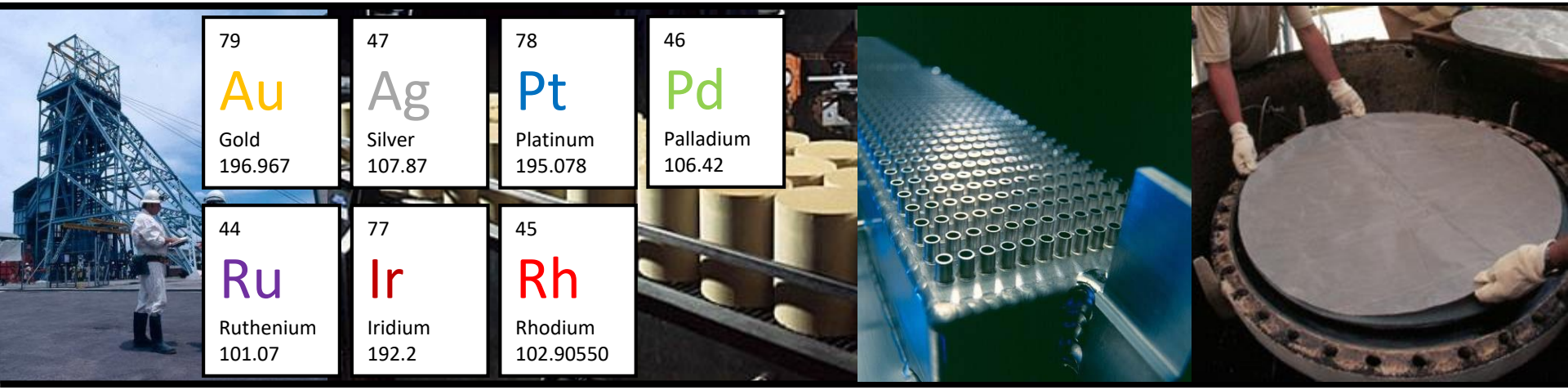

Iridium:

Can prices prove as resistant as its physical properties?

IPMI EUROPEAN CHAPTER 2018

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Business Development Strategist
Mitsubishi Corporation

Introduction to Mitsubishi Corporation (MC)

- *MC is one of the core companies of the Mitsubishi group (a multitude of independent companies)*
- *MC has a strong relationship with the Mitsubishi group of companies*

MITSUBISHI MATERIALS

JX Nippon Mining & Metals

AGC ASAHI GLASS

CAT
(J/V with Mitsubishi Heavy Industries)

NYK LINE NIPPON YUSEN KAISHA

3 core members

Mitsubishi Corporation

MITSUBISHI HEAVY INDUSTRIES, LTD.

MUFG Bank of Tokyo-Mitsubishi UFJ

MITSUBISHI MOTORS

MITSUBISHI FUSO

JX Nippon Oil & Energy

Mitsubishi UFJ Morgan Stanley

MITSUBISHI ELECTRIC

Tokio Marine & Nichido Fire Insurance Co.,Ltd.

MUFG Mitsubishi UFJ Trust and Banking

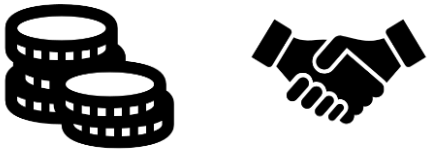
Mitsubishi Chemical Holdings Corporation

Mitsubishi Logistics

and more…

Mitsubishi: current market positioning

1) Large liquidity provider to the market, both physically and financially:



- Largest Platinum and Palladium trader on the Tokyo Commodity Exchange (TOCOM)
- In the top 3 on the New York Mercantile Exchange (NYMEX)
- Substantial over-the-counter and spot business

2) One of the largest/most active players in PGMs:

- Market share of 20-30% in PGM leasing globally
- The largest lender to industrial customers
- Strong links to the automotive sector in Japan, US and Europe (for forward purchasing, leasing, term contracts)

