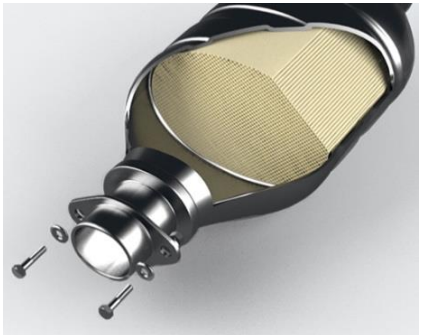
Precious Metal Refining

VFB Site Visit

14 November 2017

Umicore, global leader in….



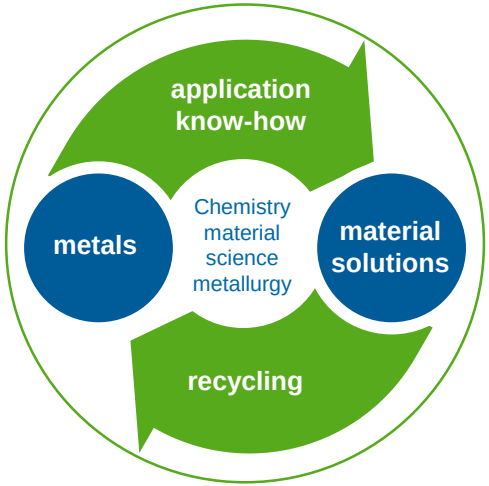
One of three global leaders in emission control catalysts for light-duty and heavy-duty vehicles and for all fuel types

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

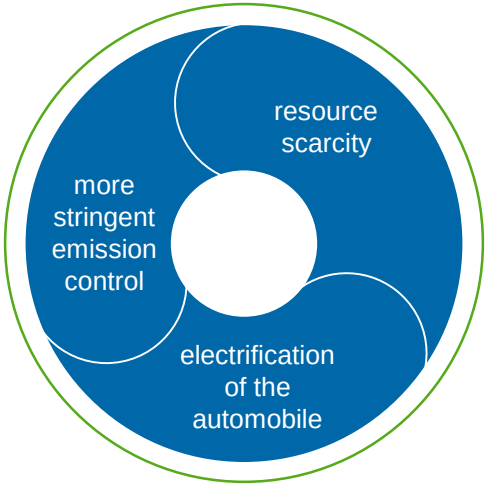
The world's leading recycler of complex waste streams containing precious and other valuable metals

Our foundations

Unique business model



Supportive megatrends



Industry leader in sustainability

Our Group structure

CATALYSIS

Automotive Catalysts

Precious Metals Chemistry

ENERGY & SURFACE TECHNOLOGIES

Cobalt & Specialty Materials

Rechargeable Battery Materials

Thin Film Products

Electroplating

Electro-Optic Materials

RECYCLING

Precious Metals Refining

Jewellery & Industrial Metals

Platinum Engineered Materials

Precious Metals Management

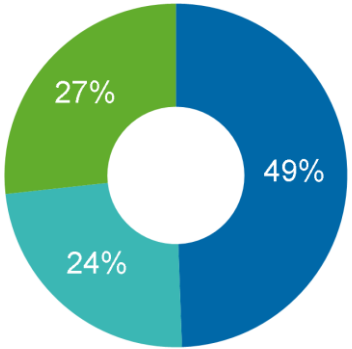
Technical Materials

Business Group split

CATALYSIS

REVENUES

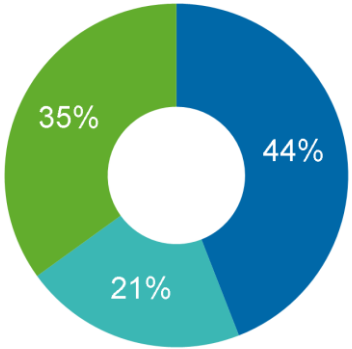
(excluding metal)



ENERGY & SURFACE TECHNOLOGIES

EBIT

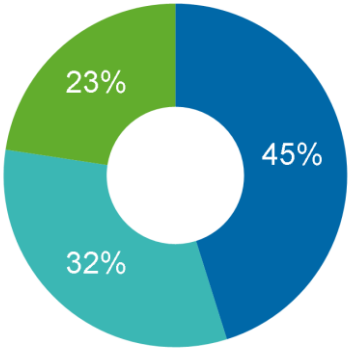
(recurring)



RECYCLING

CAPITAL EMPLOYED

(average)



Our Strategy – Horizon 2020

By 2020 we expect to have…

- Clear leadership in clean mobility materials and recycling
- Doubled the size of the business in terms of earnings
- Rebalanced the portfolio & earnings contributions
- Turned sustainability into a greater competitive edge

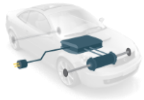
horizon 2020

Unique position in clean mobility materials

Leadership in clean mobility materials and recycling

✓✓✓ Incumbent

✓ Early stage

	Automotive catalysts	Battery materials	Fuel cell catalysts	Recycling services
				
Umicore	✓✓✓	✓✓✓	✓	✓✓✓
Automotive catalyst competitors	✓✓✓	✓	✓	✓
Battery material competitors		✓✓✓	✓	
Fuel cell catalyst competitors	✓✓✓		✓	✓

