Autocatalyst value chain
COVID-19 and beyond

IPMI Autocatalyst Seminar
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Mitsubishi’s Precious Metals Business Services

Mitsubishi Corporation offers a broad range of trading services in *Precious Metals* designed to add value and create international business opportunities utilizing over 40 years of experience in Precious metals business.

Through its extensive relationships across a wide range of industries, Mitsubishi provides clients with a “Value Chain” of precious metals services: from raw metal supply and secondary recycling to the provision of credit and financial risk management.

Mitsubishi offers a range of risk management products which can be customized to develop strategies that best suit our clients’ requirements:

- Global coverage of Au, Ag, Pt, Pd, Rh, Ru & Ir markets;
- Spot, average and forward Pricing with global logistics;
- Leases and consignments;
- Futures, options, financially settled swaps, location swaps;
- Financial commodity products for Investment (Index Linked Notes, ETFs).
COVID-19 pandemic has a dramatic impact on economic growth
But will the recovery be V-shaped, W-shaped, L-shaped?

US and China Manufacturing Purchasing Managers’ Index (>50 denotes expansion. <50 denotes contraction)

China is ahead of the curve in COVID-19: strong PMI rebound in April and May after deep contraction in March, but heading back for contraction territory?

US some months behind but showing a similar trend?

Source: Mitsubishi from Bloomberg
Economic impact of COVID-19

Unemployment measures at record highs

US weekly unemployment claims (millions)

Economic impact of COVID-19 is significant and could be long lasting
Policy response to COVID-19
Interest rates at rock bottom, fiscal stimulus at full throttle

Benchmark interest rates in USA, Eurozone, Japan (%)
Macro environment favours precious metals investment

Gold ETF holdings at record highs, platinum ETFs recently at all-time highs

Source: Mitsubishi from Bloomberg
Key questions

- How will auto industry demand look in a post-COVID world?
- What is the impact of the current crisis on primary and recycled supply of PGM?
- How will the recycling mix change as a result of COVID-19?
- What are options for metal financing in this uncertain world?
Palladium demand

Big drop in car sales/production in Q1, recovering after but with possible double dip

Monthly car sales in selected markets (millions)

Car production and sales dropped steeply in China in Q1 but now shows signs of normalising. Car sales in the US and Europe are expected to fall dramatically before recovering.
### PGM demand outlook in autocatalysts

#### A tale of 3 markets

<table>
<thead>
<tr>
<th>Country</th>
<th>Impact on PGM demand</th>
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<tbody>
<tr>
<td><strong>China</strong></td>
<td>Rapid recovery on pent-up demand / stimulus measures</td>
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<td>Individuals choose to buy a car instead of use public transport</td>
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<td>Possible delays to emissions legislation to help auto industry</td>
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<td>Possible reformulation of catalysts allowed by self-certification</td>
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<td><strong>USA</strong></td>
<td>Reopening of the economy sees a rebound in car sales</td>
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<td>Cheap credit / low interest rates keep buyers interested</td>
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<td>Renewed focus by OEMs on thrifting/substitution</td>
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<td><strong>Europe</strong></td>
<td>Patchy recovery depending on country</td>
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<td>Stimulus measures will be focused on greener vehicles</td>
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<td>No delays to emissions legislation expected</td>
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</table>
Platinum demand
Unprecedented fall in European car sales in Mar-Apr 2020

Monthly car sales in Europe

New car sales fell 55.1% in March and 76.3% in April 2020

Source: Mitsubishi from ACEA

European car sales dropped dramatically in Q1 2020 and on into April, to levels much lower than in the 2008-2009 financial crisis. How quickly will the market now recover?
Platinum demand
Further fall in diesel share to under 30% in Q1 2020

New passenger cars by fuel type in the EU
Market shares (%)

Q1 2019
- Petrol, 57.7%
- Diesel, 32.2%
- ECV, 2.5%
- HEV, 4.9%
- Alternative fuels, 1.7%

Q1 2020
- Petrol, 52.3%
- Diesel, 29.9%
- ECV, 6.8%
- HEV, 9.4%
- Alternative fuels, 1.6%

Source: Mitsubishi from ACEA

Continuing drop in diesel market share is negative for platinum demand. Growth in diesel hybrids (HEVs) has some offsetting effect.
However, overall backdrop is one of declining heavy duty diesel sales in first half of 2020, government policies will help determine the future shape of the heavy duty market.
Palladium and Rhodium demand
Tighter light duty NOx emissions favour higher Rh (and Pd) loadings

Light duty emissions legislation:

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<td>N America (CARB)</td>
<td>LEV II</td>
<td>LEV III phase-in</td>
<td>LEV III further tightening (expected)</td>
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<td>Europe</td>
<td>Euro 5</td>
<td>Euro 5b/b+</td>
<td>Euro 6b</td>
<td>Euro 6c / Euro 6d-TEMP</td>
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<td>Japan 2018 (WLTC)</td>
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<td>China gasoline (National)</td>
<td>China 3</td>
<td>China 4</td>
<td>China 5</td>
<td>China 6a*</td>
<td>China 6b + RDE</td>
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<td>India (Main cities)</td>
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<td>BS VI</td>
<td>BS VI + RDE</td>
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<td>India (National)</td>
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<td>PROCONVE L5</td>
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<td>PROCONVE L7</td>
<td>PROCONVE L8</td>
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<td>S Korea gasoline</td>
<td>K-LEV II</td>
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<td>K-LEV III phase-in</td>
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<td>S Korea diesel</td>
<td>Euro 5</td>
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Phase in of tighter NOx emissions standards in India and China favours the greater use of Rh. Loadings will rise as the limits tighten under China 6b, and Real Drive Emissions (RDE) limits are observed, however delays to implementation could impact Rh demand negatively.
**Delays to emissions legislation in China**

**Nationwide light duty gasoline standards**

<table>
<thead>
<tr>
<th>Legislation</th>
<th>Scheduled introduction</th>
<th>CO limit (g/km)</th>
<th>PN limit /km</th>
<th>Conformity Factor</th>
<th>Effective PN limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>China 5</td>
<td>Jan-2018</td>
<td>1.0</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>China 6a</td>
<td>Jan-2021*</td>
<td>0.7</td>
<td>$6 \times 10^{11}$</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>China 6b</td>
<td>Jul-2023</td>
<td>0.5</td>
<td>$6 \times 10^{11}$</td>
<td>2.1</td>
<td>$1.26 \times 10^{12}$</td>
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</tbody>
</table>

- **6-month delay** to original nationwide implementation of China 6a legislation, now delayed to January 1\(^{st}\) 2021
- Shanghai, Beijing, Tianjin cities and Guangdong region have already adopted China 6b, but outside of those areas some OEMs are only like to fit China 6a catalysts
- Scrappage scheme in **Beijing** to replace older China 3 vehicles with China 6b ones

Overall provided there is no further relaxation/delay in standards, average PGM loadings should continue to rise in China
Thrifting / substitution
Pressure is on in the current environment to reduce cost of catalyst system

It is technically possible to increase the Pt content of a gasoline catalyst and remove Pd...but this has been avoided due to the issues in re-engineering the whole vehicle to prevent Pt sintering. OEMs now looking at this more closely

Source: Mitsubishi from Bloomberg
**PGM demand:**
Many uncertainties in autocatalyst demand post COVID-19

<table>
<thead>
<tr>
<th>Factor</th>
<th>Detail</th>
<th>Impact on PGM demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions legislation</td>
<td>Possible delays to implementation of emissions legislation in China</td>
<td>Neutral to negative but limited in scope to China (not Europe)</td>
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<td></td>
<td>Recognition of benefits of clean air elsewhere more generally favours tighter control of pollution in future</td>
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<tr>
<td>Catalyst loadings</td>
<td>Reformulation of catalysts in favour of Pt-richer chemistries</td>
<td>Positive (Pt) but impact to be felt over several years</td>
</tr>
<tr>
<td>Auto industry stimulus measures</td>
<td>Likely to favour ‘green’ vehicles, i.e. batteries/hybrids. May penalise diesel vehicles depending on local policies</td>
<td>Neutral to negative (Pt)</td>
</tr>
</tbody>
</table>
**PGM demand**

Substantial drop in demand is expected in 2020 due to decline in the auto sector.

*Source: Mitsubishi from JM (to 2019) Mitsubishi forecast for 2020*
Non-auto platinum demand
Strong physical demand in China for industrial applications

All-time high sales of platinum on SGE in March due to strong buying into dip by industrial users, partly as glass manufacturers bought ahead of planned expansions in next 2 years.
**Industrial platinum demand**

Oil price collapse is good news in terms of lower feedstock prices

Fall in crude and other feedstock prices (propane, ethane) is positive for petrochemical producers whose margins depend on low input costs

Demand outlook for end-use products from the petrochemical industry is mixed, however the use of polypropylene products for PPE and packaging is increasing in the post COVID world
Platinum supplies
Regionality in PGM mining

**Canada**: closure of Impala and Glencore mines

**USA**: no reported closures

**Russia**: no reported COVID-19 closures

**Zimbabwe**: has continued to operate but delays to processing in South Africa

**South Africa**: forces majeures at major producers
Platinum prices: short to medium term

Platinum has lost ~40% of its value at the lows this year

Platinum has fallen to 20-year lows on demand concerns – closure of South African mining operations has brought limited upside so far

Sept 19: fears of labour disruption

Nov 19: producers conclude 3-year wage deals with unions

Jan 20: Pt reaches 3-year highs on speculative investor interest

Feb 20: Coronavirus concerns hit industrial and investment demand

6th March 20: Anglo American declares force majeure due to explosion at converter plant

30th March 20: Anglo, Impala, Sibanye declare force majeure due to South Africa’s 21 day coronavirus lockdown

1st May: South Africa relaxes lockdown and allows partial reopening of mines
**PGM supplies in South Africa**

**Logistics difficulties**

Northern limb open pit mines were re-opened in April however these are on a Rh-poor ore body.