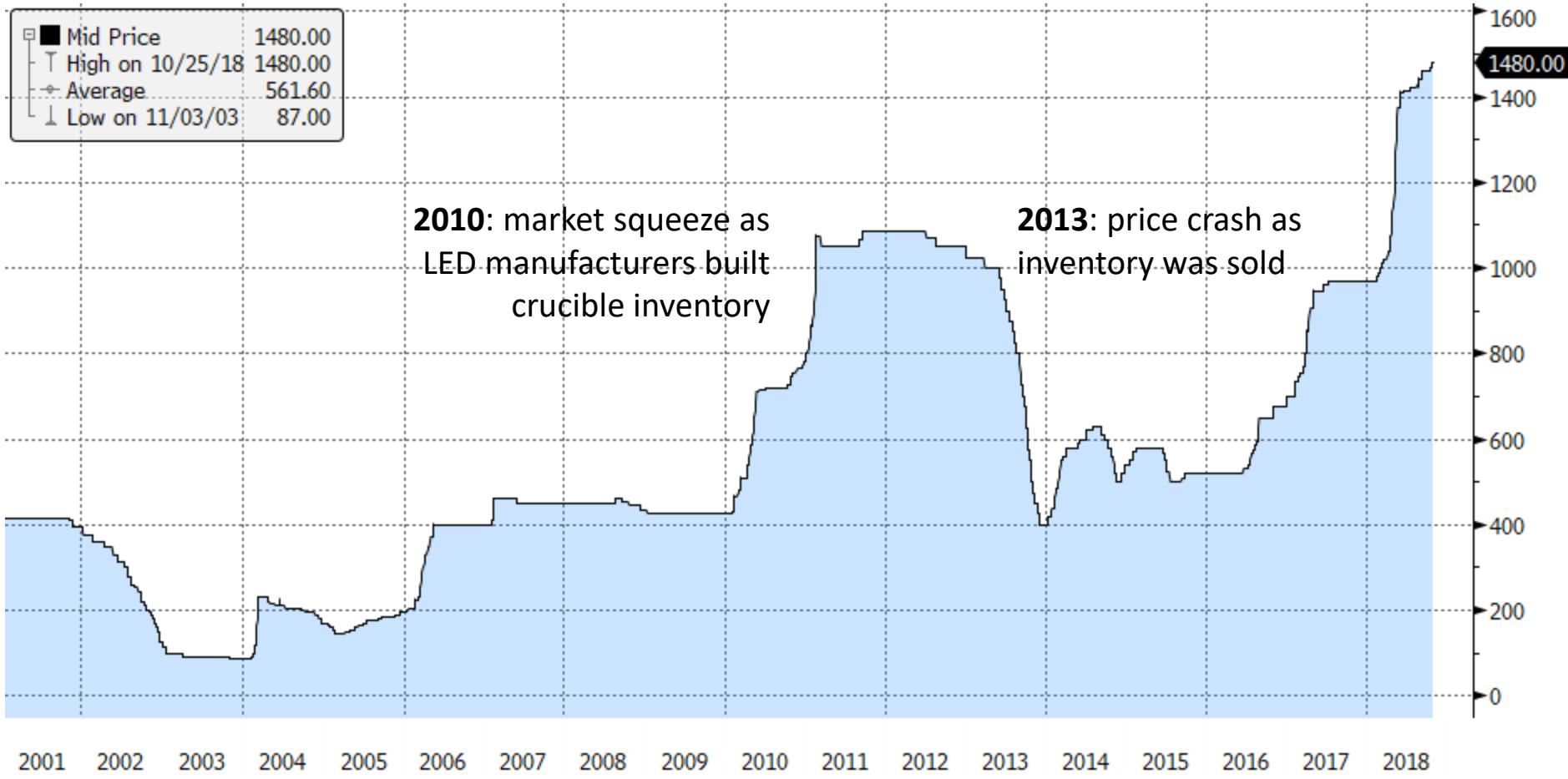
3) Active in Market Development, e.g.:

- **Developing PGM investment in Japan** through the launch of ETF (Fruit of Gold series) in 2012, which is the **only physically-backed ETF in Japan**.

Iridium prices

Currently at all time highs

JM Base Price $/oz



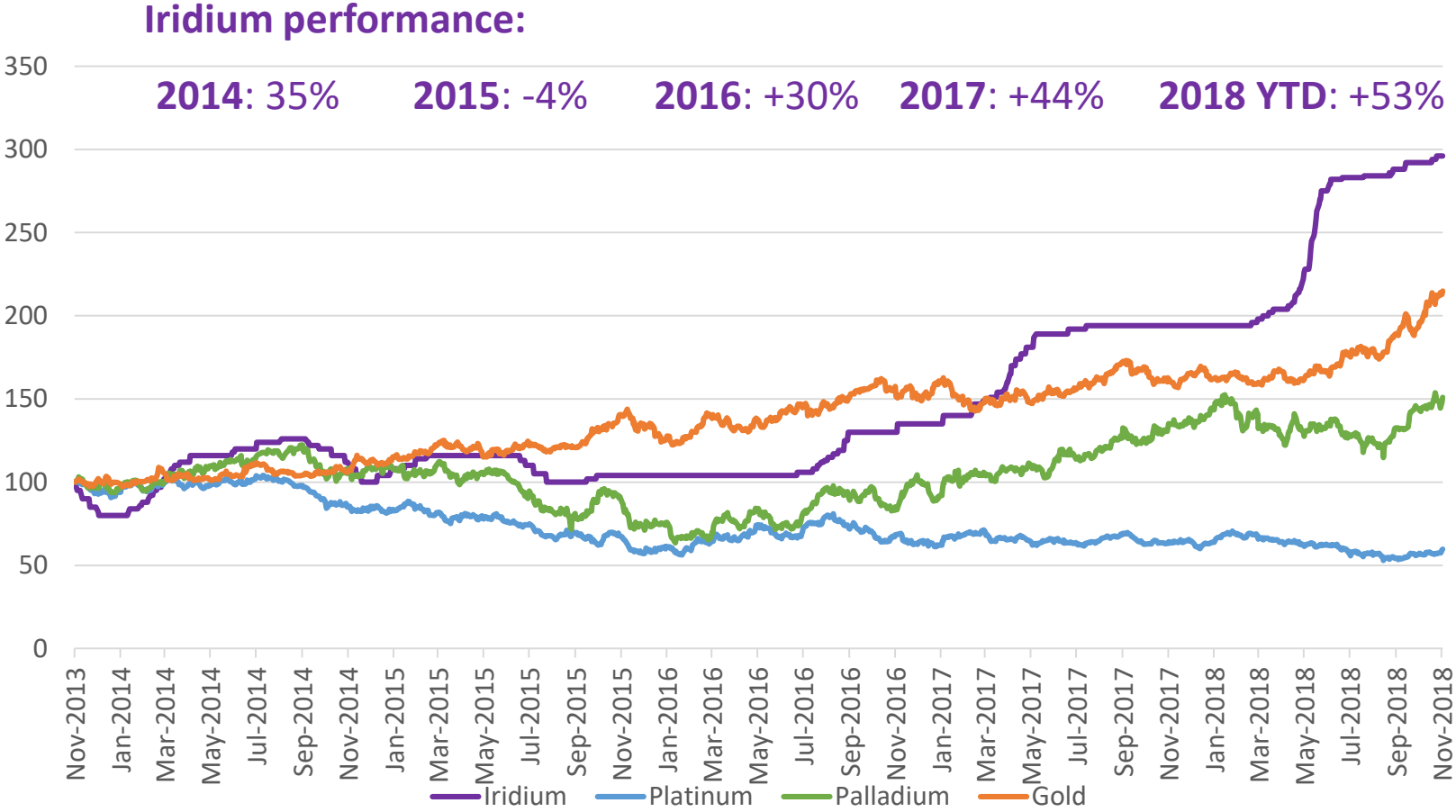
Source: Mitsubishi from Bloomberg

High prices may be limiting industrial uptake at present, and there is a risk of substitution