Grow faster than the market **in LDV and HDD**

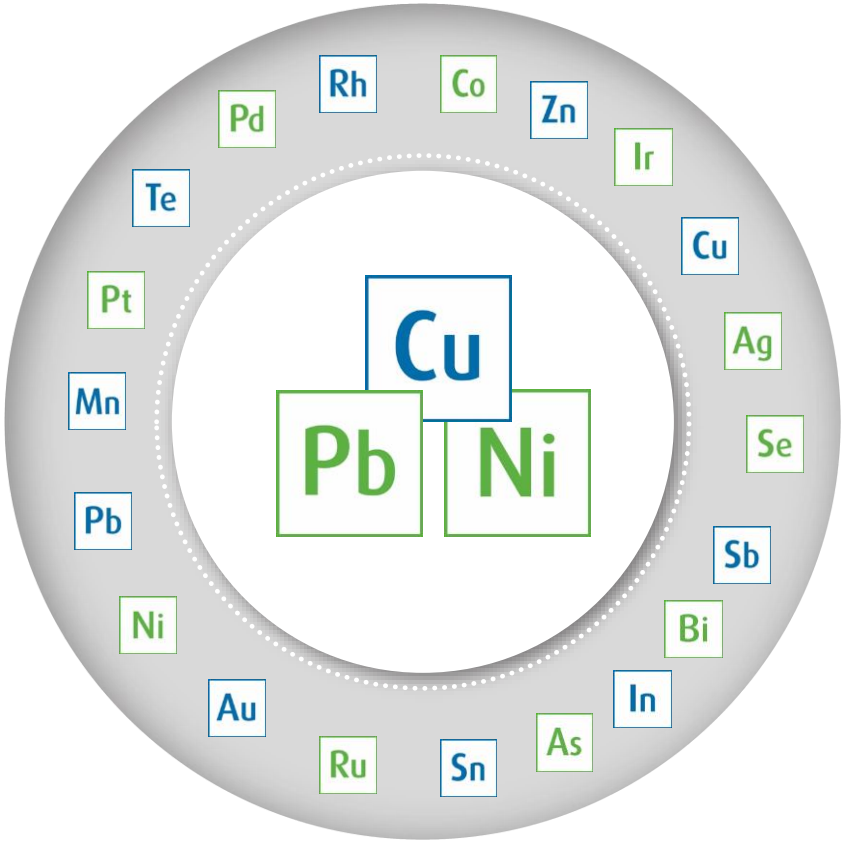
Clear leadership in cathode materials for xEV

