WHY HYDROGEN IS A NEW DEMAND DRIVER FOR PLATINUM

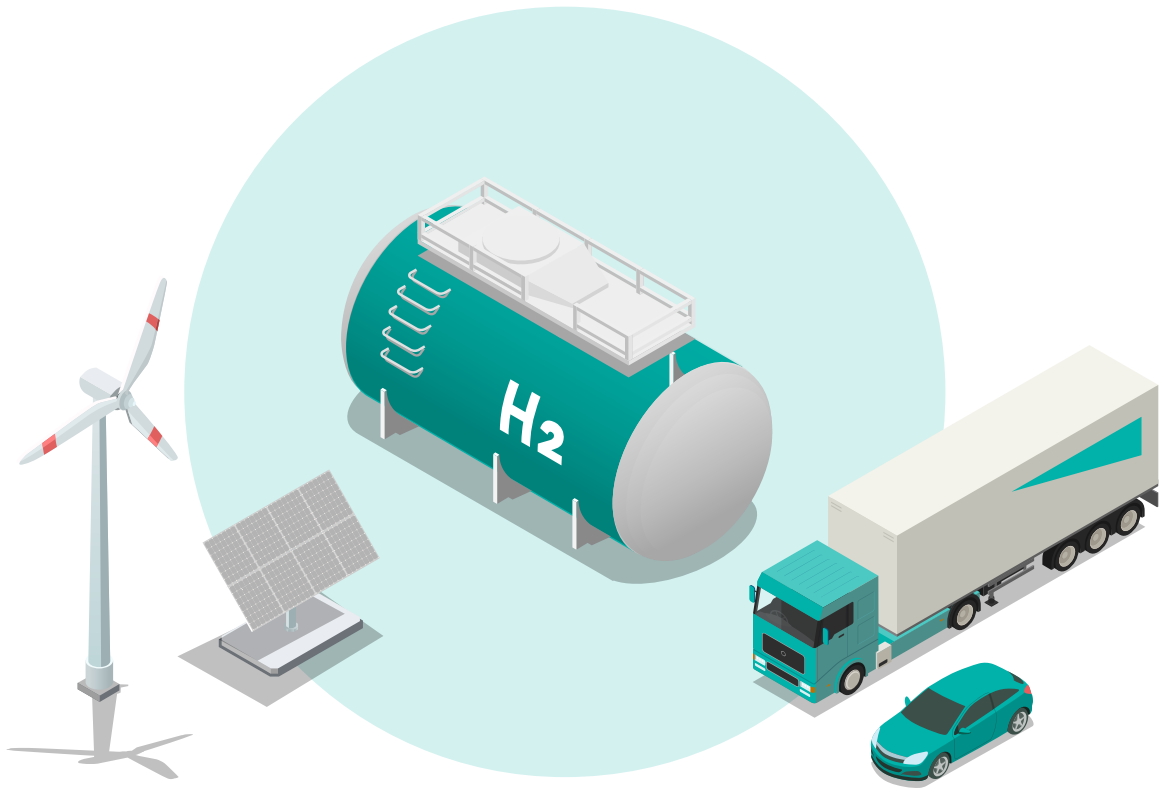
The need to decarbonise is more acute than ever and platinum-based technologies have a significant role to play in the energy transition.

HYDROGEN ECONOMY

Platinum unlocks the hydrogen economy

Proton exchange membrane (PEM) technology uses platinum catalysts in two key applications – electrolysers and hydrogen (H_2) fuel cells to produce electricity. Fuel cell electric vehicles (FCEVs) are a major market for hydrogen fuel cells.

A PEM electrolyser produces carbon-free green hydrogen from renewable energy. If a FCEV is powered with green hydrogen it provides completely emissions-free transportation.



