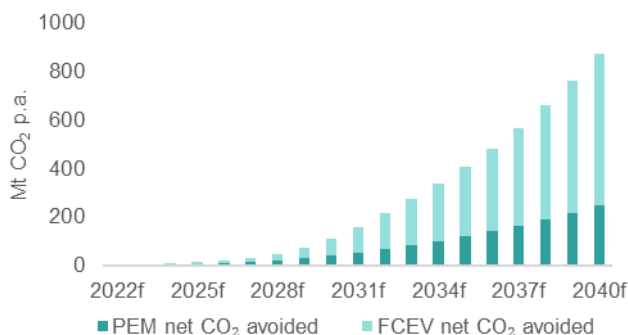


Green hydrogen production and FCEV usage highlight platinum's role in significantly reducing CO₂ emissions

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 CO₂ emissions reductions by 2030.

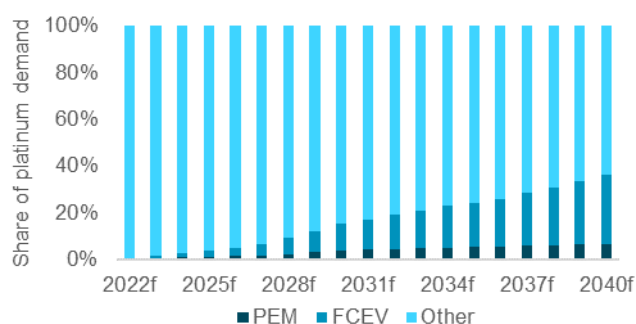
Platinum continues its long-standing roles in reducing harmful emissions from internal combustion engines (ICE), and reducing CO₂ emissions when used as a catalyst in industrial applications by significantly improving yields, and reducing energy requirements. Platinum is already playing a crucial and 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 CO₂ emissions avoided will be significant. The CO₂ 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 CO₂ 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 CO₂ emissions totalled 34.2 Gt in 2020, which means that CO₂ 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 CO₂ emissions, making material contributions to the UN's targeted CO₂ cuts by 2030



Source: WPIC Research, Assumes 100% of FCEV CO₂ savings but PEM CO₂ savings are reduced by the H₂ 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 CO₂ 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 CO₂ savings are greater from displacing ICE vehicles with FCEVs thereby avoiding the CO₂ 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 CO₂ 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 CO₂ savings of up to 11% of the Paris Agreement's 2030 targets.

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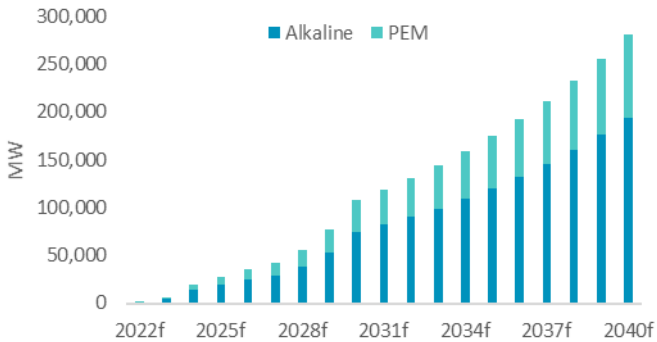
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Platinum's attraction as an investment asset arises from:

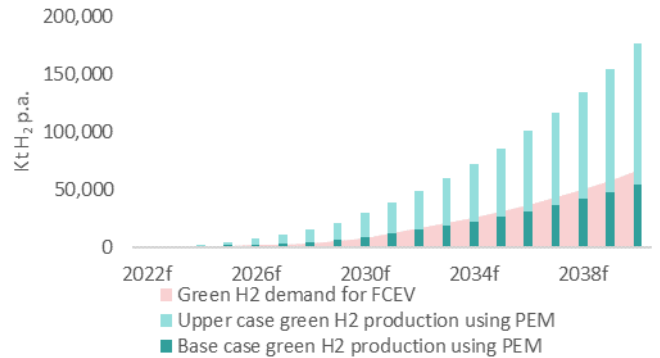
- Supply severely constrained for three more years despite some new investment in mining capacity
- Platinum price remains historically undervalued and significantly below both gold and palladium
- Automotive PGM demand growth should continue due to increasingly restrictive emissions rules
- Market balance 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



