

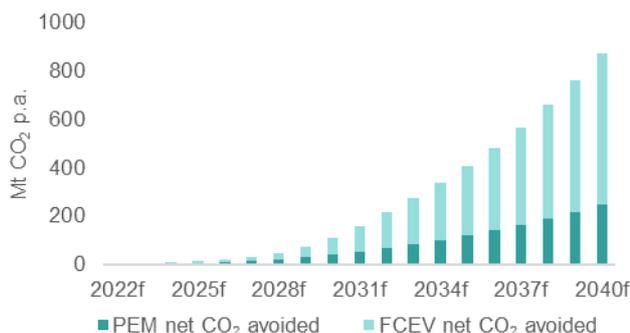
# PLATINUM PERSPECTIVES

## Green hydrogen production and FCEV usage highlight platinum's role in significantly reducing CO<sub>2</sub> emissions

Platinum is an essential catalyst in the production of green hydrogen using PEM electrolyzers and in its use in fuel cells. We estimate that displacing natural gas with green hydrogen in combination with FCEVs displacing ICE vehicles could deliver up to 11% of the Paris Agreement's targeted CO<sub>2</sub> emissions reductions by 2030.

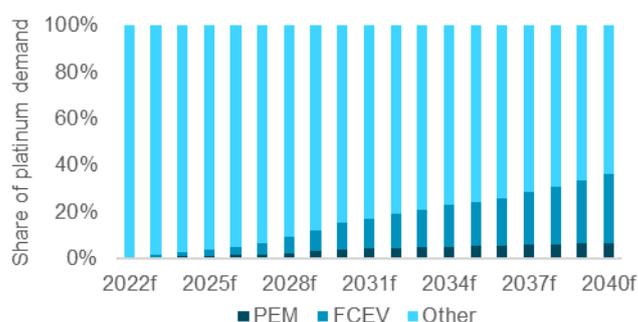
Platinum continues its long-standing roles in reducing harmful emissions from internal combustion engines (ICE), and reducing CO<sub>2</sub> emissions when used as a catalyst in industrial applications by significantly improving yields, and reducing energy requirements. Platinum is already playing a crucial and growing role in the global energy transition to net zero. It is used in the production of green hydrogen as a catalyst in proton exchange membrane (PEM) electrolyzers running on renewable electricity, as well as in hydrogen fuel cells that generate electricity for fuel cell electric vehicles (FCEV) and stand-by or remote power supplies. The potential CO<sub>2</sub> emissions avoided will be significant. The CO<sub>2</sub> savings are realised when platinum-facilitated green hydrogen displaces natural gas, gasoline or diesel, even after deducting platinum's own emissions, generated during mining, smelting and refining. According to the Paris Agreement, the world needs to reduce CO<sub>2</sub> emissions by 7.6% p.a. between 2020 and 2030 to limit warming to 1.5°C, or 2.7% p.a. to limit warming to 2°C. Global CO<sub>2</sub> emissions totalled 34.2 Gt in 2020, which means that CO<sub>2</sub> reductions by 2030 of 8.2 Gt or 18.7 Gt are necessary to limit warming to 2°C, or 1.5°C respectively.

*PEM electrolyzers and FCEVs have the potential to significantly reduce CO<sub>2</sub> emissions, making material contributions to the UN's targeted CO<sub>2</sub> cuts by 2030*



Source: WPIC Research, Assumes 100% of FCEV CO<sub>2</sub> savings but PEM CO<sub>2</sub> savings are reduced by the H<sub>2</sub> allocated to FCEV use to avoid double counting the savings

*Platinum demand from PEM electrolyzers and FCEVs becomes a meaningful component of global demand by 2030 and potentially the largest segment by 2040*



