

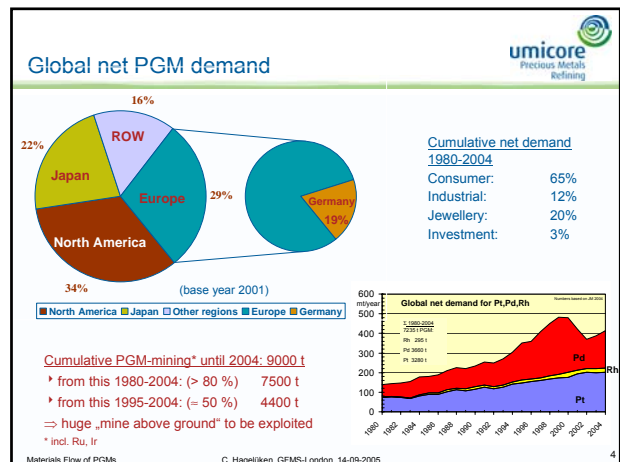
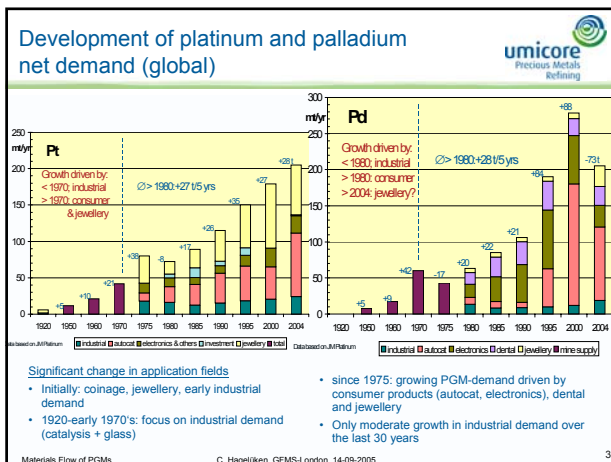
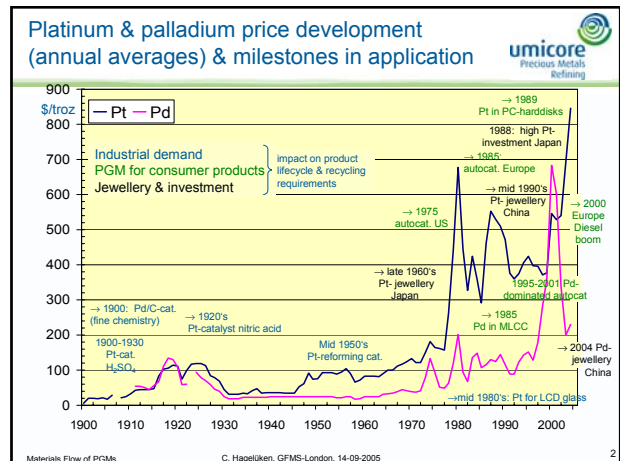
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Materials Flow of Platinum Group Metals in Germany

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Umicore Precious Metals Refining

GFMS
Precious & Base Metals Seminar
London, September 14





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Material Flows of PGM - System Analysis and Measures for a Sustainable Optimisation

Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

Research Project:

- Conducted by Umicore & Öko-Institute, August 2001 - Sept. 2004
- Funded by the German Federal Ministry of Education & Research
- Case study of situation in Germany (global market environment is considered) → reference for PGM industry worldwide
- 250 p. final report (German) published in 4/2005 (GDMB Medienverlag)
- GFMS: review of report, context chapter putting the results in a global perspective, executive summary.
- Joint publication of extended report in English language in 6/2005 (published by GFMS, London)

Project target:
How to improve life cycle efficiencies for PGM's and minimise PGM-losses.
Basis: In-depth market analysis


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Areas of Investigation: All relevant application segments for PGMs

- Automotive catalysts
- dental
- electroplating
- glass
- chemical & oil refining catalysts
- electronics
- fuel cells
- jewellery
- others

Analysis & quantification of PGM flows (incl. gross demand & recycling)
Identification of deficits & assessment of recycling potentials
Proposals for improvement in selected segments
Development of scenarios for future PGM flows (- 2020)
Analysis of their economical and ecological consequences



