Agenda

1. Business group profile
2. Shared characteristics of the business units
3. Growth & profitability drivers
4. Asian presence
5. Key takeaways
Business group profile

Energy & Surface Technologies

Thin Film Products (TFP)

Electro-Optic Materials (EOM)

Rechargeable Battery Materials (RBM)

Cobalt & Specialty Materials (CSM)

Electroplating (EP)

In

Ge

Ni Co

Re Co Ni

Ag Sb Ta W

Sb Se

Li Mn

W Ta Cu

Au Ag Rh Ru

Pd Pt
## Materials for energy and surface applications

<table>
<thead>
<tr>
<th></th>
<th>RBM</th>
<th>CSM</th>
<th>EP</th>
<th>TFP</th>
<th>EOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrification of</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Wear and corrosion protection and</td>
</tr>
<tr>
<td>vehicles</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>decorative coating</td>
</tr>
<tr>
<td>Efficient portable</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Optics and electronics</td>
</tr>
<tr>
<td>devices</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>High efficiency</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>solar cells</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light emitting</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>diodes (LED)</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Energy storage</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- **RBM:** Redox Battery Materials
- **CSM:** Ceramic Solar Materials
- **EP:** Electrochemical Polymer
- **TFP:** Ternary Functional Polymers
- **EOM:** Electrochemical Oxidative Materials
## Closing the loop

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rechargeable Battery Materials</td>
<td>Closed loop through Battery Recycling pilot ready for scaling up</td>
<td>Ni, Mn, Co, Li</td>
</tr>
<tr>
<td>Cobalt &amp; Specialty Materials</td>
<td>Residues from the tooling and aerospace industries and catalysts from the petrochemical industry</td>
<td>Re, Co, W, Ta, Cu, Ni</td>
</tr>
<tr>
<td>Electroplating</td>
<td>Residues from electroplating baths (other BU)</td>
<td>Au, Ag, Rh, Ru, Pd, Pt</td>
</tr>
<tr>
<td>Electro-Optic Materials</td>
<td>Ge bearing residues</td>
<td>Se, Ge</td>
</tr>
<tr>
<td>Thin Film Products</td>
<td>In bearing residues</td>
<td>In, Sn</td>
</tr>
</tbody>
</table>
Asian presence increasingly important

- Shift of several industries to Asia
- Supply coming from Asia
- Lower cost environment

- Rechargeable Battery Materials
- Cobalt & Specialty Materials
- Electroplating
- Electro-Optic Materials
- Thin Film Products
<table>
<thead>
<tr>
<th>Business unit</th>
<th>Main growth drivers</th>
<th>Profitability drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rechargeable Battery Materials</td>
<td>Vehicle electrification</td>
<td>Scale effects, product and process technologies</td>
</tr>
<tr>
<td>Cobalt &amp; Specialty Materials</td>
<td>Growth in RBM Plating and chemicals industries</td>
<td>Supply chain integration, process excellence</td>
</tr>
<tr>
<td>Electroplating</td>
<td>Asian demand in electronics</td>
<td>Product &amp; applied technology</td>
</tr>
<tr>
<td>Electro-Optic Materials</td>
<td>Infra-red optics in consumer electronics, new satellite programs</td>
<td>Supply chain integration, product technology</td>
</tr>
<tr>
<td>Thin Film Products</td>
<td>Display industry growth, thin film batteries</td>
<td>Scale effects, product &amp; process technologies</td>
</tr>
</tbody>
</table>
Key takeaways

All activities are related to the core competences of Umicore

Double digit revenue and earnings growth potential

Importance of Asian presence, integrated supply chain & scale
Agenda

1. Business profile
2. Market drivers and prospects
3. Growth opportunity
4. Key takeaways
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A close fit with megatrends

**Transportation:** fuel-based towards electricity-based

**Electricity generation:** increasing share from non-fossil sources (wind, sun, bio, hydro,...)

**Metal-based** functional materials enable recyclability
A leading player in the industry

Market characteristics

- Li-ion battery technology is established reference for portables and automotive applications
- Cathode material is important to performance and cost of a Li-ion battery

Umicore offering

- A broad spectrum of metal-based materials used in Li-ion batteries
- Umicore is a leading cathode material supplier with a large industrial footprint. We have produced enough cathode materials to:
  - Provide a smartphone to every person on the planet
  - Power more than 1 million EVs
- Technology leadership and a proven quality track record combined with a strong application know-how are key for business success
A global presence

R&D and Industrialization
- Product R&D (KR, JP, BE)
- Process Development (BE, KR)
- Engineering (KR)

Operations
- LCO, NMC (KR, PRC)
- LFP (BE)
- ISO9001/14001/18001
- TS16949

Application Technology
- Battery Lab (KR, JP, BE)

Customer Teams
- Dedicated teams
  - Sales & Marketing
  - Applied Technology

Total RBM workforce: approx. 500 people
Unique integration in the value chain

Umicore occupies a unique position in the value chain guaranteeing high speed to market, supply security, and responsiveness to customer needs.
Unique industrialization capabilities

- Two decades of market presence in cathode materials for Li-ion batteries
- Established industrial footprint close to the customer
- Strong industrialization capabilities building on historical Umicore key competences
- Process innovation fuels productivity improvements while maintaining highest quality standards (stringent automotive standards)
- Integrated process flows with guaranteed access to critical raw materials allows an agile market approach
Umicore’s production plant in Cheonan

