



ENGELHARD

Materials Services

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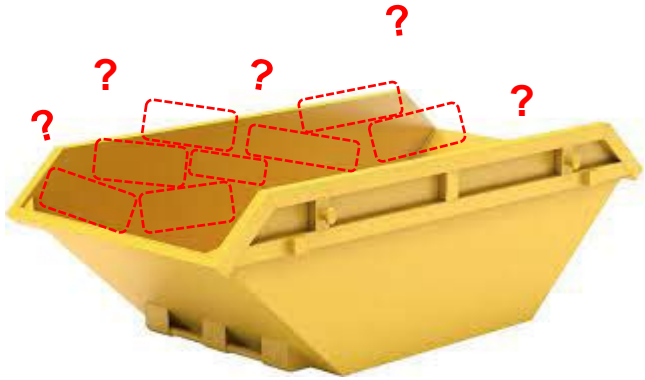
Autocat recycling market update

IPMI

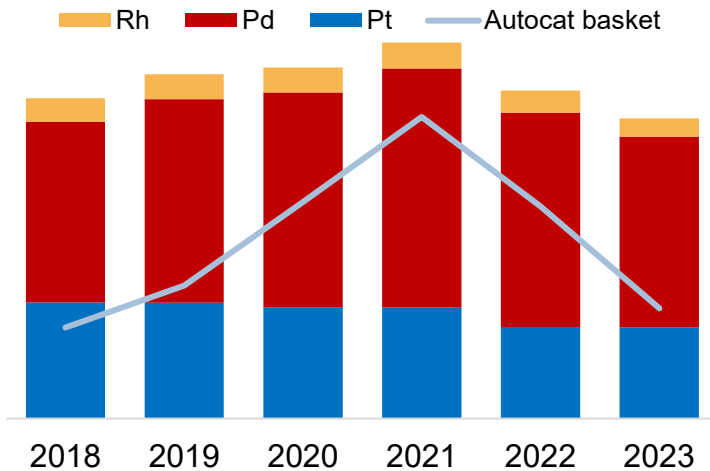
Vienna, 14.11.2023

2023 a very subdued year for scrap cat volumes...

Down 15-25% y/y despite near-record high PGM prices in H1



Global autocat recycling market, toz



Where are the catalysts?

- Varying narratives / nobody knows:
 - **Longer useful life of vehicles**, partly due to post-Covid home-office hybridization
 - **Scrapyards** prioritizing other revenue streams
 - **ELV exports** quietly up
 - (Hoarding somewhere in the value chain)
 - (Stolen converters flushed out of chain)

Most narratives have a temporary effect, but the point of resolution is unclear

Market reaction

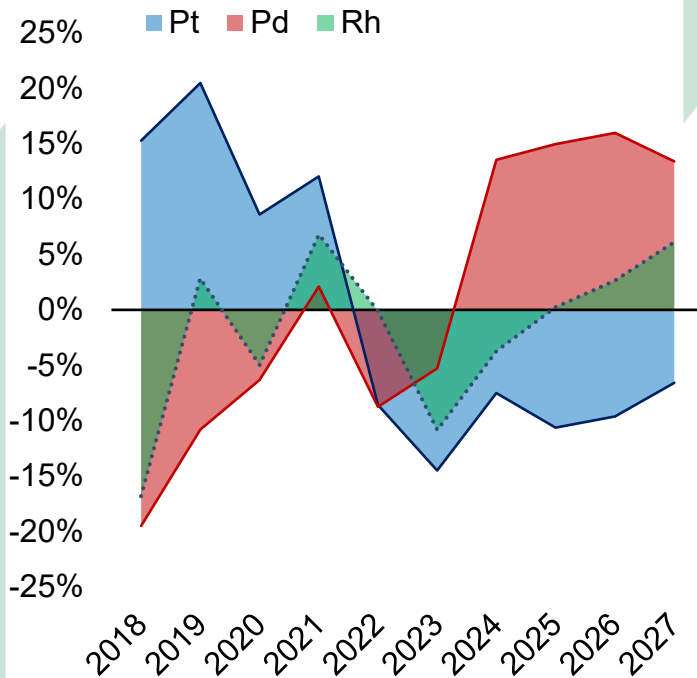
- Many collectors report losses as midstream over-capacity forces **uneconomical processing** and/or **speculative behaviour**
- **Diversification** a growing theme

Good prices but not enough volume for players to make a profit

Market balance paints a partial picture for prices

The rest can be explained by movements in forwards & stockpiles

Fundamental market balance as a % of annual demand



Market balance picture:

- ICEs overall are going to **decline**, especially impacting Pd and Rh where this accounts for >85%
- Auto demand has partially **substituted** Pd for Pt
- Nascent applications favour **Pt, Ir and Ru**
- South African & Russian primary supply largely **inflexible**; we assume some S.A. mines close (left) but this is far from guaranteed

Pt market tightens, Pd heads to unsustainable surplus, Rh moves back into balance near term (then surplus)