Iridium prices

Long term correlations

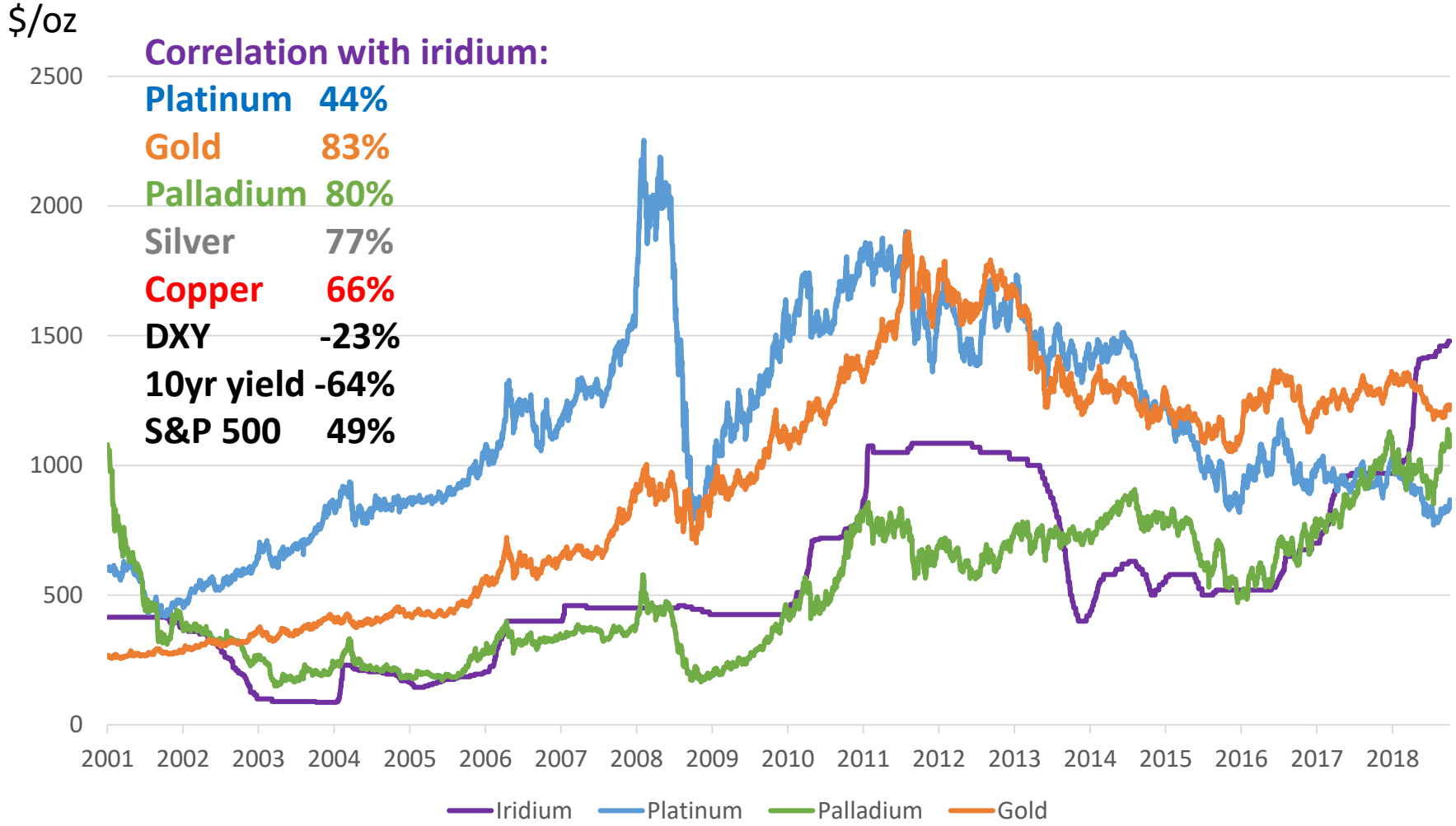
Indexed performance (where Nov 2013 = 100)