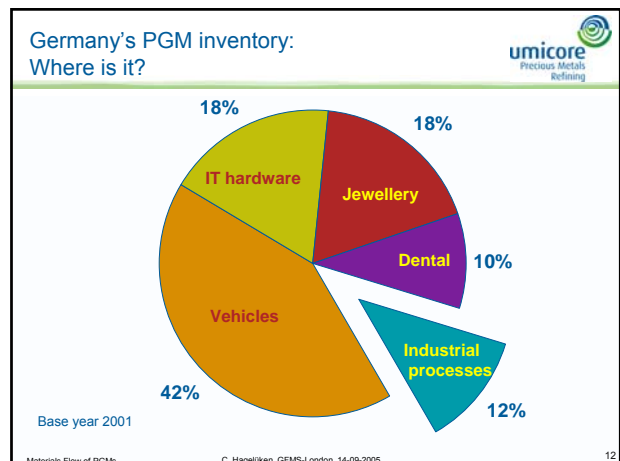
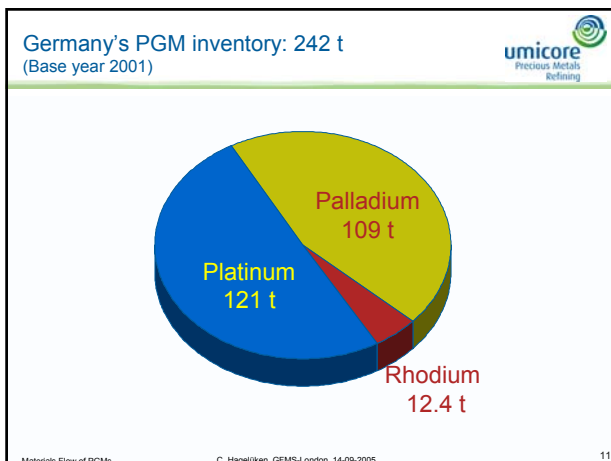
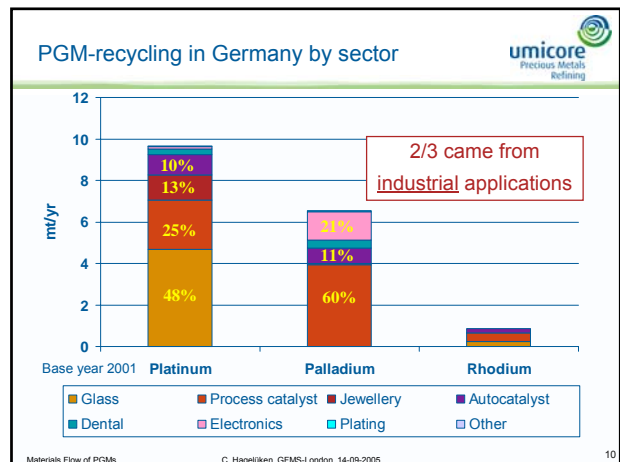
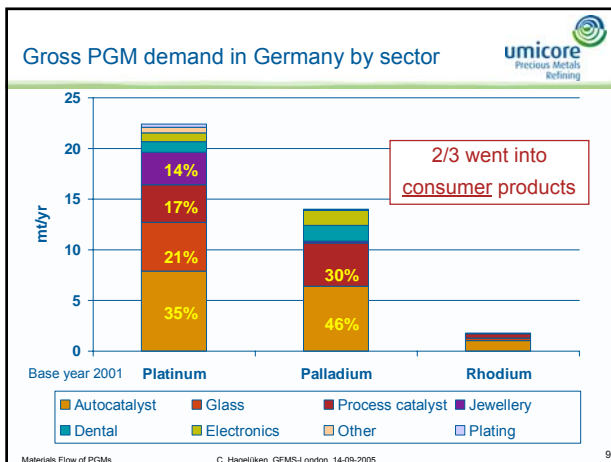
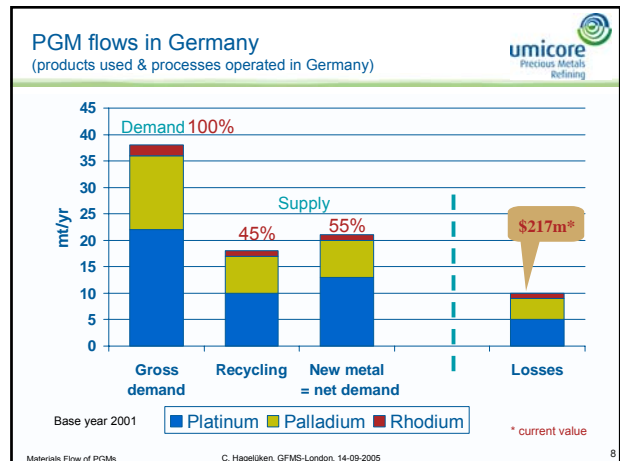
- Bottom up data collection, top-down cross-checking
- gross & net demand, recycling volumes, losses, inventory for Pt, Pd, Rh

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What questions does the report address?

- What PGM materials are being recycled?
- What escapes recycling and why?
- Why have recycling volumes often disappointed?
- What are the lifecycles within processes and of products?
- Why are some sectors more efficient than others?
- What kind of recycling structures exist?
- What isn't working and can it be fixed?
- What future contribution can we expect from recycling?
- Is recycling more environmentally friendly than mining?