Unique position in recycling

Unique technologies in Hoboken for treating complex residues and by-products

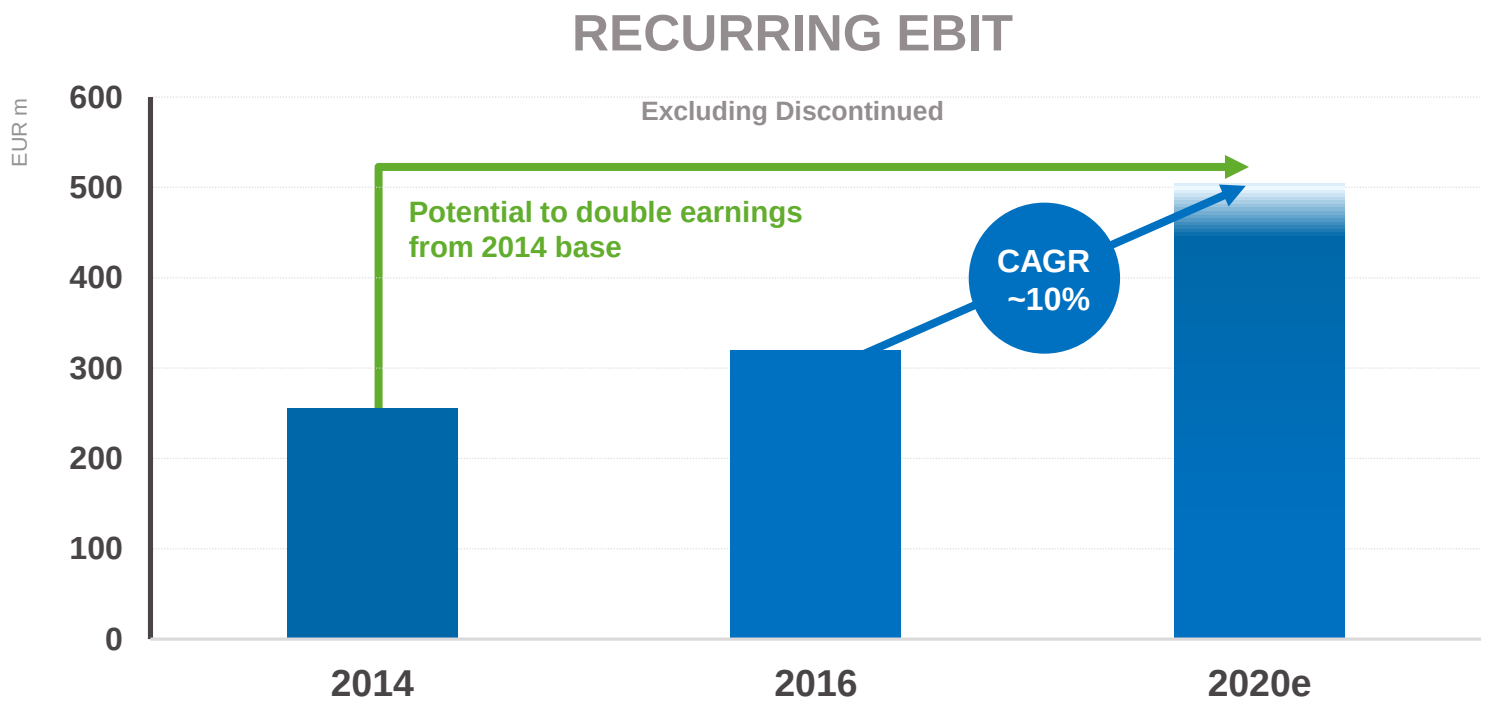
Over 200 input streams

Recovery of **20 metals**



Leadership in clean mobility materials and recycling

Doubling the earnings



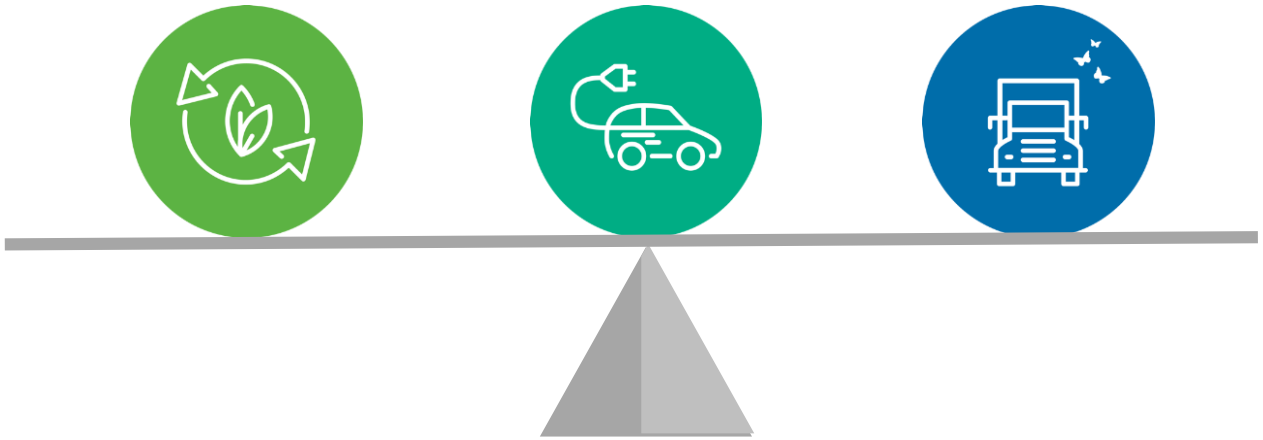
×2

Doubled the size of the business in terms of earnings

Increase ROCE
to beyond 15% target

Rebalancing the portfolio

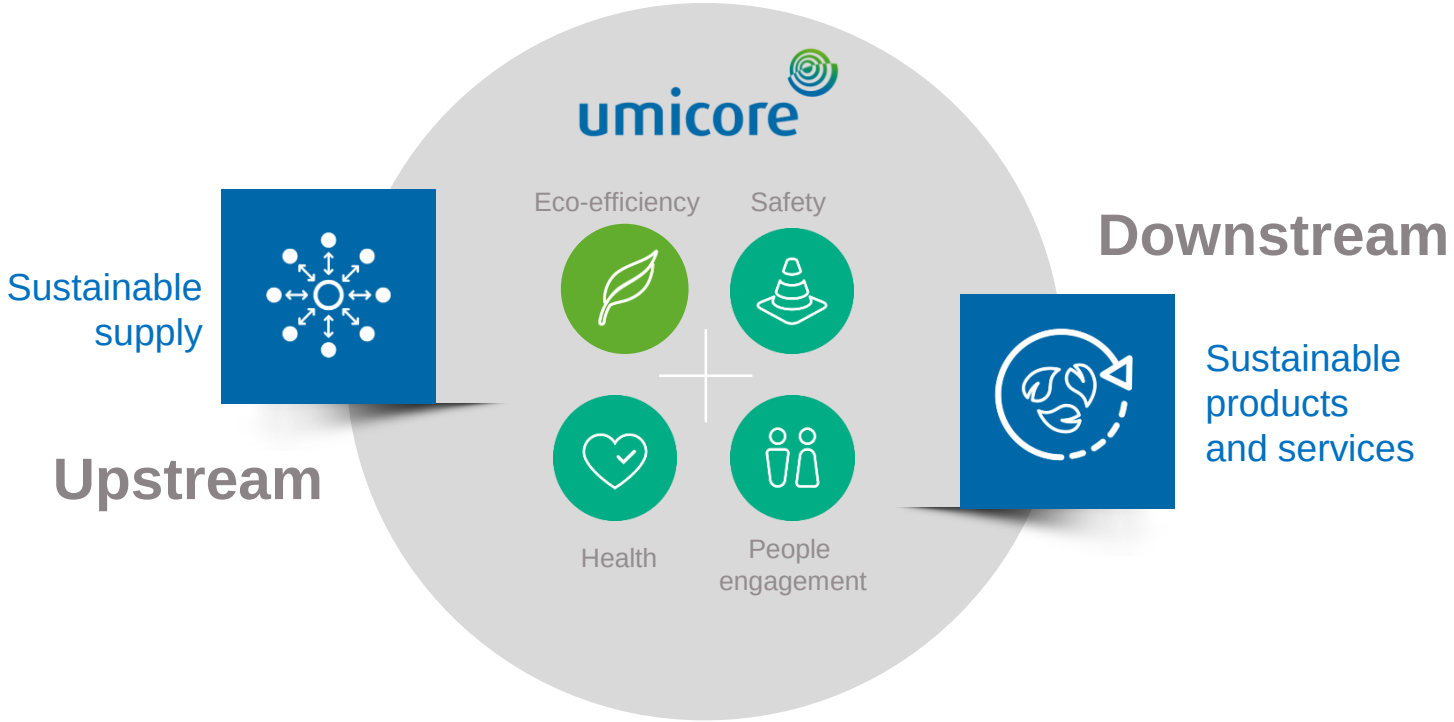
Rebalanced the portfolio & earnings contributions