Source: Mitsubishi from Bloomberg

Iridium prices

Correlations with other assets

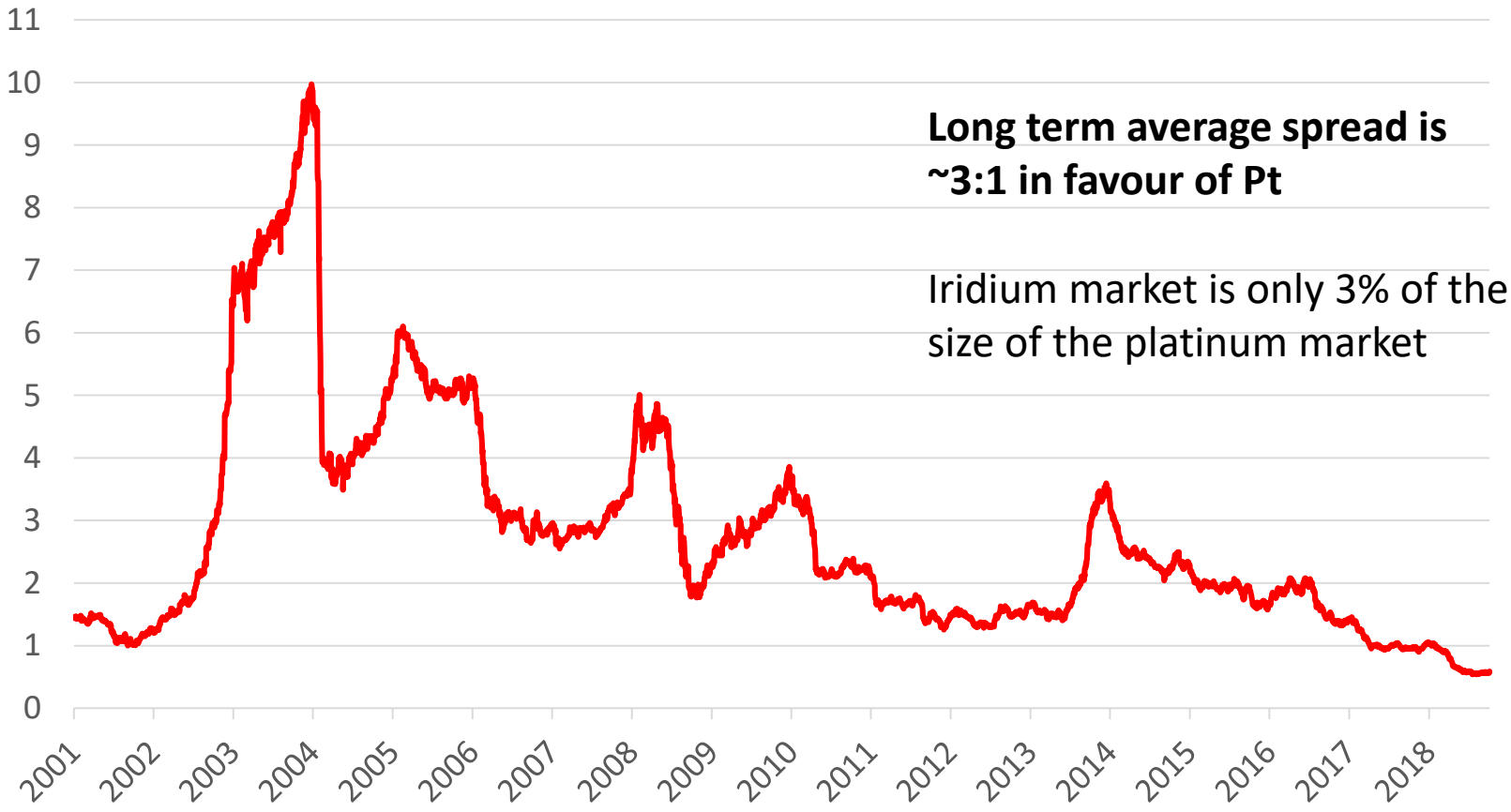


Source: Mitsubishi from Bloomberg

Iridium prices

Parity with platinum brings potential for substitution

Platinum / iridium ratio

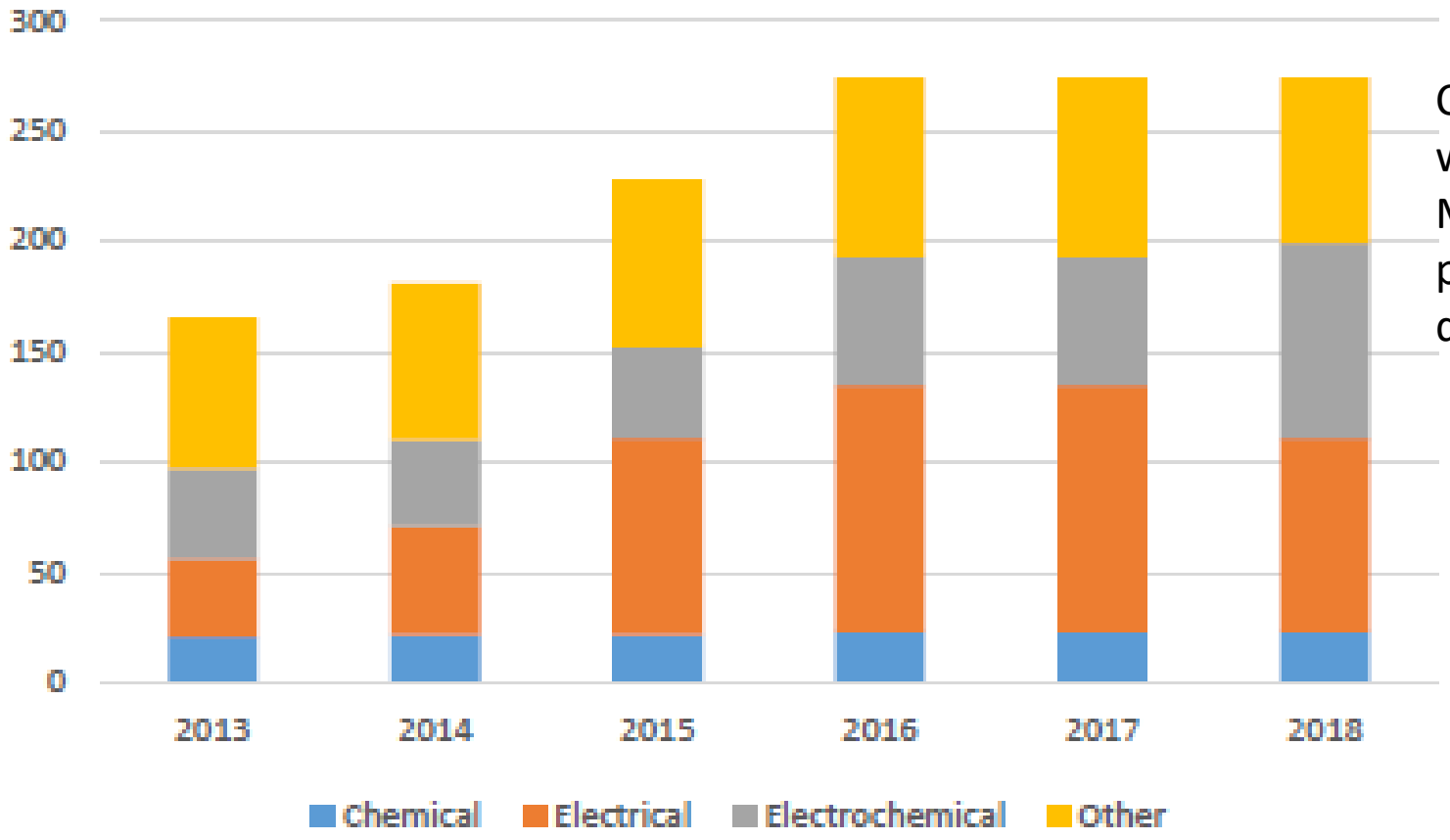


Source: Mitsubishi from Bloomberg

Iridium demand

Tiny market, diverse demand areas

Iridium demand (koz)



