Introducing Umicore

Umicore NAATBatt March 2019
Who we are

A global materials technology and recycling group

One of three global leaders in emission control catalysts for light-duty and heavy-duty vehicles and for all fuel types

A leading supplier of key materials for rechargeable batteries used in electrified transportation and portable electronics

The world’s leading recycler of complex waste streams containing precious and other valuable metals
Our foundations

**Unique business model**

**Supportive megatrends**
- more stringent emission control
- resource scarcity
- electrification of the automobile

**Industry leader in sustainability**
Our strategy

By 2020 we have…

clear leadership in clean mobility materials and recycling

turned sustainability into a greater competitive edge
Unique position in clean mobility materials

ICE
Emission control catalysts

(p)HEV
Battery materials and emission control catalysts

BEV
Battery materials

Fuel cells
Electro-catalyst and battery materials
Unique position in recycling

RECOVERING OVER 20 METALS

Unique technologies and recycling services treating production scrap, by-products, and complex residues
Turning sustainability into a greater competitive edge

We have transformed Umicore into a sustainability leader over the past 15 years

The purpose is to generate more concrete benefits from our sustainability efforts eg:
Delivering on our Horizon 2020 strategy

- Clear leadership in clean mobility materials and recycling
- Rebalanced the portfolio & earnings contributions
- Doubled the size of the business in terms of earnings
- Turned sustainability into a greater competitive edge
Umicore integration in battery & fuel cell value chain
Access to market, supply security, customer orientation

Raw material

Metal

Product

Application

Portable electronics
Power tools
(P) HEV / EV / FCEV
E-bikes
Stationary power

Umicore closes the material loop by innovative recycling technology

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Closing the battery loop
• crucial to enable offtake of sustainable e-mobility

• Recycling is a sustainable source of Co & Li, driven by
  • Resource availability (complementing primary supply)
  • Responsible sourcing requirements
  • Environmental benefits (vs. mining) → reducing CO₂ footprint of e-mobility

• Geographic diversification, reducing dependence on DRC (60% mine production, ~50% of global reserves)
  • US is resource-rich if we consider our waste as “urban mine”

• Li-Ion battery recycling offers an additional source of Co even today.
  • Currently ~30,000mt per year Co used for portable electronics with very low returns (= 2 large mines or 3-4 Mio full EVs)

“Umicore Rechargeable Battery Materials is powering ahead with a new investment of €660 million in China and Europe that will bring total capacity to at least 175,000 metric tons by 2021.”
Battery recycling requirements

• **Basic technical requirements:**
  - High effective **recycling rates** → secondary metals need to fit for new (LIB-) products
  - **Environmentally sound** & energy efficient recycling processes throughout the chain
  - Safe handling of battery systems and recycling materials (→ electric charge, electrolyte)

• **Economic requirements:**
  - Cost efficiency & economies of scale
  - Handling of mass flows on **industrial scale**
  - Flexibility in handling various battery types
  - and chemical compositions
Experience in Industrial Scale Processing

Precious metals recycling on industrial scale
>1,350 t / day
500,000 t / year

Umicore

Battery recycling on industrial pilot scale
7,000 t / year

Delivers...

...experience and know-how to grow from current to future high volume scale
Presence of Umicore Battery Recycling

North America
- USA
  - 4 Drop off points
- Raleigh, NC
  - Umicore representatives

South America
- Brazil
  - Drop off point

South Africa
- Drop off point

Europe
- Hanau, DE
  - Drop off point
  - Dismantling line
- Hoboken, BE
  - Recycling plant UHT
  - 7000 tpy capacity
  - € 25M investment

Asia / Pacific
- Umicore representatives
  - Japan-Korea-Australia-India

Other countries
- Thailand, Singapore, Taiwan, Hong Kong, Sri Lanka, China, Dubai
- Collaborations with local partners

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Variable feed size

Flexible on Size
- Medium sizes → directly to furnace
- Larger sizes after (partial) dismantling

No pre-treatment necessary = direct feed to the furnace

<table>
<thead>
<tr>
<th>Battery Type</th>
<th>Size Range</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile phone battery</td>
<td>± 0.030 kg</td>
<td>0.5 – 0.7 kg</td>
</tr>
<tr>
<td>Laptop battery</td>
<td>1 – 1.5 kg</td>
<td></td>
</tr>
<tr>
<td>Power tool battery</td>
<td>± 3 kg</td>
<td>15 - 20 kg</td>
</tr>
<tr>
<td>E-bike battery</td>
<td></td>
<td>30 - 60 kg</td>
</tr>
<tr>
<td>XEV / Industry battery module</td>
<td></td>
<td>150 - 500 kg</td>
</tr>
<tr>
<td>HEV battery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EV battery</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Illustration from different sources
Umicore Recycling process for Li-Ion Batteries