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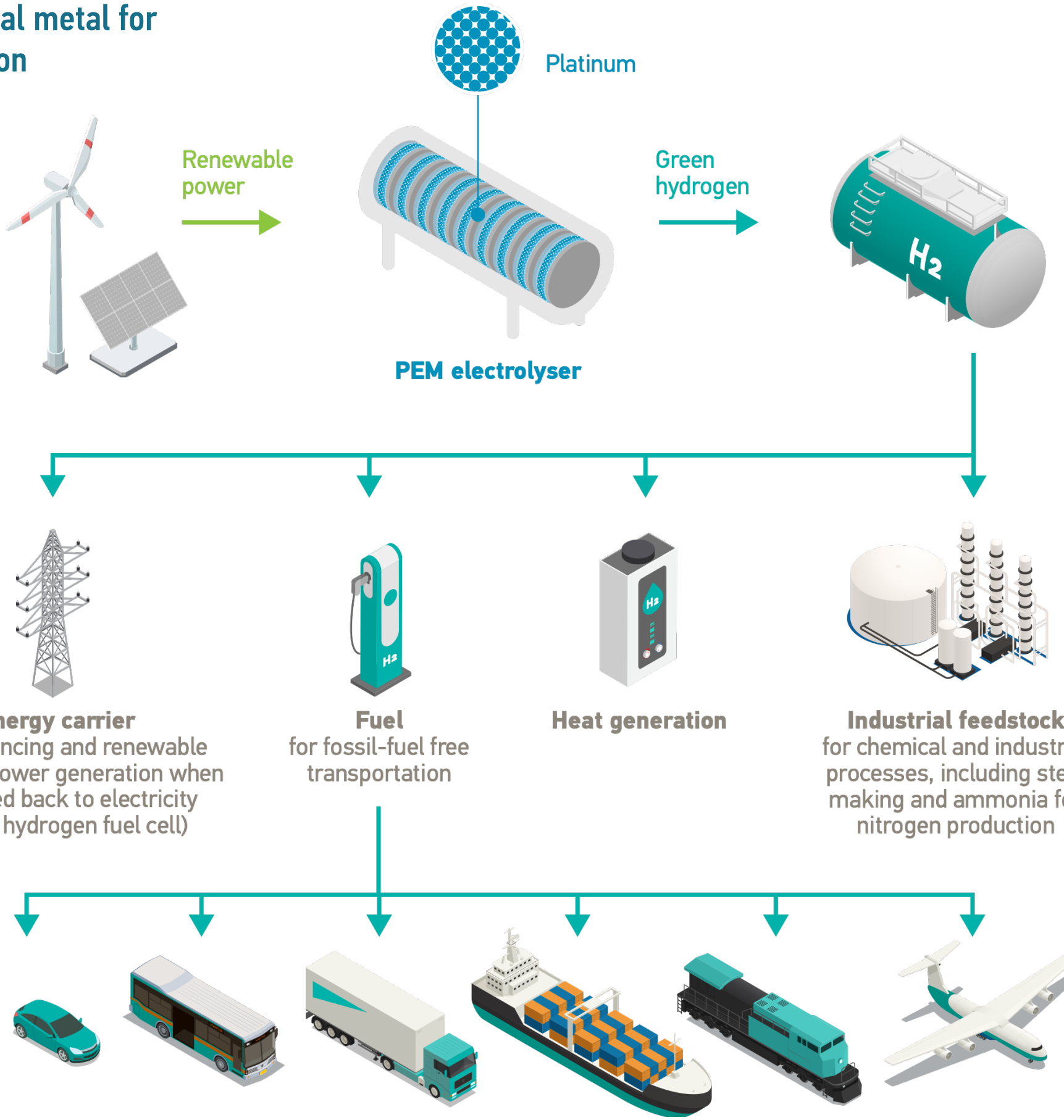
Platinum is a critical metal for the energy transition



Energy carrier
(grid balancing and renewable electrical power generation when converted back to electricity using a hydrogen fuel cell)

Fuel
for fossil-fuel free transportation

Heat generation

Industrial feedstock
for chemical and industrial processes, including steel making and ammonia for nitrogen production

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Platinum-based technology could deliver meaningful CO_2 reduction

Platinum-based PEM technologies that enable the use of green hydrogen in decarbonisation could deliver up to 11% of global CO_2 reduction targets.