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To recap.....

- 2/3 of gross PGM demand went into consumer products
- PGM inventory comprised 88% consumer products
 - Who said these were industrial metals?!
- And yet, end-of-life consumer products generated only 1/3 of all PGMs recycled
- Why?
 - Short lifecycles in industrial applications e.g. glass
 - Recycling structures are fundamentally different:

→ Industrial applications = "closed loop" systems
 → Consumer products = "open loop" systems

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"Closed loop" recycling / direct cycles for PMs in industrial processes

- Final products typically contain no PGM
- PGMs survive; recovery is an economic imperative
- Physical location of PGMs is confined to users plant
- Provider, user & refiner of PGM product work closely together:
 - Technical performance of PGM product is critical
- User typically retains ownership of the PGMs
- Spent products recycled by provider or specialised refiners into new
- Professional handling, rather transparent material flows

→ Inherently efficient; >90% measured efficiency

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"Open loop" recycling / indirect cycles for consumer durable products ... a complex affair

- Multiple changes of ownership, no connection remains between final owner and product manufacturer
- Involvement of "the general public"
- Often longer product lifecycle (e.g. car catalysts)

- Intransparent material flows, "informal" participants in early stages of recycling chain
- Often limited awareness of PM-values & inadequate removal of PM-bearing parts
- Electronics: high dilution of PMs in end product hinder economic viability of recycling
- High exports of cars, computers etc. to less developed countries with poor recycling infrastructure/awareness
- Highly complex structures with numerous opportunities for failure of PM-recovery
 - Inherently inefficient, PGM recycling rate usually < 50% for entire lifecycle
 - This is not unique for Germany!

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Recycling chain for autocatalysts - PGM-refining takes place at the very end

Again, this type of structure is not unique to Germany

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Open loop recycling - the consequences

PGM recycling from consumer products falls a long way short of its potential

- used autocatalysts & end-of-life electronics only < 40 %
- dental even worse

Can this be improved?

Recycling legislation should aid improvement

- EU laws on end-of-life vehicles and electronic waste recycling
- responsibility for recycling transfers to original producers

But...other supportive action is required:

- improved awareness of PGM value is required
- financial & environmental benefits of PGM recycling need to be understood
- more transparency is required and some rationalisation is necessary.
- dismantling and pre-processing procedures need optimising.
- action by regulators to eliminate "informal sector" and regulate/control exports

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Consequences for the recycling of used autocatalysts

PGM recycling will grow organically

- Historical growth in autocatalyst application
- Rising proportions of catalyst equipped ELVs

However, losses will also grow organically

3 t in 2001, could top 10 t by 2020

"Closing the loop" could double PGM recovery by 2020

→ requires fundamental changes in the recycling practice (streamlining, industrial structures, transparency & control)

... and deliver environmental benefits

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Environmental benefits

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- Germany consumed 21 tonnes of new PGM in 2001
- Mine production of 21 tonnes of PGM generates:

mine waste/tailings	4,000,000 tonnes	} (equivalents)
Carbon dioxide*	300,000 tonnes	
Sulphur dioxide	20,000 tonnes	

 → *Equivalent to production of 168,000 tonnes of steel
- Increased recycling reduces dependence on mining
- Emissions value of "closing the loops" in Germany:

Carbon dioxide	90,000 tonnes	} (equivalents)
Sulphur dioxide	7,000 tonnes	
mine waste/tailings up to 4,000,000 tonnes		

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PGM-recycling will become of growing importance for future PGM-supply

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- Almost 50% of global PGM gross-demand today is covered by recycling.
- Large future potential for recycling: ~ 50 % (4400 t) of all-time cumulative PGM-demand took place in the last 10 years.
- Specific logistical & technical requirements evolved for different recycling materials. Further investments and process development needed at PGM-refiners to comply with new refining challenges.
- Significant changes occurred in the PGM-recycling industries especially over the last 3 decades.
- Mastering the PGM-lifecycles from consumer products is the key challenge to be solved:
 - Increase transparency and efficiency of PGM flows (incl. exports)
 - Rationalise recycling chain, improve cooperation of industrial stakeholders
 - Control / eliminate the informal sectors, more focus on business ethics
- "Real" smelting & refining companies play crucial role in future PGM-supply.

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"Materials Flow of PGMs in Germany"

- Unique
- Immensey detailed
- Highly authoritative

Published in June 2005

- English language, hard copy
- ca 300 pages with over 70 charts & tables
- Price US\$495, €395, £265

To purchase a book contact GFMS London
peter.ryan@gfms.co.uk or laurette.perrard@gfms.co.uk

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Thank you for your attention




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