Lithium is recovered in addition to Co, Ni, Cu on an industrial scale

Solution to the growing demand for sustainably sourced materials in a circular economy
Challenges for a circular battery business

- **Intrinsic success factors:**
  - Material value → battery chemistry & price development Co, Ni, Cu, Li
  - Battery composition & design; accessibility of battery in ELV
  - Business models (B2C vs B2B)
    → Battery lease to car owner, shared mobility, EV fleets/service model (B2B):
    → B2B creates inherent incentives for reparability/2nd life & quality recycling;
      critical mass/cost effectiveness @ industrial players; built-in transparency

- **External success factors:**
  - Collection infrastructure, need responsible logistics companies
  - External collection, recycling incentives and regulator support
    → deposits, fees, EPR systems, public procurement...?
  - Quality & economic viability of recycling processes
    → technical & environmental performance; available quantities/economies of scale
  - Legislation / monitoring / enforcement → securing comprehensive & sound recycling
  - Stakeholder collaboration → OEMs, retailers, users, take back schemes, recyclers

No recycling without collection and feed into suitable processes!
Preparing the ground for further growth

Clean Mobility innovation roadmap spanning the next 20 years

Full electric
Plug-in hybrid
Fuel cells
Cleaner combustion engines

Battery Recycling gaining traction

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Annexes
### Global presence:

<table>
<thead>
<tr>
<th>Region</th>
<th>People</th>
<th>Production Sites</th>
<th>R&amp;D</th>
<th>Technical Centers</th>
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</thead>
<tbody>
<tr>
<td>North America</td>
<td>838</td>
<td>11</td>
<td>2</td>
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</tr>
<tr>
<td>South America</td>
<td>678</td>
<td>5</td>
<td>1</td>
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<tr>
<td>Asia / Pacific</td>
<td>2,922</td>
<td>14</td>
<td>6</td>
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<tr>
<td>Europe</td>
<td>5,723</td>
<td>17</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

- **People:** Total number of people across all regions.
- **Production Sites:** Total number of production sites across all regions.
- **R&D | Technical Centers:** Total number of R&D technical centers across all regions.

**Figures exclude associated companies (December 2018)**
Key figures 2018

- **Revenues**: € 3.3 bn
- **Recurring EBIT**: € 514 m
- **Recurring EPS**: € 1.36/share
- **R&D spend**: € 196 m

**REVENUES BY GEOGRAPHY**
- Europe: 39%
- North America: 42%
- South America: 4%
- Asia-Pacific: 11%
- Africa: 3%

**INPUT MATERIALS**
- Primary materials: 42%
- Secondary materials: 47%
- End of life materials: 11%
Our strategic ambitions are supported by

- **Unique business model**
- **Strategic positioning**
- **Strong commitment to innovation**
- **Solid financial structure**

Clear leadership in clean mobility materials and recycling

Turn sustainability into a greater competitive edge
Our strategic ambitions are supported by

- Automotive
- Recycling
- Energy
- Precious metals
- Chemicals
- Electronics
- Manufacturing
- Optics and displays
Our Group structure

**CATALYSIS**
- Automotive Catalysts
- Precious Metals Chemistry

**ENERGY & SURFACE TECHNOLOGIES**
- Cobalt & Specialty Materials
- Electroplating
- Electro-Optic Materials
- Rechargeable Battery Materials

**RECYCLING**
- Jewelry & Industrial Metals
- Precious Metals Management
- Precious Metals Refining
Catalysis overview

Automotive Catalysts
A world leader in emission control catalysts for light-duty and heavy-duty vehicles for all fuel types. Now also including non-road heavy-duty diesel catalysts and stationary catalysts for industrial plant emissions control.

Precious Metals Chemistry
Developer and producer of metal-based catalysts used in chemistry, life sciences and pharmaceutical applications.
Producer of cobalt and nickel specialty chemicals for a wide range of applications, including tires, pigments, catalysts and surface treatment. Now also responsible for proprietary Li-ion rechargeable battery recycling technology.

A leading cathode material supplier for lithium-ion rechargeable batteries used in portable electronics and electrified vehicles.

Supplier of precious metal electrolytes & processes for technical, functional and decorative applications.

Supplier of products for thermal imaging as well as wafers for space solar cells and high brightness LEDs and chemicals for fiber optics. Now also producer of evaporation material and sputter targets for optics and microelectronics industry.
Recycling overview

**Precious Metals Management**
Services for hedging, leasing, purchasing and sale of precious metals to internal and external customers.

**Precious Metals Refining**
Operator of the world’s most sophisticated precious metals recycling facility able to recover 17 precious and other valuable metals from complex waste streams.

**Jewelry & Industrial Metals**
Supplier of precious metals creating products for the jewelry and industrial sector and specialist in the manufacturing of platinum group metals components for the special glass and chemical industries, offering recycling solutions.
materials for a better life