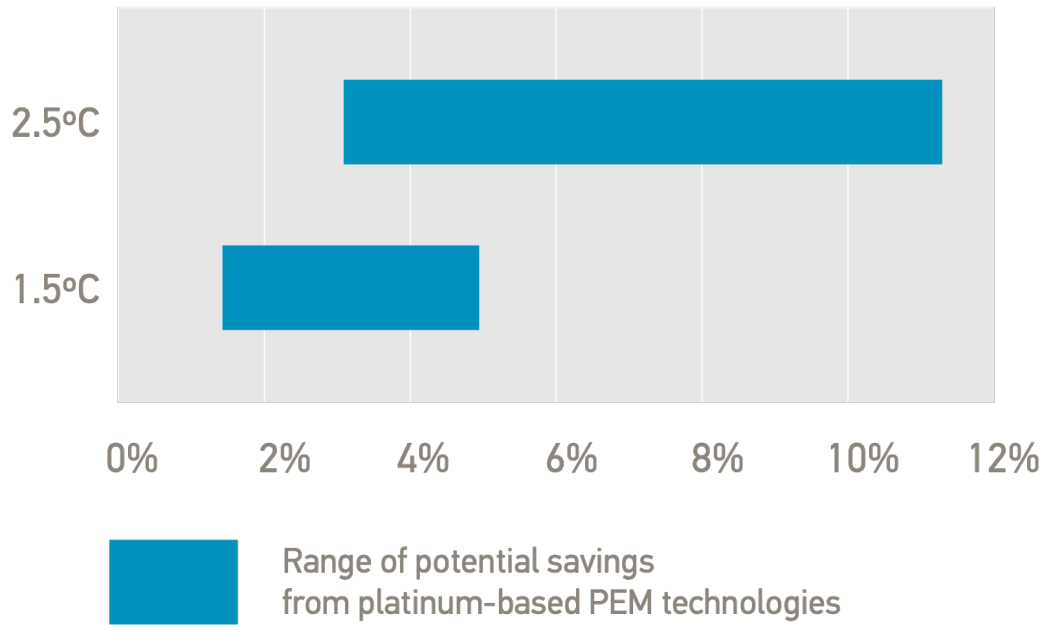
The Paris Agreement set 2050 CO_2 reduction targets to limit global warming to at least 2 °C or better still, 1.5 °C; PEM technologies could help achieve these important goals.

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

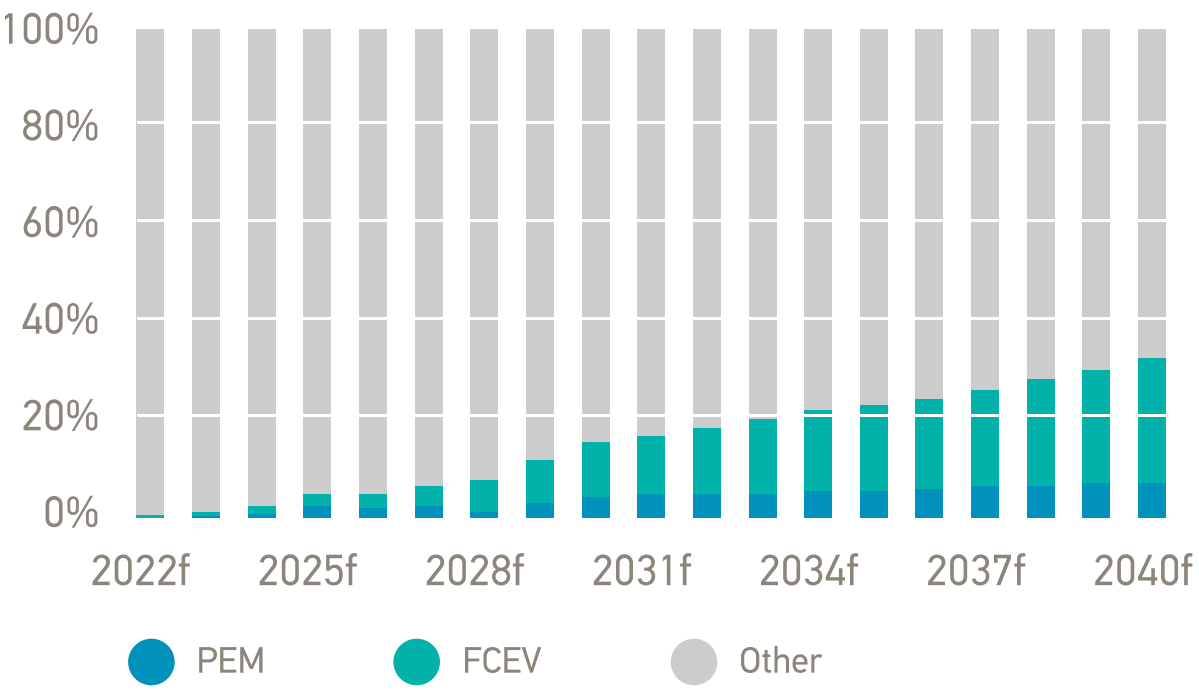
11%
GLOBAL CO_2
REDUCTION TARGETS
could be delivered by
PEM TECHNOLOGIES