More significant relative contribution expected from both Catalysis and Energy & Surface Technologies in 2020

Sustainability as a competitive edge

Turned sustainability into a greater competitive edge

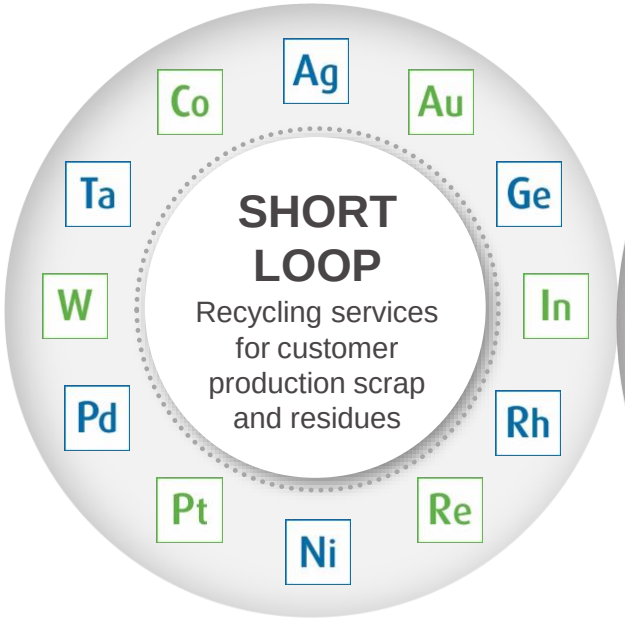


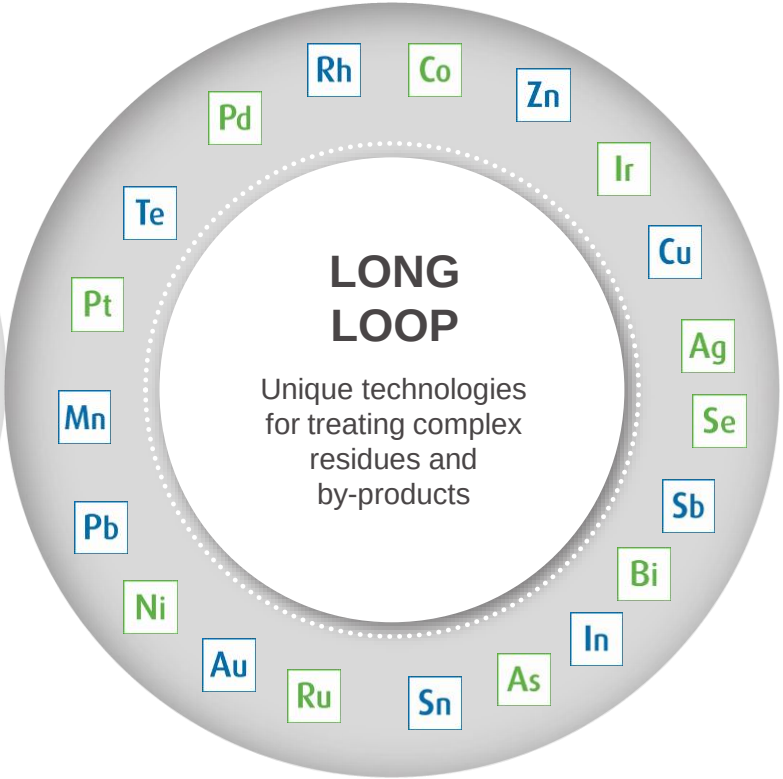
The Recycling Business Group

Recycling

Precious Metals Refining	Operates the world's most sophisticated precious metals recycling facility and recovers 17 precious and other valuable metals from complex waste streams. Proprietary technology for the recycling of Li-ion rechargeable batteries.
Jewellery & Industrial Metals	Supplier of precious metals creating products for the jewellery sector and industrial applications as well as recycling old jewellery and production scrap.
Platinum Engineered Materials	Specialist in the development and manufacturing of PGM based gauzes and components for the special glass and chemical industries.
Precious Metals Management	Services for hedging, leasing, purchasing and sale of precious metals to internal and external customers.
Technical Materials	Supplier of silver and other metal containing products for technical applications in the electric and power, lighting, heating-ventilation-air conditioning (HVAC) and tooling sectors.