Market reaction

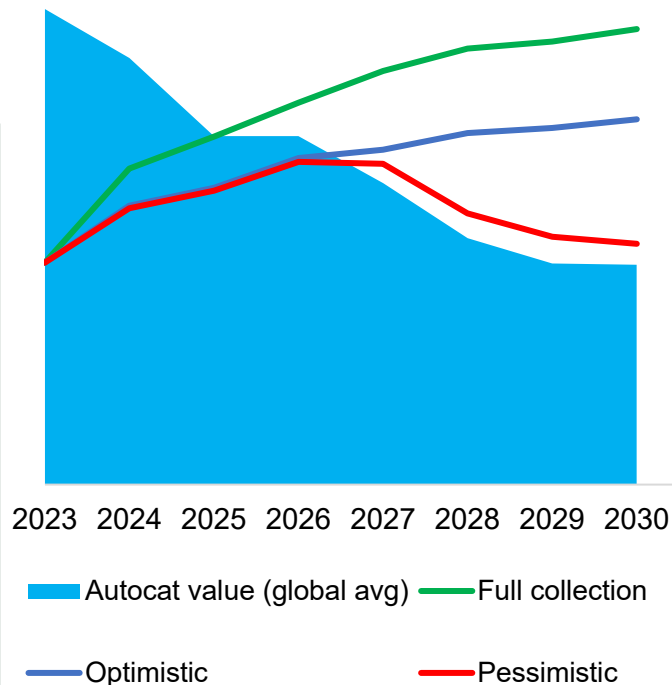
- Elevated Pt stocks being dumped into consumption
- Pd & Rh safety stocks and forwards being drawn down almost in tandem, despite risks in the Rh market

Falling price of Pd & Rh will reduce autocat value, especially LDG

Much more volume should be coming available

But how much of it will be collected and processed?

Autocat secondary prod (PGM oz)
vs average autocat value (\$/cat)



Rising volumes

- Vehicle sales in the period 2009-2019 (coming back as scrap over the forecast) increased >40%
- Loadings also grew substantially over this period
- Metal hitting the scrapyards in 2030 could be double that of 2023

Falling collection rates

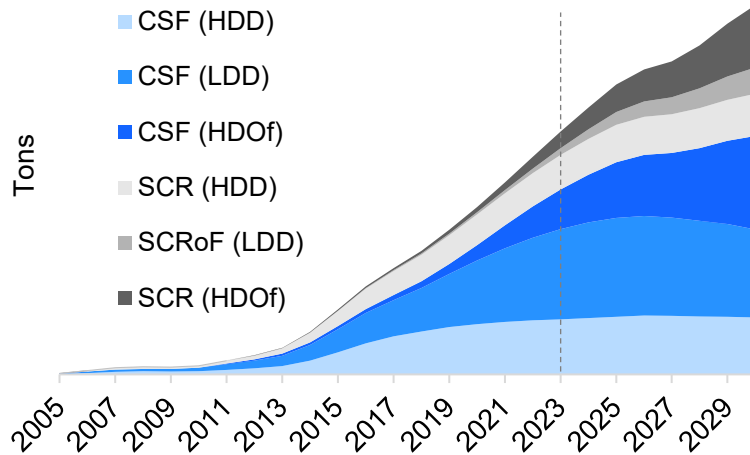
- Value per catalyst will fall with Pd and Rh prices
- Processors with large asset base and fixed cost components will have to protect margin, meaning it will be squeezed upstream
- Biggest losers will be the original owners
- Collector market will likely consolidate and shift to lower-margin, higher-volume business
- Low-grade material will be set aside

Market priority will shift from volume to value as it chases grade

The race for diesel is on, watch out for hurdles

New technologies will be needed to debottleneck silicon carbide processing

SiC scrap returning



The trouble with SiC

- High-Pt DOC is standard ceramic, but is often commingled with low-grade CSF (DPF) and even PGM-free SCR, both made of SiC
- Silicon carbide froths in smelters, presenting major safety and operational risks
- CSFs have been around since 2006 and we are still approaching the peak of prevalence in scrap
- Today's market blends high-C and sends through a few large polymetallic smelters, but as SiC share of the mix grows, bottlenecks will form

Solution: dissolution

- Potential for specialized smelting (high capex solution in a downturn market)
- Lower-capex hydrometallurgical options are being proposed and may help the market to pivot

Higher carbon tolerance will become a notable point of difference



Other factors may arise to support recycling

Green credentials & localized chains may spur private or gov't support



1 kg of mined PGM



30,000kg of CO₂ – or the weight of 15 cars

*For context: producing 1 kg of steel emits just **2kg of CO₂***

The case for support

- The CO₂ footprint of recycled PGM is **97% lower** than mined PGM
- Increasingly, recyclers have tools available to **prove origination**; these players should earn preferential treatment from end use customers seeking to reduce value chain emissions

Path of policy

- The draft **European Supply Chain Due Diligence Directive** would require large EU companies to manage societal and environmental impacts along their entire value chain
- EU's draft **CRMA** is seeking 15% of supply to come from recycling as a protective measure

Un-used metal should be left in the ground, not in the yard

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