75%
of projected
hydrogen-related
PLATINUM DEMAND
comes from FCEVs

Contribution to Paris Agreement
CO_2 reduction targets



Share of platinum demand



Metals Focus 2022 and 2023, WPIC Research 2024 onwards (total demand) and PEM and FCEV demand

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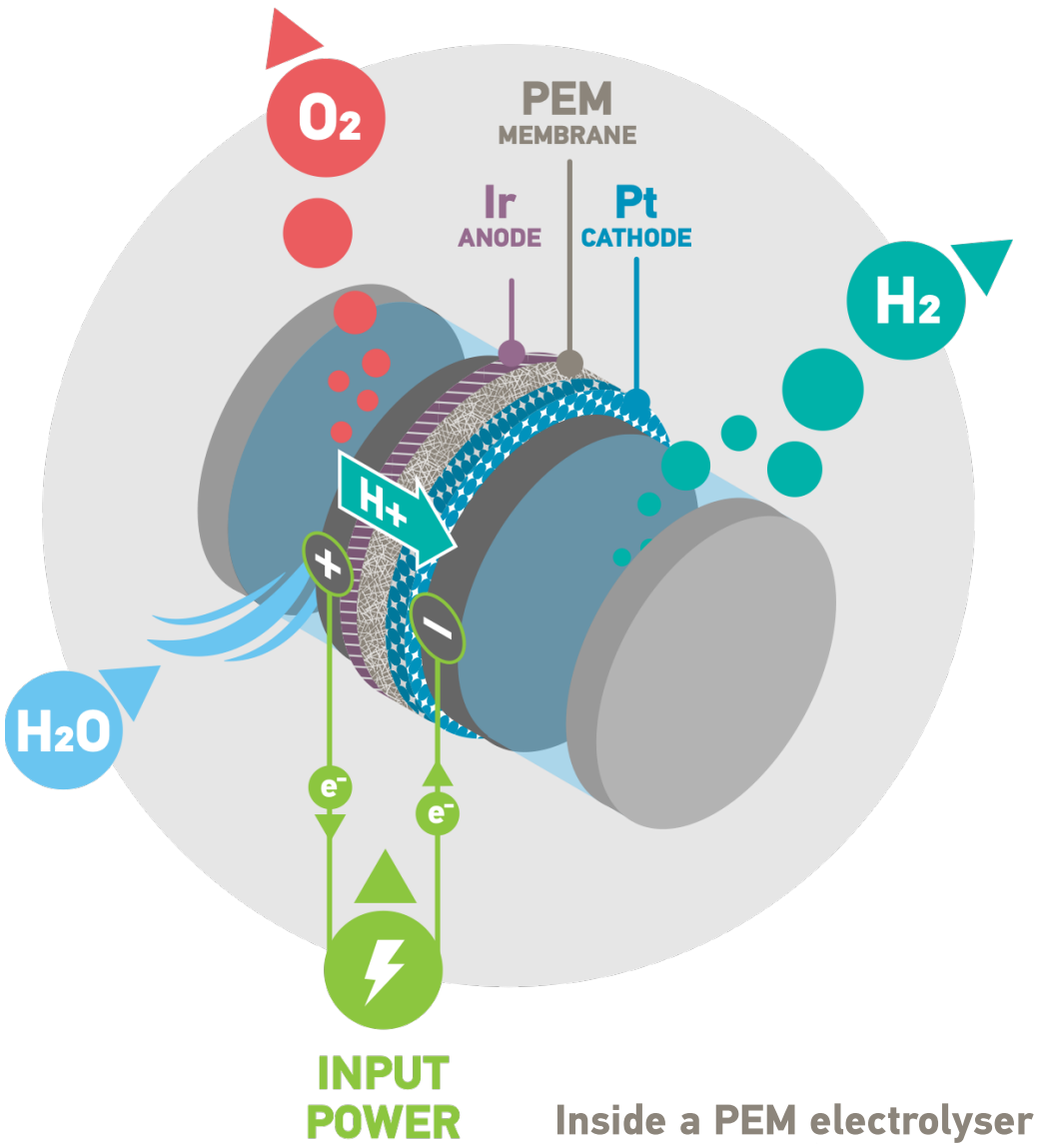
PEM ELECTROLYSER

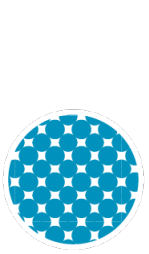
Platinum is crucial to PEM electrolysers

In an electrolyser electricity is used to break water into hydrogen and oxygen in a process called electrolysis. If the electricity comes from renewable sources the hydrogen produced is green hydrogen.