Loops in recycling





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 loop in recycling

Technical Materials

Ag

Ag

Jewellery and Industrial Metals

Ag Au Pt Pd Cu

Pt

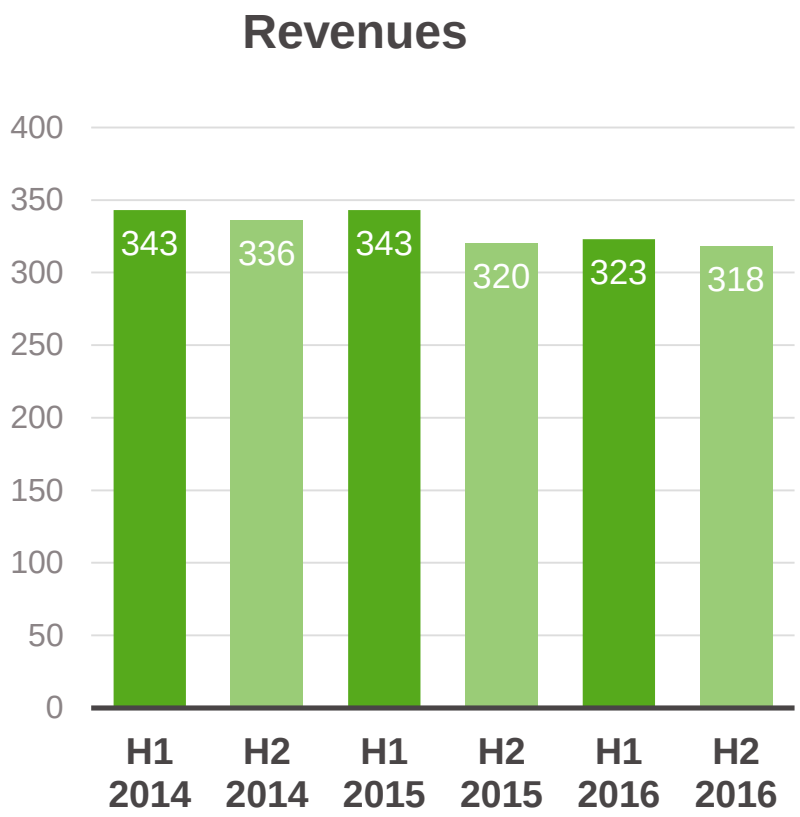
Platinum Engineered Materials

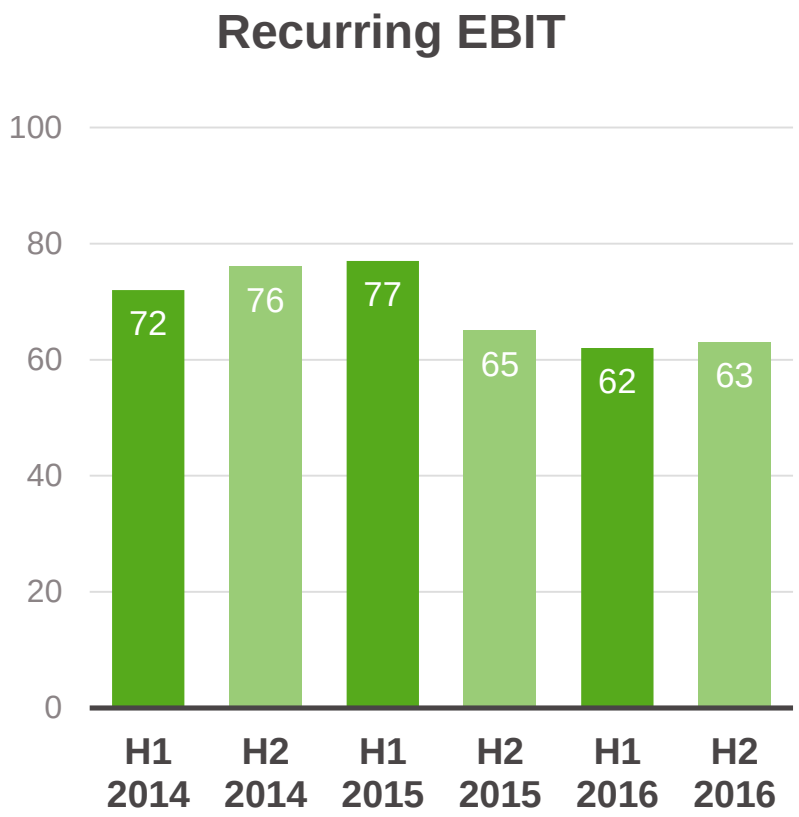
Pt Pd Rh

Precious Metals Management (PMM) sources precious metals for industrial business units

Recycling key figures FY 2016

in million €





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Precious Metals Refining

Precious Metals Refining

Precious Metal Refining today

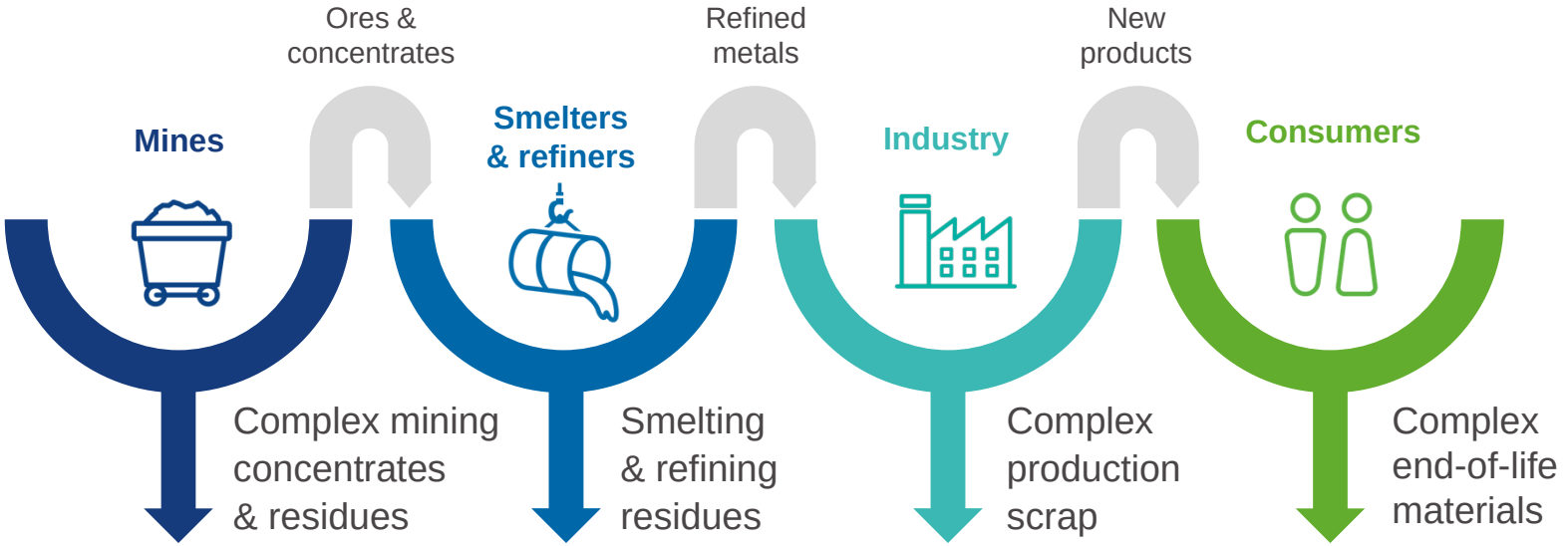
Largest and most complex precious metals recycling operation in the world