Compare with 7.5 Moz pa platinum demand…

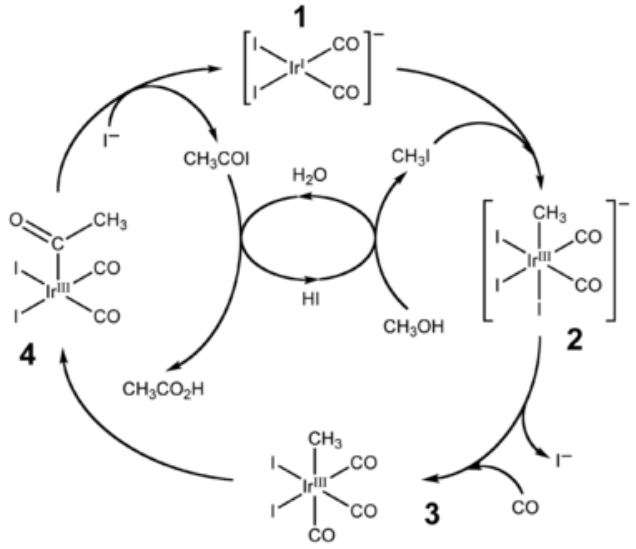
Source: Mitsubishi from Johnson Matthey

Chemical demand

Cativa / Monsanto Process is key

- The **Cativa / Monsanto** process is a method for the production of acetic acid by the carbonylation of methanol.
- This can use an **iridium** catalyst promoted by ruthenium, and also can use rhodium
- Periodic catalyst **changeouts** can lead to market tightness
- Growth prospects for acetic acid, therefore Ir demand are positive based on paints/coatings, pharma and food, however the 'war on plastic' will be a drag on growth in the packaging and polymers sectors
- Potential growth in Ir demand in other chemical applications, e.g. **gas to liquids**

Cativa Process catalyst cycle:



Electrical demand

Crucibles have been the mainstay of demand but highly cyclical

Iridium's high melting point and corrosion resistance makes it ideal for growing various crystalline substances used in a variety of end applications