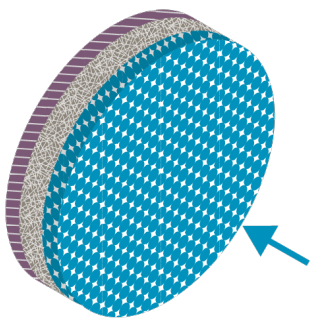
An electrolyser converts electrical energy into chemical energy, or electrons into molecules. PEM electrolysers harness the catalytic properties of platinum and its sister metal iridium. The platinum catalyst enables the splitting of the water into its constituent parts, providing a highly reactive surface area that can withstand corrosive conditions.

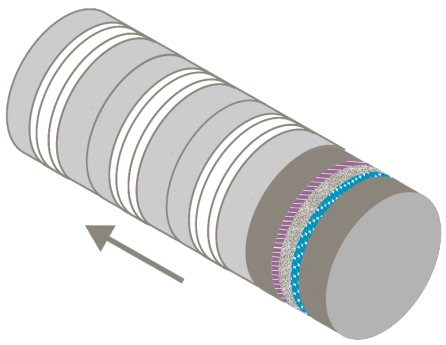


Inside a PEM electrolyser



Platinum





The PEM is coated with platinum at the cathode and iridium at the anode to make the catalyst coated membrane. Electrolysers can be scaled by combining individual cells to form an electrolyser stack, enabling multi-megawatt electrolyser installations.

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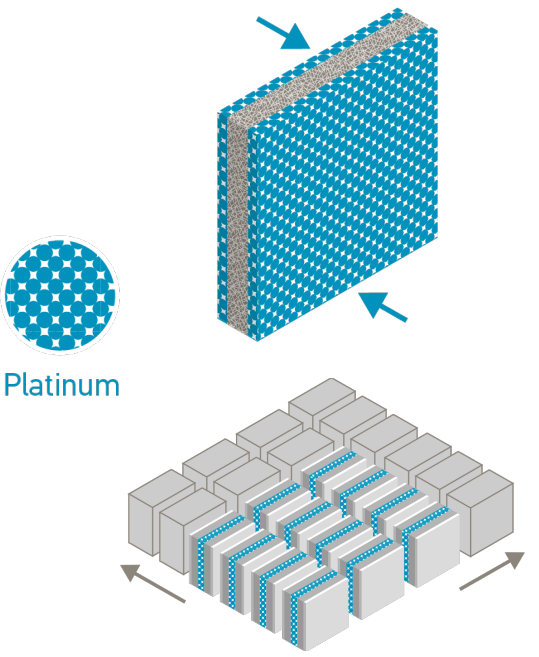
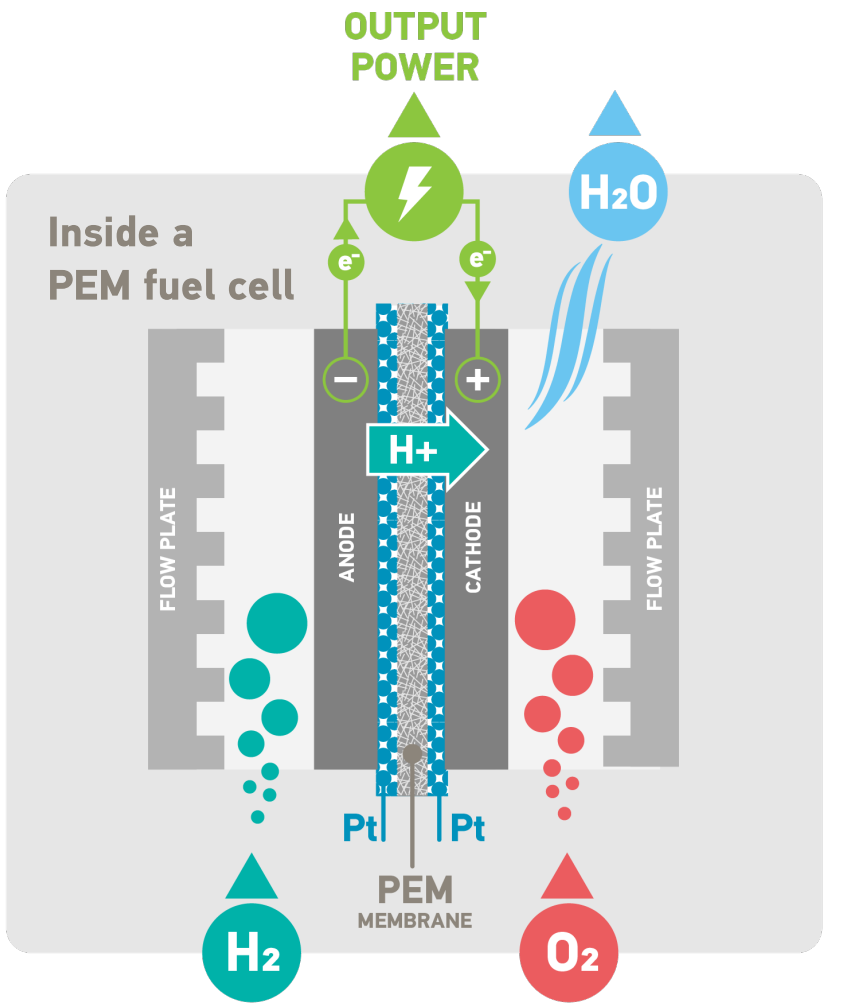
PEM FUEL CELL

