
  Supply limitations vs growing demand

- **Eco-efficiency**
  Reduce eco impact of metal supply

- **Legislation & business ethics**

- **Material complexity**
  More different metals in smaller %

With its unique competences, Umicore is ideally positioned to answer the above themes.

- Increasing metal prices
- Increasing need for recycling
- Increasing need for eco-efficient refining
- Increasing need for refining/recycling of complex feed

Above trends positively impact Umicore’s profitability.
Forward-looking statements

This presentation contains forward-looking information that involves risks and uncertainties, including statements about Umicore’s plans, objectives, expectations and intentions.

Readers are cautioned that forward-looking statements include known and unknown risks and are subject to significant business, economic and competitive uncertainties and contingencies, many of which are beyond the control of Umicore.

Should one or more of these risks, uncertainties or contingencies materialize, or should any underlying assumptions prove incorrect, actual results could vary materially from those anticipated, expected, estimated or projected.

As a result, neither Umicore nor any other person assumes any responsibility for the accuracy of these forward-looking statements.
Koen Demesmaeker was appointed Senior Vice President Precious Metals Refining in October 2010. He holds a masters degree in commercial sciences from the Lessius University College in Antwerp and joined Umicore in 1981. He has held several positions in sales and raw materials supply, and was the Commercial Director of Precious Metals Refining since 2003. In this capacity, Koen has led the outstanding development of the supply base of the business unit.