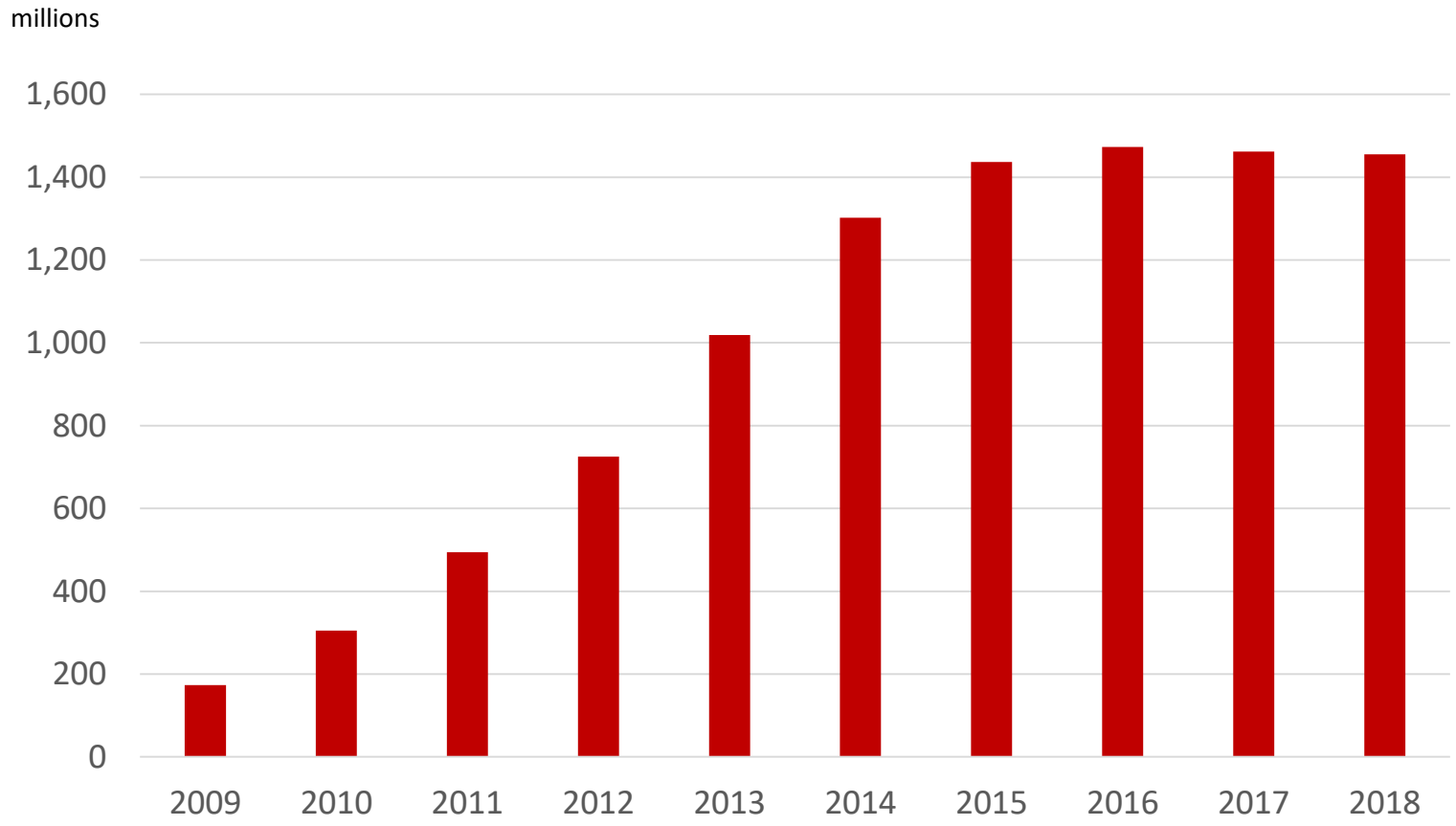
Iridium crucibles

	Current market	Future market
LEDs	▪ Demand for Ir crucibles for manufacturing sapphire crystals used in LEDs has been quiet due to previous capacity growth and a slowdown in global smartphone / tablet sales	▪ Potential slowdown in demand related to tariffs on Chinese exports to the US as well as possible economic slowdown. ▪ Growth of 5G mobile devices bodes well for smartphone demand
SAW filters	▪ Production of lithium tantalate for surface acoustic wave filters using Ir crucibles has been stable	▪ Increase in SAW filters per device is positive for Ir crucible demand as additional capacity is built
Medical imaging	▪ Iridium crucibles are used to grow scintillator crystals for use in positron emission tomorgraphy (PET) scanners for medical diagnosis	▪ Outlook is positive as ageing populations and better access to healthcare drives demand for PET scanners

Electrical demand: LEDs in smartphones

Smartphone shipments appear to have peaked

Annual smartphone shipments



Source: IDC, Statistica

Electrical demand

Iridium is a critical component of red and green OLED emitter compounds

Iridium produces brighter, more vivid red and green colours in OLED emitter compounds

LCD vs OLED smartphone

	Current market	Future market
Smart phones	▪ Cheaper than LCD screens ▪ Significant uptake of Ir compounds in OLEDs for mobile devices, especially high-end models	▪ Growth in surface area of screen, therefore more demand for Ir ▪ Increasing numbers of devices using OLED screens
TVs	▪ Limited use in TVs at present – as OLED TVs use an iridium free white emitter with a colour filter (not suitable for smart phones due to size)	▪ Further growth in OLED TV market and adoption of Ir based OLED emitters due to superior colour

Also potential future use of Ir compounds in VR OLED headsets

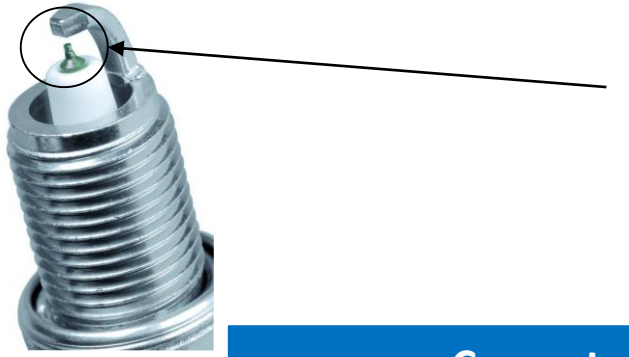
Electrochemical demand

Diverse areas for Ir and Ru usage

	Current market	Future market
Chlor-alkali industry	▪ Replacement of mercury based cells in favour of Ru-Ir catalyzed membrane cells has favoured Ir demand but replacement cycle is ending	▪ Limited further uptake in existing industry
Water treatment: Electro-chlorination	▪ Promising area that offers chemical-free water treatment ▪ Limited uptake to date in certain niche applications, eg swimming pool water treatment	▪ IMO ruling on ballast water treatment has potential to drive demand for electrochlorination units on ships ▪ Greater need for effective treatment of waste water in stressed areas
PEM electrolysis	▪ Production of hydrogen for industry and in a more limited way for fuel cell applications	▪ Electrolysis of water to provide grid balancing ▪ Production of renewable hydrogen ▪ Production of commodity chemicals e.g. ammonia via electrolysis

Other demand

Spark plugs are a key area



Iridium tip in the spark plug gives superior durability and performance due to iridium's thermal and chemical resistance

	Current market	Future market
Auto Spark plugs	▪ Growth in spark ignited vehicles (gasolines) at the expense of diesels ▪ Growth of high end and performance engines	▪ Vehicle electrification limits future growth of spark ignited engines
Aero and industry Spark plugs	▪ Steady demand	▪ Growing demand from the aerospace sector ▪ Growing demand for efficient, clean mobile power generation