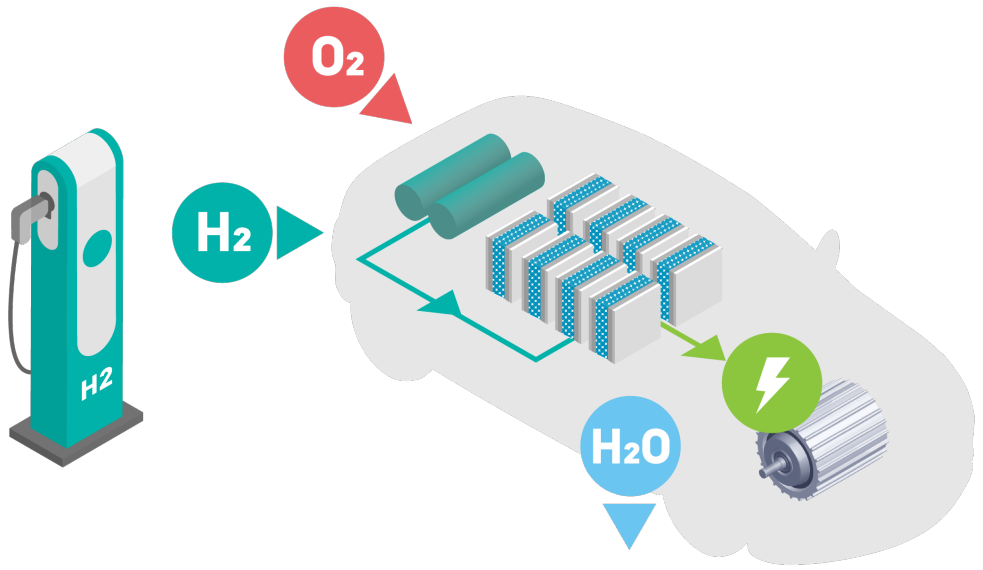
Over forty years of proven technology

Platinum is the catalyst that is used in PEM fuel cells as it provides the durability, stability and reactivity necessary to strip the hydrogen of electrons to produce electricity, leaving the hydrogen protons to pass through the PEM.

The PEM membrane is coated on both sides with a platinum catalyst. Platinum's superior catalytic and conductive properties turn hydrogen and oxygen (from air) into electricity, with water and heat as the only by-products. A single fuel cell alone only produces a few watts of power, so multiple fuel cells are combined to create the right electric output, from a few kilowatts to multi-megawatt installations.







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MARKETS

Markets for platinum-based PEM technology are growing rapidly

Hydrogen will play a pivotal role in efforts to reach net zero, and investment, collaboration and the roll-out of supportive government policies are intensifying in order to achieve this, directly benefiting platinum demand.

More than **US$300bn** **in hydrogen investments** are earmarked through to **2030**

1 million FCEVs are expected on **China's roads by 2035**

By 2030 **1 in 8** newly-registered **COMMERCIAL VEHICLES** worldwide will be powered by **hydrogen fuel cells**

The annual global export market for **green hydrogen** is expected to be worth circa **US$300bn** BY 2050

Demand for hydrogen could rise **7x** by 2050 **with 2/3 of production** coming from electrolysis

30 countries have developed, or are in the process of developing, **hydrogen plans central to their decarbonisation strategies.**

Broad-based commercial **adoption of FCEVs** could add over **3 moz** to annual platinum demand in 10 years

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