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



Industrial by-products

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Recyclables

Industrial by-products

	Pb Lead / Zn Zinc	Cu Copper	Ni Nickel PGM	Precious Metals
WET	 e.g. lead sulphate	 e.g. electrolysis slimes	 e.g. hydroxide	 e.g. filter cake
LUMPY/ METALLIC	 e.g. drosses	 e.g. mattes	 e.g. slags	 e.g. impure bullion
DUSTY/ FREE-FLOWING	 e.g. fine drosses	 e.g. complex concentrate	 e.g. flue dust	& many more

Recycables

Electronic Scrap

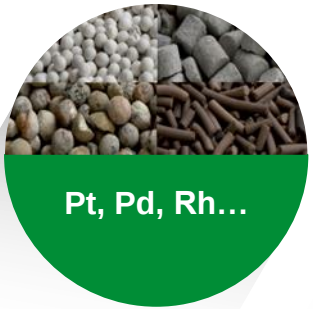
e.g.

mobile phones

printed circuit boards

Spent Automotive Catalysts

end-of-life car catalysts



Spent Industrial Catalysts

industrial catalysts from oil refining & petrochemical industry

Other precious metal bearing materials

e.g.

fuel cells

photographic residues

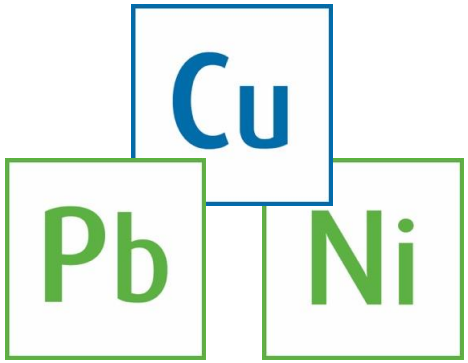
A global customer base

6,400 lots

>500 customers

The refining process

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

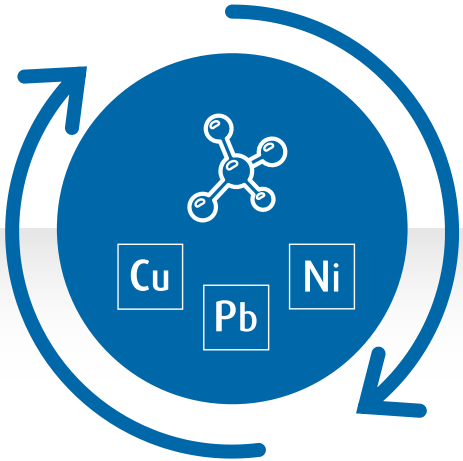
- Umicore technology guarantees environmentally friendly processing, a high yield and a more competitive cost
- Umicore introduced its unique Ultra High Temperature technology for Battery Recycling more than 5 years ago

The refining process

Recyclables

Industrial
by-products

Collector metals



17 different
metals

How PMR generates revenues

Main revenue drivers

Treatment & refining charges	Metal yield
Treatment charges are determined, among other criteria, by the complexity of the materials.	Umicore assumes the risk of recovery above or under the contractually agreed recovery rate.