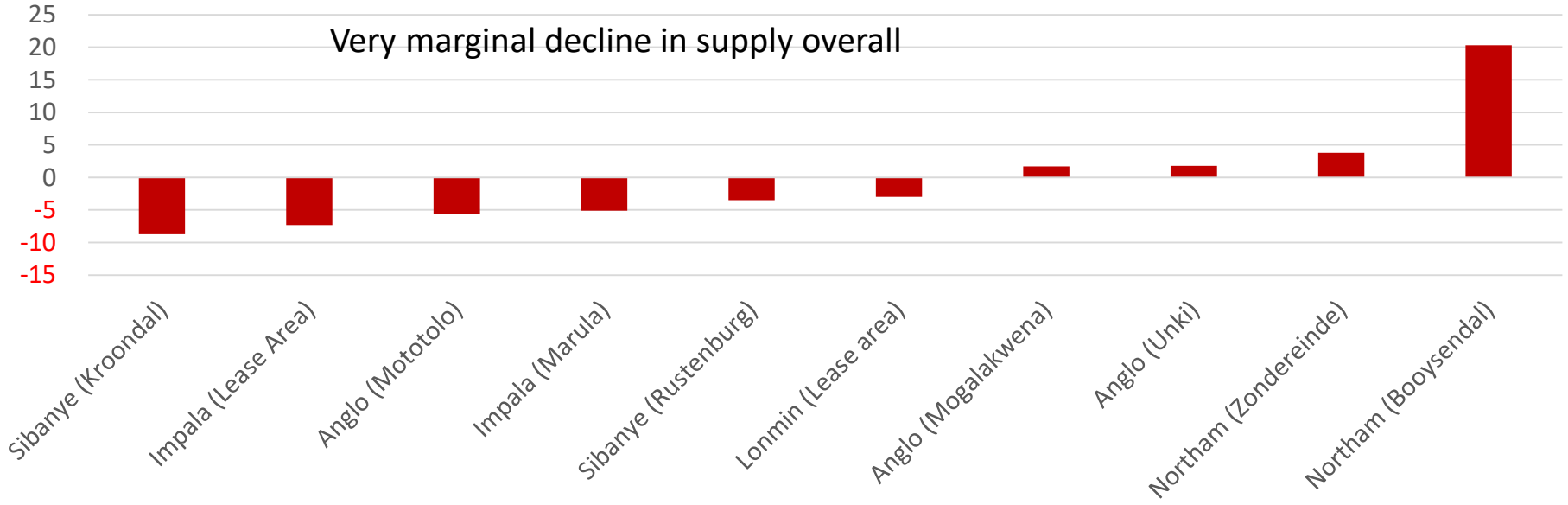
Future of mining in South Africa 2017-2022: iridium

Overall picture

Iridium output from South is expected to decline by ~6 koz between 2017 and 2022

- Decline in output at Sibanye, Impala and Lonmin on key UG2 and Merensky ore bodies has a negative impact on Ir output. Growth in output at Mogalakwena will only marginally add to Ir ounces.
- However growth in output at Northam's Booysendal mine , as well as increased production at Zondereinde will largely offset the decline in older western limb assets

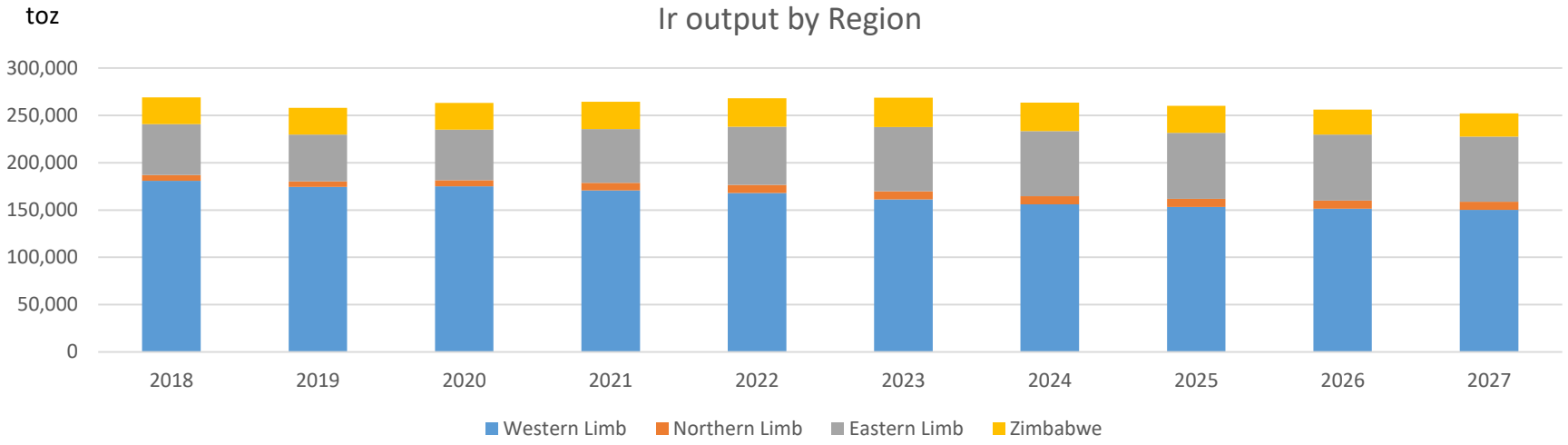
Projected changes by mine (koz)

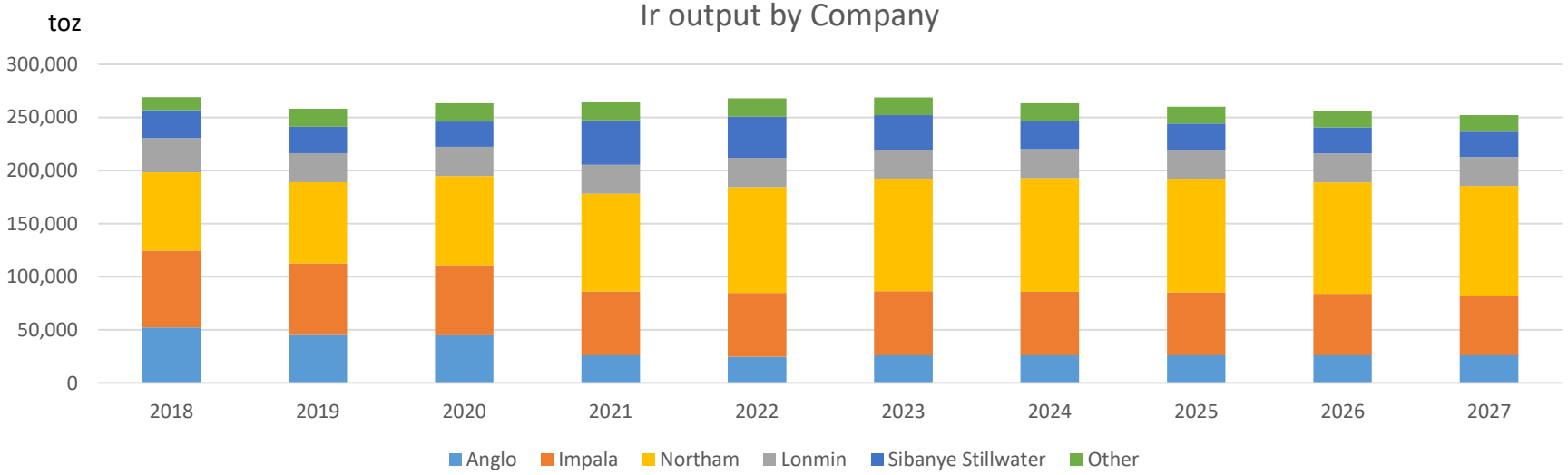


Mines where Ir output will decline (2017-2022)