The biggest cathode material production facility in the world
<table>
<thead>
<tr>
<th>1</th>
<th>Business profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Market drivers and prospects</td>
</tr>
<tr>
<td>3</td>
<td>Growth opportunity</td>
</tr>
<tr>
<td>4</td>
<td>Key takeaways</td>
</tr>
</tbody>
</table>
Supportive market conditions
Base case

The main growth driver will be **vehicle electrification**

**Portable**
Societal driver

**Electrification**
Regulatory driver

**Energy Storage System**
Regulatory driver

Bar chart showing the rechargeable battery market (GWh) from 2015 to 2025.
Exciting upside potential
High case

The main growth driver will be **vehicle electrification**
Market focus: Portables

- Main Li-ion market segment today driving material technology directions
- Smart phone, tablet and notebook applications are the volume drivers in the electronics subsegment
- Electric Power Two-Wheels is a new growth driver based on similar battery and material technologies
- Market growth rates stabilizing towards 4-6% p.a.
Market focus: Electrified transport

- Market segment is very diverse (automotive, heavy duty, marine, aviation) though near-term driven by automotive
- Car market continues on growth track
- Electrification roll-out geographically and technologically diversified
Market focus: Electrified transport

<table>
<thead>
<tr>
<th>Segments</th>
<th>Battery Size (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro HEV</td>
<td>0.4</td>
</tr>
<tr>
<td>HEV</td>
<td>1</td>
</tr>
<tr>
<td>pHEV</td>
<td>10</td>
</tr>
<tr>
<td>EV medium</td>
<td>25</td>
</tr>
<tr>
<td>EV long</td>
<td>75</td>
</tr>
<tr>
<td>Delivery van</td>
<td>50</td>
</tr>
<tr>
<td>E-bus</td>
<td>200</td>
</tr>
</tbody>
</table>

Understanding Li-ion battery requirements for automotive subsegments

Selecting most cost effective Li-ion battery system for a given Power to Energy requirement

Expanding to small delivery vans, utility vehicles and e-buses
Market focus: Electrified transport

- Aligning the right material technology and production capacities with the specific market demand profiles is crucial.
- Energy, more specifically ‘Cost of Energy’ ($/kWh), is a key driving force for material choices in Li-ion battery technology.
- Additional user requirements determine material technology decisions (e.g. fast charge capability, cold cranking,…)
Market focus: Energy Storage Systems

- Li-ion based storage systems serve only a niche segment
- Industrial power grid connected systems offer the main opportunity
- Increasing non-fossil electricity forces regulators to define ‘minimum’ connected electricity storage buffers to guarantee power grid stability
- Reliability and long-term TCO form the value proposition
- Technical requirements and market size do not require application specific material design optimization
Agenda

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### Umicore cathode material heat map

#### Segment

<table>
<thead>
<tr>
<th>Segment</th>
<th>Cathode Material Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portables Premium</td>
<td>HE LCO ✓</td>
</tr>
<tr>
<td></td>
<td>NMC/NCA ✓</td>
</tr>
<tr>
<td>Portables Standard</td>
<td>NMC ✓</td>
</tr>
<tr>
<td></td>
<td>LCO ✓</td>
</tr>
<tr>
<td></td>
<td>LMO ✓</td>
</tr>
<tr>
<td>Automotive ‘Energy’</td>
<td>NMC/NCA ✓</td>
</tr>
<tr>
<td></td>
<td>LMO ✓</td>
</tr>
<tr>
<td>Automotive ‘Power’</td>
<td>NMC/NCA ✓</td>
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<tr>
<td></td>
<td>LMO ✓</td>
</tr>
<tr>
<td></td>
<td>LFP ✓</td>
</tr>
<tr>
<td>Energy Storage System</td>
<td>LFP ✓</td>
</tr>
<tr>
<td></td>
<td>NMC/NCA ✓</td>
</tr>
<tr>
<td></td>
<td>LMO ✓</td>
</tr>
</tbody>
</table>

Umicore’s portfolio focuses on **sizeable segments offering significant market growth**
Material specific market opportunity evolution

Portables 2015-2020
- HE LCO and NMC technologies of choice
  - HE LCO: 14%
  - NMC: 31%
  - LCO: 19%
  - LFP: 4%
  - Other: 3%

Transportation 2015-2020
- NMC the technology of choice
  - NMC: 22%
  - HE LCO: 22%
  - LFP: 22%
  - Other: 15%

ESS 2015-2020
- NMC and LFP remain leaders
  - NMC: 40%
  - LFP: 40%
  - LCO: 20%

Umicore covers the main market segments with its HE LCO, NMC and LFP materials with freedom to operate and is well positioned for future material trends and market growth.
Significant accessible market for Umicore

Base case

Umicore is well positioned to participate strongly in the market growth
Significant accessible market for Umicore
High case

Cathode material demand in kt (indexed)

Markets accessible for Umicore

Umicore's supply chain integration and industrialization competences support a transformational growth scenario
Growth strategy 2015-2020

1. **Maintain leadership in portable applications**
2. **Establish technology-based leadership in xEV and continue massive industrial expansion**
3. **Cost leadership through economies of scale, process development, competitive sourcing (jointly with CSM) and operational excellence**
4. **Reach sustainable profitability**
Agenda

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Key takeaways

Li-ion is the technology of choice for portable and automotive segments in the coming decade

Market demand remains strong and transport electrification is the main growth driver

Umicore is uniquely positioned to capture this growth due to its customer proposition

- Excellent cathode materials technology and freedom to operate
- Production expertise and ability to scale up volumes
- Integrated supply chain