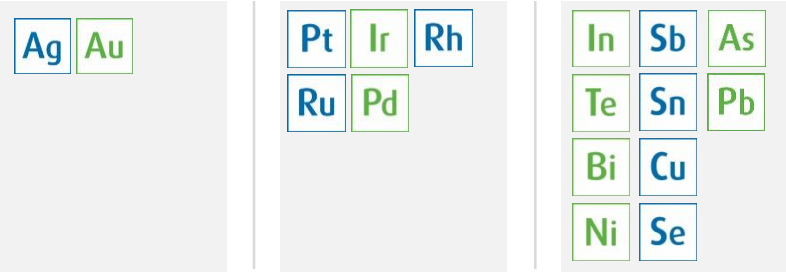
Metal price exposure

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

Competitive landscape

No one can take in the wide span of materials and metals

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

Most competitors are customers

They usually focus on niches

No other company can process as wide a scope of materials as Umicore

By-products Recyclables

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

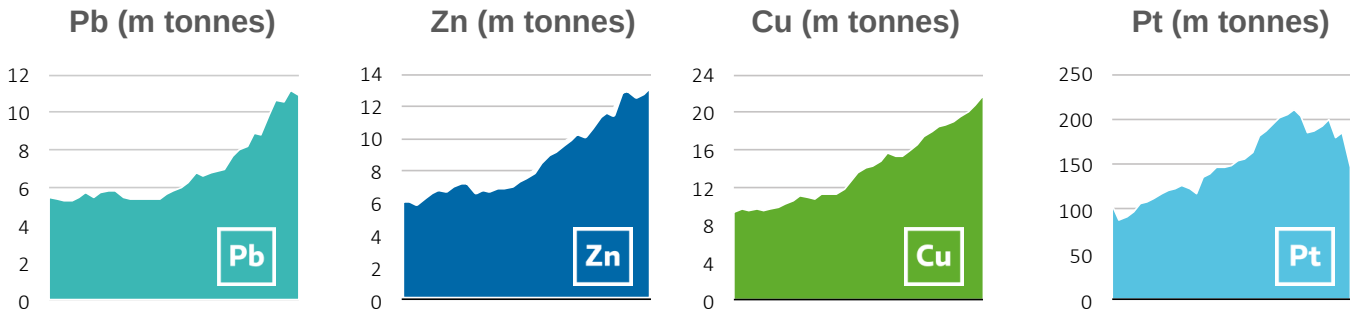
Resource scarcity

Opportunity for PMR to process more metals

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



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**

Trading companies like Trafigura, Ocean Partners and others have made significant investments in storage and blending capacity in recent years as the volume of complex concentrates in the market have increased.

Metal Bulletin
Oct 2014

Many of the new mines currently coming on stream are producing concentrates with high levels of impurities.

South American mining company, Reuters
Dec 2014

So we are actively looking at process changes and new technologies in order to cope with the complexity in a suitable manner.

Copper refiner, Metal Bulletin
Apr 2015

Eco-efficiency

Trends towards higher recycling rates

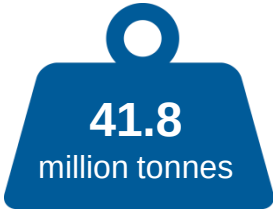
Base metal smelters are increasingly obliged to find an outlet for their by-products

Recycling markets of end-of-life products to increase

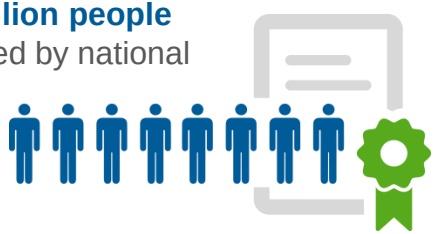
Processing complex materials in an environmentally friendly way **will become the norm**

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

E-waste
generated
in 2014



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

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

Investment to increase capacity at Hoboken by 40%

Further improvement of competitiveness through **economy of scale**

Ramp-up 2016-2018

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)