Source: Metals Focus 2022 (total demand), WPIC Research 2023 onwards

Using the IEA global database of planned electrolyser projects, we estimate PEM electrolyzers operating on renewable energy could generate between 9 Mt and 29 Mt of green hydrogen per annum by 2030, dependent on the PEM portion (31%-96%) of all installations. If this green hydrogen is all used to displace natural gas, cumulative CO<sub>2</sub> savings are between 0.18 Gt and 0.58 Gt by 2030. Whilst displacing natural gas for heating and industrial uses is likely to occur quickly, the potential CO<sub>2</sub> savings are greater from displacing ICE vehicles with FCEVs thereby avoiding the CO<sub>2</sub> emissions from gasoline or diesel. If c.40% of total forecast green hydrogen production is used to fuel FCEVs between now and 2030 under our base case scenario, cumulative CO<sub>2</sub> savings are increased to between 0.24 Gt and 0.63 Gt, or 1% to 11% of the savings needed to meet the Paris Agreement's targets of limiting warming to 1.5°C or 2°C respectively. Annual platinum demand in 2030 from FCEVs and electrolyzers, dependant on the PEM portion, would be between 1.6 Moz and 2.4 Moz.

**Platinum plays an essential role in the production and use of green hydrogen in PEM electrolyzers and FCEVs.**

**We estimate that the combination of green hydrogen displacing natural gas and FCEVs displacing ICE vehicles could result in net CO<sub>2</sub> savings of up to 11% of the Paris Agreement's 2030 targets.**

Trevor Raymond  
Director of Research  
+44 203 696 8772  
[traymond@platinuminvestment.com](mailto:traymond@platinuminvestment.com)

Edward Sterck  
Analyst  
+44 203 696 8786  
[esterck@platinuminvestment.com](mailto:esterck@platinuminvestment.com)

Brendan Clifford  
Head of Institutional Distribution  
+44 203 696 8778  
[bclifford@platinuminvestment.com](mailto:bclifford@platinuminvestment.com)

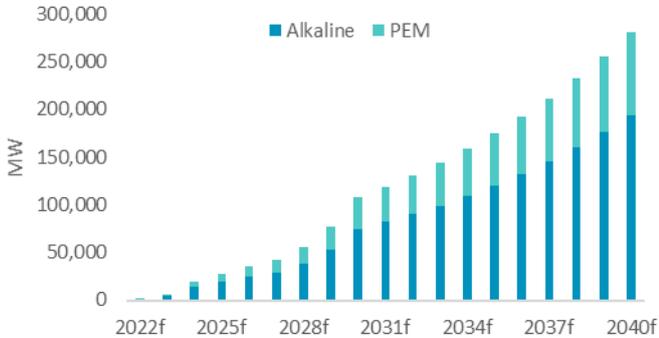
World Platinum Investment Council  
[www.platinuminvestment.com](http://www.platinuminvestment.com)  
166 Piccadilly,  
London, W1J 9EF

August 2022

**Platinum's attraction as an investment asset arises from:**

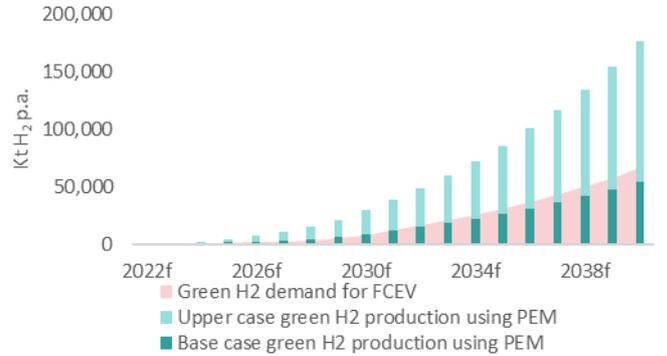
- Supply severely constrained for three more years despite some new investment in mining capacity
- Platinum price remains historically undervalued and significantly below both gold and palladium
- Automotive PGM demand growth should continue due to increasingly restrictive emissions rules
- Market balance and price mismatches between palladium and platinum drive substitution
- Investment demand is softer after two record years, but price and fundamentals remain attractive