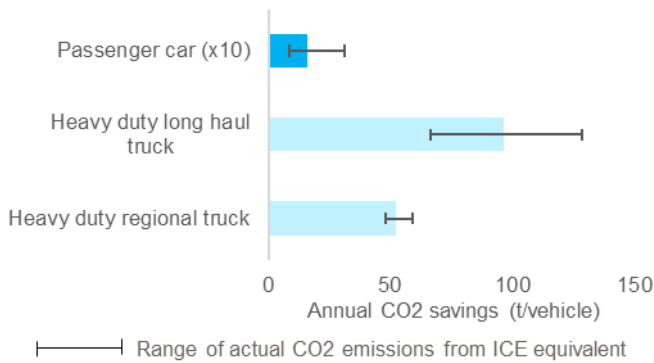
Source: IEA, WPIC Research, N.B. based upon our current understanding of loadings, iridium demand from PEM electrolysers is not a constraint until after 2030

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



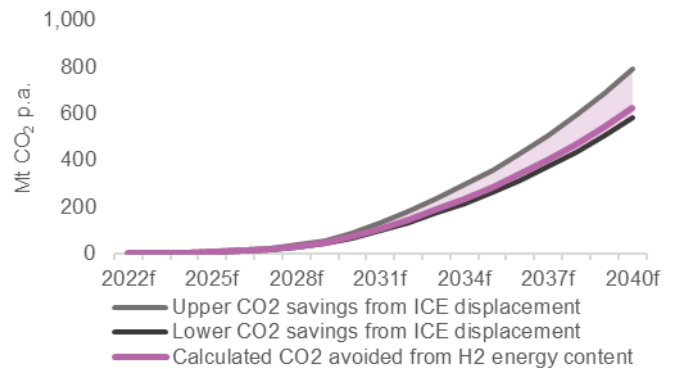
Source: WPIC Research

Figure 3: Our base case FCEV CO₂ 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



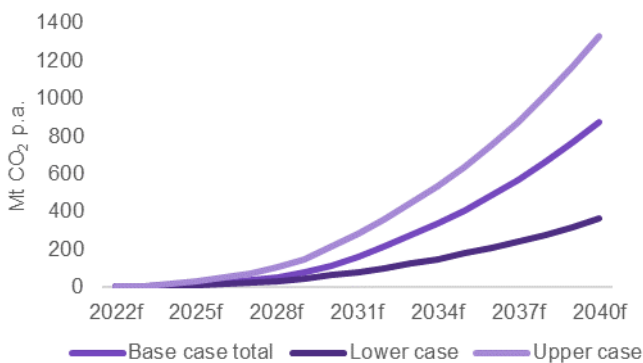
Source: WPIC Research

Figure 4: This results in a significant range in the potential real-world CO₂ savings, with our estimates conservatively at the lower end of the potential savings



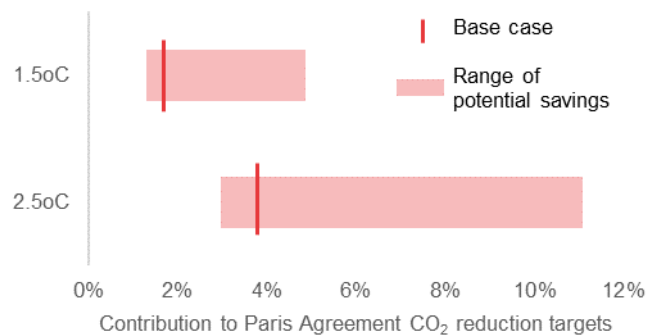
Source: WPIC Research

Figure 5: The various combinations of PEM and alkaline electrolysers significantly increases the range of potential CO₂ savings



Source: WPIC Research

Figure 6: The UN has set 2030 CO₂ 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

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