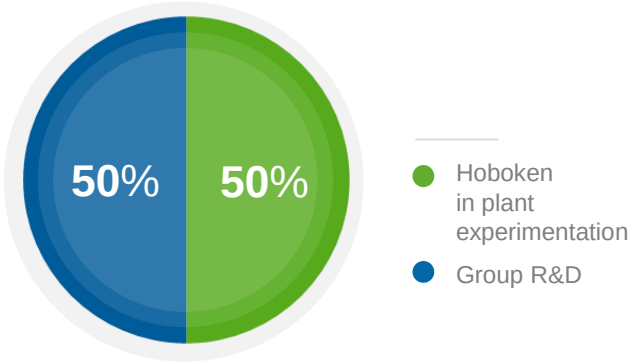
Debottlenecking **never stops**

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**

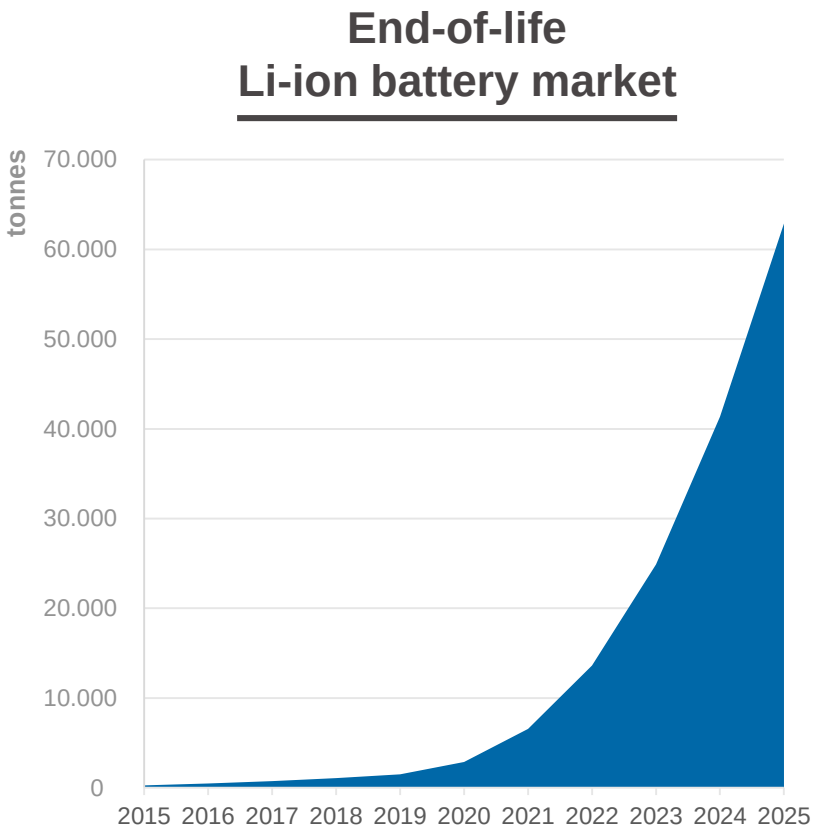


Recycling development

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




Hoboken plant

Hoboken plant

125 years of history

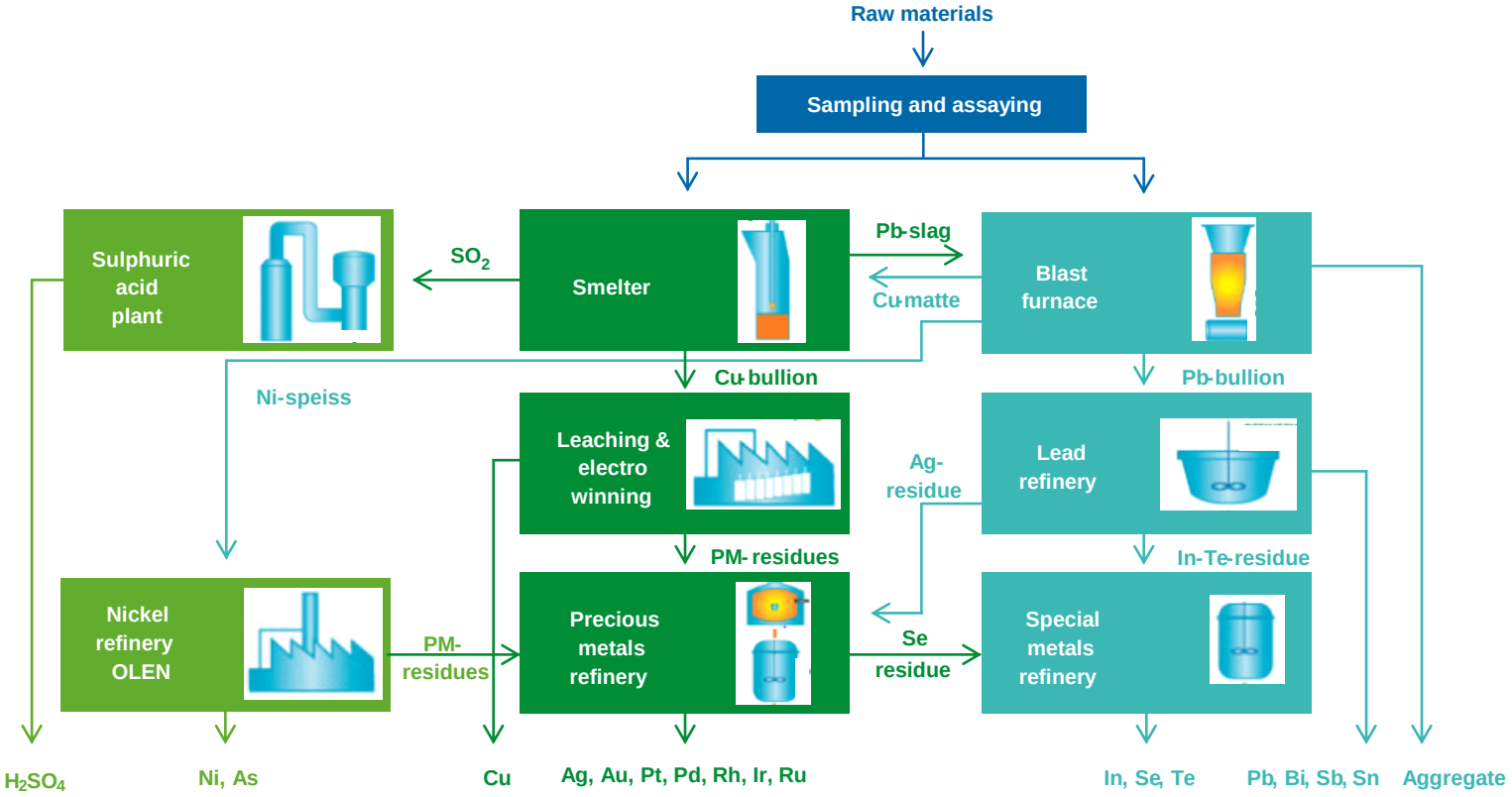
Lead and precious metals refiner

Precious and specialty metals recycler

Transformation process started in late nineties

Continued process improvements and innovations since

Unique metallurgical flowsheet



Precious metals operations

Cu-bullion

SMELTER

- Unique application of **ISASMELT** technology
- Precious metals concentrated in **copper bullion**

LEACHING & ELECTROWINNING

- Highly **flexible** technology
- Copper leaching to collect **precious metals residue**
- Production of **pure copper cathodes**

PM-residue

PRECIOUS METALS REFINERY

- Both **classical and unique** processes used
- Incorporating **pyro- and hydro-metallurgy**
- Production of **high purity** metals

Base metals operations

BLAST FURNACE

- **Production** of **lead bullion**
- Construction aggregate to construction industry in **three grain sizes**: Umirock, Betogrind, Betozand

Pb-bullion

LEAD REFINERY

- Refining of lead bullion
- Production of 99,99% lead, LME-registered brand
- A major European lead producer

In-Te-residue

SPECIAL METALS REFINERY

- Refining side-stream materials from the lead and precious metals refineries
- Production of high purity metals

Eco-efficiency

Sustainability

External engagement and recognition

Cautionary statement

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.

materials for a better life

Investor Relations
Evelien Goovaerts
evelien.goovaerts@umicore.com
+32 2 227 78 38

Eva Behaeghe
eva.behaeghe@umicore.com
+32 2 227 70 68