**Figure 1:** In our base case 31% of electrolyser capacity additions will be PEM, but the IEA database suggests up to 96% could be, although iridium supply constraints may push developers toward alkaline electrolysers



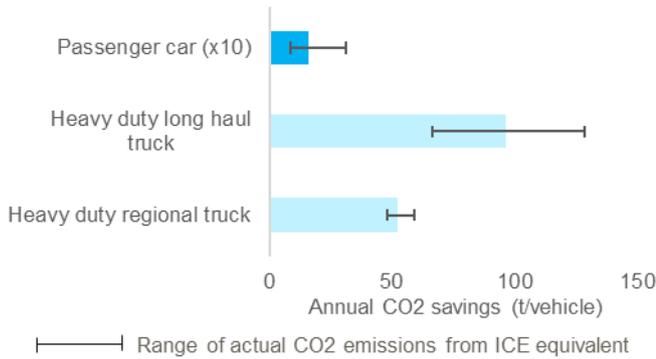
Source: IEA, WPIC Research, N.B. based upon our current understanding of loadings, iridium demand from PEM electrolysers is not a constraint until after 2030

**Figure 2:** The split in hydrogen production between PEM and alkaline electrolysers remains undetermined, but the combination in aggregate is adequate to satisfy our forecast FCEV demand for hydrogen



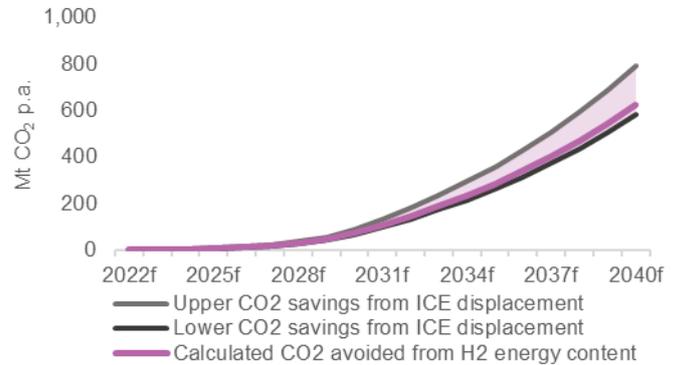
Source: WPIC Research

**Figure 3:** Our base case FCEV CO<sub>2</sub> savings use the energy content of hydrogen vs petrol and diesel, but real-world savings depend upon the efficiencies and size of ICE vehicles displaced by FCEVs



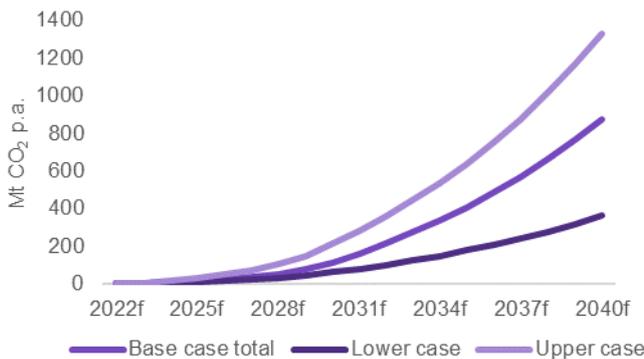
Source: WPIC Research

**Figure 4:** This results in a significant range in the potential real-world CO<sub>2</sub> savings, with our estimates conservatively at the lower end of the potential savings



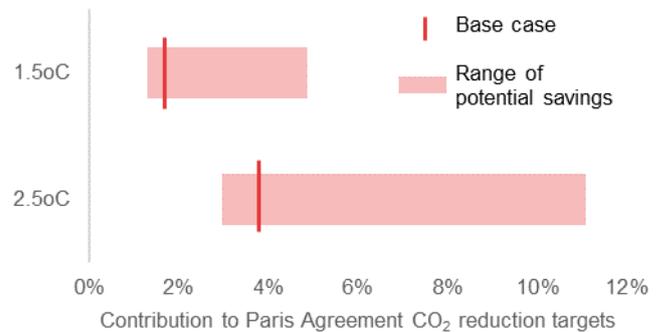
Source: WPIC Research

**Figure 5:** The various combinations of PEM and alkaline electrolysers significantly increases the range of potential CO<sub>2</sub> savings