Mines where Ir output will increase (2017-2022)

Future of mining in South Africa 2017-2022: iridium

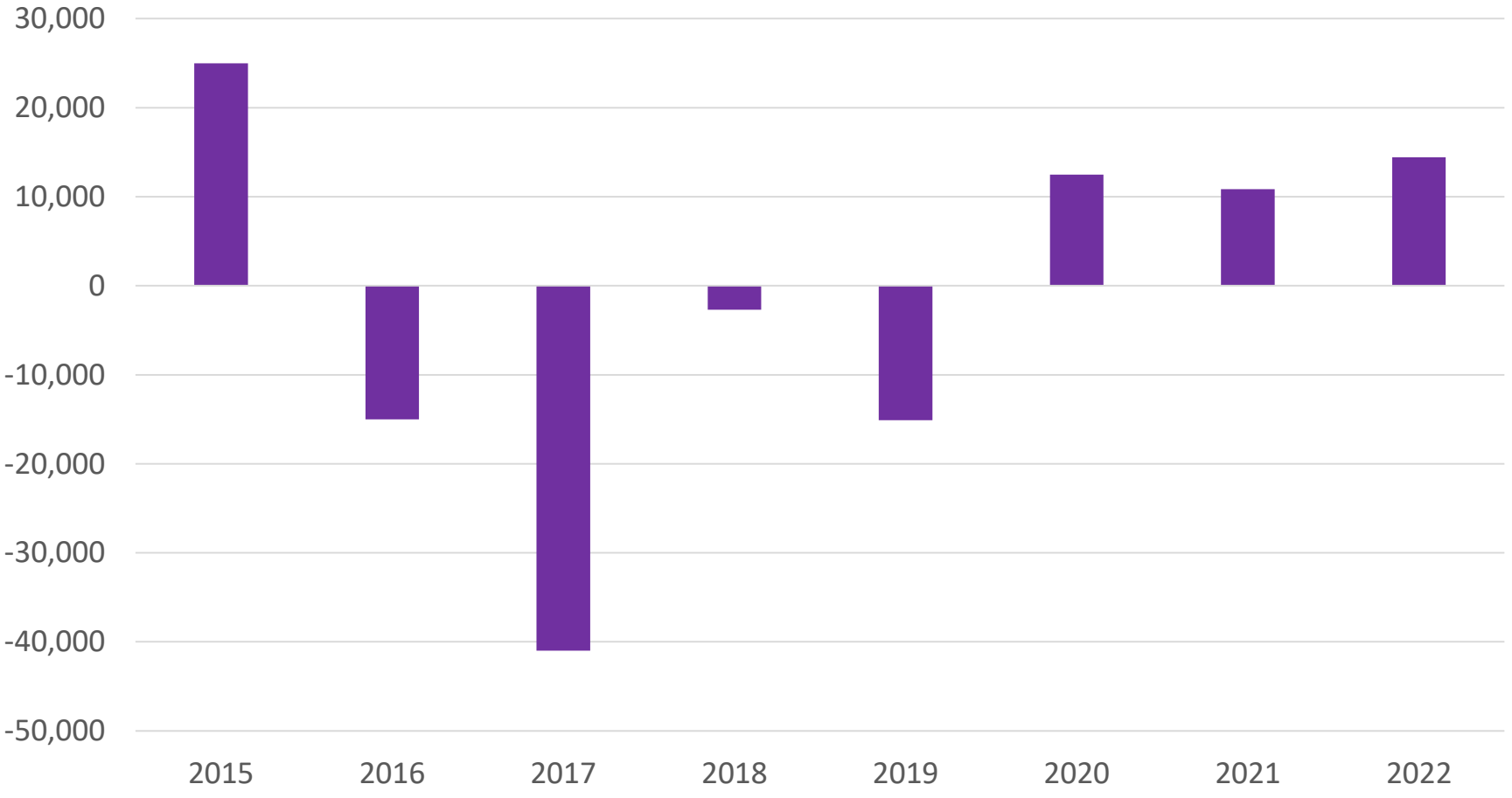




Supply-demand balance

Market moving back towards surplus

Iridium supply-demand balance (toz)



Source: Mitsubishi estimates

Iridium: Summary and outlook

- **Current high prices** bring the risk of surpressed demand and possible substitution, though Ir demand applications are largely niche
- **South African supply cuts have less impact on Ir than on Ru** due to prill split and some growth on the eastern limb / Zimbabwe
- **Speculative investor and strategic industrial stockpiles** of Ir have the potential to bring additional supply to the market
- **Recycling of old crucibles could also bring more supplies**
- **Electronics demand still looks positive in OLEDs** as uptake continues to grow – this application also 'consumes' iridium
- **Uptake of 5G devices** also keeps demand prospects for crystalline materials grown in Ir crucibles positive for the next 3-5 years
- **The current political / trade climate** brings a risk of a slowdown in the electronics sector, which is key to Ir demand
- **Electrochemical applications** for Ir (and Ru) have a promising longer term future in water treatment, hydrogen production and possibly as the basis for the chemical value chain

Thank you!

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