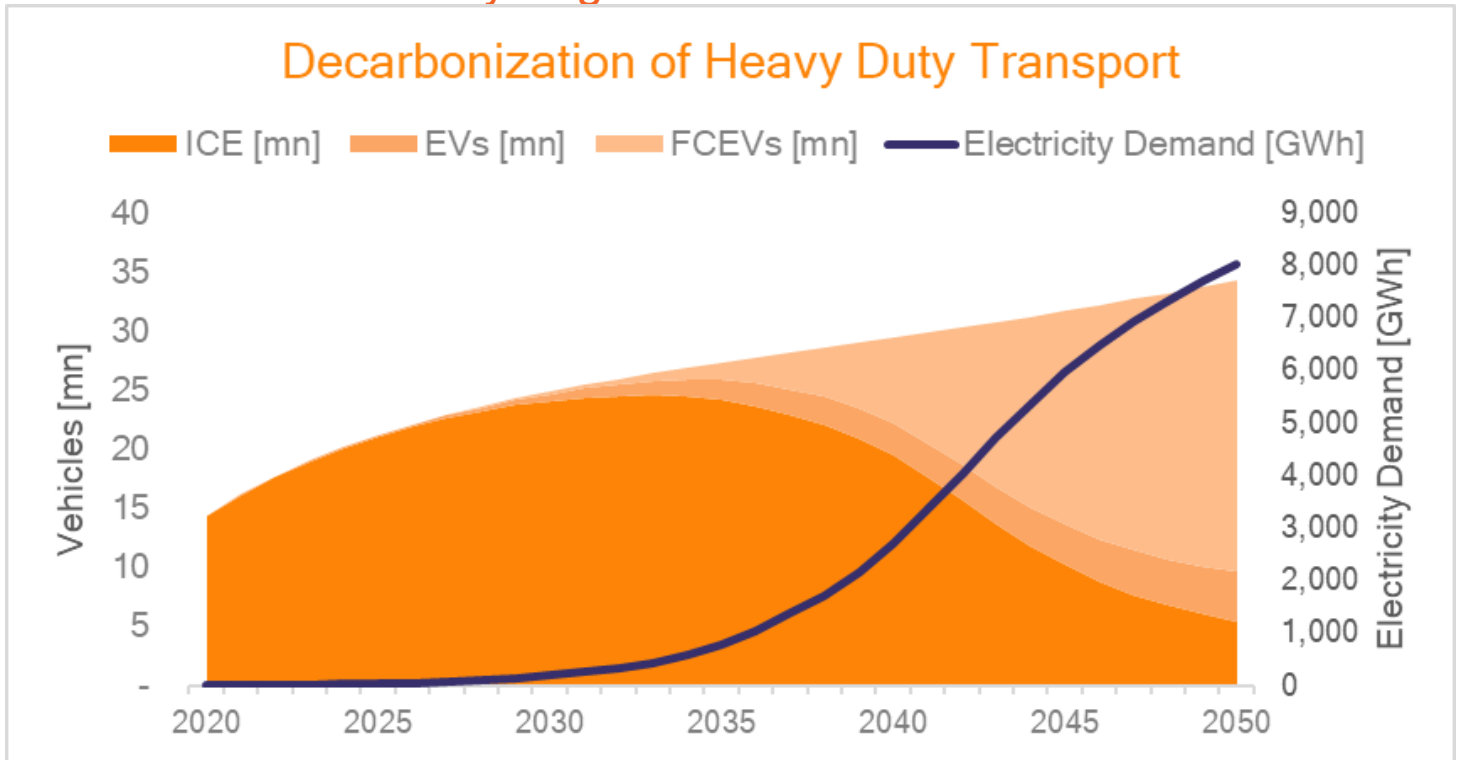


Heavy duty transport transition WILL rely more on hydrogen than batteries – Executive Summary

Hydrogen Forecast to 2050



This is one of 20 research papers that Rethink Energy produces each year, alongside 10 full forecasts to 2050 for each of the different renewables areas—solar, wind, hydrogen, green steel, heating and cooling, floating solar, offshore wind, etc.. where each of those have detailed spreadsheet models attached and a webinar to explain them. This entire catalog of renewables are available for paying customers for \$4,600 a year.

Companies mentioned in this report: Airbus, Aviation H2, Boeing, Citroen, Coradia, Daimler Mercedes-Benz, De Havilland Canada, Deutsches Zentrum für Luft und Raumfahrt, EDF Renewables, Esoro, Foton, Fraunhofer Institute, Gasunie, H2FLY, Hyundai, Hyzon Motors, International Maritime Organisation, Kenworth, MagniX, Nikola, Nokia, Nouryon, Orsted, Peugeot, Scania, Shell Aviation, SkyNRG, Tesla, Universal Hydrogen, Vauxhall, Volkswagen, Volvo, ZeroAvia, ZeroWaste

Lead analyst:
Harry Morgan

“Rethink has a commitment to forecasting markets that others shy away from – those on the verge of radical transformation”