Source: WPIC Research

**Figure 6:** The UN has set 2030 CO<sub>2</sub> reduction targets to limit global warming to 1.5°C or 2°C; platinum containing PEM electrolysers and FCEVs will contribute meaningfully towards these



Source: UN, WPIC Research

**IMPORTANT NOTICE AND DISCLAIMER:** This publication is general and solely for educational purposes. The publisher, The World Platinum Investment Council, has been formed by the world's leading platinum producers to develop the market for platinum investment demand. Its mission is to stimulate investor demand for physical platinum through both actionable insights and targeted development: providing investors with the information to support informed decisions regarding platinum; working with financial institutions and market participants to develop products and channels that investors need.

This publication is not, and should not be construed to be, an offer to sell or a solicitation of an offer to buy any security. With this publication, the publisher does not intend to transmit any order for, arrange for, advise on, act as agent in relation to, or otherwise facilitate any transaction involving securities or commodities regardless of whether such are otherwise referenced in it. This publication is not intended to provide tax, legal, or investment advice and nothing in it should be construed as a recommendation to buy, sell, or hold any investment or security or to engage in any investment strategy or transaction. The publisher is not, and does not purport to be, a broker-dealer, a registered investment advisor, or otherwise registered under the laws of the United States or the United Kingdom, including under the Financial Services and Markets Act 2000 or Senior Managers and Certifications Regime or by the Financial Conduct Authority.

This publication is not, and should not be construed to be, personalized investment advice directed to or appropriate for any particular investor. Any investment should be made only after consulting a professional investment advisor. You are solely responsible for determining whether any investment, investment strategy, security or related transaction is appropriate for you based on your investment objectives, financial circumstances and risk tolerance. You should consult your business, legal, tax or accounting advisors regarding your specific business, legal or tax situation or circumstances.

The information on which this publication is based is believed to be reliable. Nevertheless, the publisher cannot guarantee the accuracy or completeness of the information. This publication contains forward-looking statements, including statements regarding expected continual growth of the industry. The publisher notes that statements contained in the publication that look forward in time, which include everything other than historical information, involve risks and uncertainties that may affect actual results. The logos, services marks and trademarks of the World Platinum Investment Council are owned exclusively by it. All other trademarks used in this publication are the property of their respective trademark holders. The publisher is not affiliated, connected, or associated with, and is not sponsored, approved, or originated by, the trademark holders unless otherwise stated. No claim is made by the publisher to any rights in any third-party trademarks

#### WPIC Research MiFID II Status

The World Platinum Investment Council (WPIC) has undertaken an internal and external review of its content and services for MiFID II. As a result, WPIC highlights the following to the recipients of its research services, and their Compliance/Legal departments:

WPIC research content falls clearly within the Minor Non-Monetary Benefit Category and can continue to be consumed by all asset managers free of charge. WPIC research can be freely shared across investment organisations.

1. WPIC does not conduct any financial instrument execution business. WPIC does not have any market making, sales trading, trading or share dealing activity. (No possible inducement).
2. WPIC content is disseminated widely and made available to all interested parties through a range of different channels, therefore qualifying as a "Minor Non-Monetary Benefit" under MiFID II (ESMA/FCA/AMF). WPIC research is made freely available through the WPIC website. WPIC does not have any permissioning requirements on research aggregation platforms.
3. WPIC does not, and will not seek, any payment from consumers of our research services. WPIC makes it clear to institutional investors that it does not seek payment from them for our freely available content.

More detailed information is available on the WPIC website:

<http://www.platinuminvestment.com/investment-research/mifid-ii>