The **rhodium rich western limb** mines are the ones likely to be the last to reopen as these are deep level underground mines where it is difficult to enforce social distancing.

Eastern limb mines are in ramp up mode.

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*Source map: Mitsubishi from Cawthorn (2010) Platinum Metals Review*
**PGM supply**

**Mine supply to be impacted by South African shutdowns**

**Platinum supply (koz)**

**Palladium supply (koz)**

**Rhodium supply (koz)**

**South African** supplies to the market are due to fall by 800 koz (22%) in 2020 due to COVID-19 related forces majeures and slow ramp-up to full production.

**South African** supplies to fall ~20% in 2020 due to force majeure on refined metal due to COVID lockdown

**South African** supplies to fall ~25% in 2020 due to relative change in ore body contribution

**Source:** Mitsubishi from JM (2014-19) Mitsubishi forecasts (2020)
PGM recycling
Fall in recycling due to COVID-19

Overall, Pt/Pd/Rh recycling to fall by 24% in 2020 but adequate inventories at refiners in late 2019 prevent the decline from being more significant.
**Scrappage schemes**

**Disproportionate impact on the 3 metals**

Promotion of battery electric vehicles by auto stimulus / scrappage schemes will generally lower net PGM demand

- May encourage scrappage of older diesels
- Unlikely to favour purchase of new diesels
  - Overall increase in Pt rich catalysts for recycling

- Encourages purchases of small gasoline vehicles
  - Promotion of hybrids would help demand
  - Overall more Pd recycling but may be offset by new demand

- High prices encourage more Rh recycling, especially of older vehicles
  - However refinery issues discourage timely outturn
  - New gasoline vehicles may have higher Rh content than e.g. Euro 4/5
  - Overall more Rh recycling but not necessarily more availability, rise in new demand
Platinum supply-demand balance
Moving into surplus as demand decline outweighs supply decline

Platinum is expected to be in a small surplus in 2020, but the timing of demand recovery and any supply increases will be crucial to the short term market dynamics. Investors are likely to remain interested in platinum, but at lower levels than last year.
Platinum prices: long term
Platinum has recently fallen to 20-year lows on demand destruction due to COVID-19.

Platinum ($/oz)

However, fall in South African platinum supplies has helped support prices.
Platinum forward market
Market has moved into a backwardation for the first time in a decade

Platinum is normally in contango (i.e. forward rate is positive) due to expectations of adequate supply in future

Platinum has moved into a backwardation as closure of South African mines limits the volume of metal available for immediate delivery – when metal for immediate delivery commands a premium to metal for forward delivery, the resulting negative forward rate leads to an increase in lease rates since:

Lease rate (%) = Cash borrowing cost (%) − Metal forward rate (%)

Platinum market backwardation is highly unusual and is only likely to endure for as long as South African mine disruption continues...which could be several more weeks.
**Palladium supply-demand balance**

Remaining in small deficit, but much closer to balance than without COVID-19

Market is close to balance on lower supplies and lower demand: slower than expected recovery in supplies from recycling or a faster than expected recovery in demand in key markets like China could move the market into a deeper deficit.
Palladium long term structural deficit:
Less near term liquidity squeeze leads to palladium market backwardation

Palladium backwardation has eased recently as metal for immediate delivery is less in demand from industrial / auto users. Drawdown of refining inventory further eases physical availability.

However the backwardation is likely to remain in the medium to longer term as near market liquid stocks of metal remain limited, especially if demand improves.

Source: Mitsubishi from various sources
Palladium prices: short to medium term
Currently finding support at the 100 day moving average

All-time high: $2,883
$1,500 recent low: 50% trading range in just a few weeks

Palladium has been on a downtrend since the global COVID crisis intensified in March, as its main demand area (autocatalysts) has been damaged.
Rhodium market balance
Moving in a deeper deficit despite a fall in demand

The fall in rhodium demand is outweighed by the fall in supply, leaving the market in a bigger deficit than in 2019, though with many uncertainties.
Rhodium prices have been extremely volatile, shooting up on supply tightness and then falling rapidly on demand destruction.
Conclusions/ lead-in to panel discussion

- How will auto industry demand look in a post-COVID world? Lower in 2020, brighter in 2021?
- What is the impact of the current crisis on primary and recycled supply of PGM? Lower in 2020
- How will the recycling mix change as a result of COVID-19? More Pt and Rh? in the mix
- What are options for metal financing in this uncertain world? Elevated prices, tighter markets