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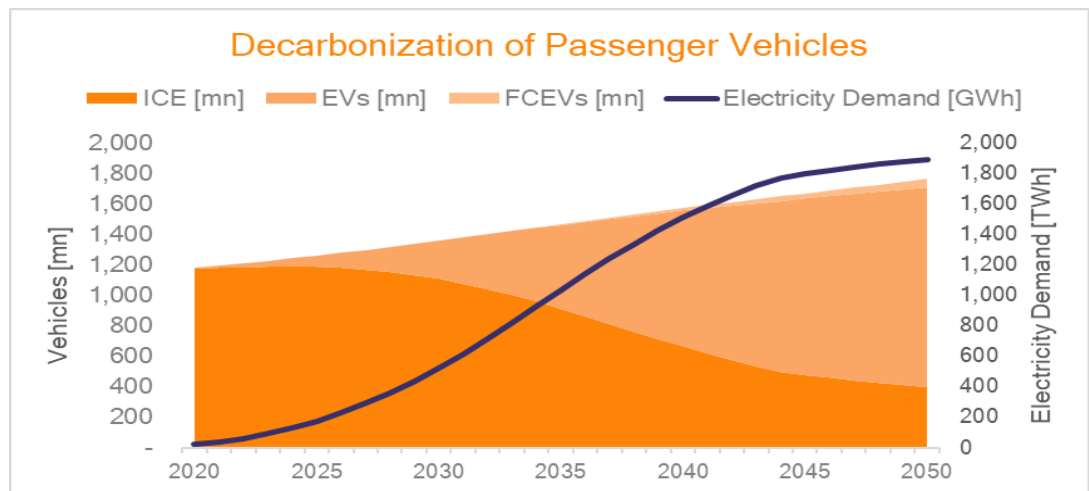
Hydrogen comes too late to decarbonize passenger vehicles

The plummeting costs of lithium-ion batteries, and worldwide legislation to accelerate the phaseout of internal combustion engine (ICE) vehicles, has seen the global share of plug-in electric vehicles rise from 2.6% in 2019, to 7.2% in 2021. Across Europe – the strongest segment of this market, due to laws making ICE vehicles illegal in new cars after 2035 or beyond – and countries like France and Germany are typical, with France having leapt from some 11.6% of cars being EVs during 2020, to 21% being EVs in 2021.

A growing number of countries have now pledged themselves to phasing out the sales of ICE passenger vehicles entirely – most recently China and Europe by 2035 – and by 2050, we expect to see most car sales coming from electric models.

With unit lifetimes typically in the region of 15 to 25 years, the total number of ICE vehicles on the roads will fall from a peak of 1.18 billion in 2023 to under 400 million by 2050. Meanwhile, the number of battery electric vehicles will have risen from 16.2 million at the end of 2021, to 1.31 billion.

To support these, there will be 460 million individual charging posts, with the great bulk of these among the top 41 countries by energy use. The rest of the world however will still follow the market leaders into zero emissions and will contain roughly another 34.4 million charge points. About 62% of these charging posts will be private, the great bulk of which will be in individual homes. About 33% and rising, of the public charge points, are already fast chargers and soon that is all that anyone will install going forwards.



Hydrogen fuel cell cars, offering advantageous refuel times, cycle life, range, and utilization rates at the expense of an initial 40% increase in cost to drivers, will see limited traction in this space. Its advantages are becoming less and less relevant to the consumer with battery electric models like Tesla's Model 3 quoting ranges of up to 322 miles and with issues around long charging times diminishing, so too do most worries around the battery's life cycle.

However, there will always be some consumers that are not content with 30-minute charge times, so those that require high utilization rates are more likely to pick hydrogen over battery electric. This will be mostly seen within cities where a hydrogen infrastructure has started to develop, with taxis offering a key opportunity in this market. We expect to see FCEVs account for 3.1% of on-road vehicles in 2050, rising from 40,000 vehicles in use today to 54.2 million.

The business case of fuel cells in transport therefore lies around two key characteristics: Energy intensity, the percentage of a vehicle's weight that is the fuel itself; and Utilization, the percentage of time that the vehicle need to be in motion.

Who should buy and read this report?

Anyone planning policy or products for the transport transition should read this report and rely on its conclusions. There remain many misunderstandings around the need for Hydrogen particularly in transport and this Research paper walks you through the science you need to understand.

It will help you plan for these outcome including the falling cost of Green hydrogen, the falling cost of fuel cells, and how hydrogen is likely to be transported and under what circumstances. This is also vital for anyone who invests in the energy sector.

All Rethink Energy reports are consistent with our global model of electricity – Annual Primary Electricity which is currently in version 2.0 and to some extent relies on forecasts which are found inside this annual publication. Rethink Energy Annual Primary global electricity model is the basis of this and many of our other reports and shows long term trends in renewable energy and the rate of energy transition from fossil fuels.

No other forecasting organization has our level of success in accurately forecasting the energy transition and in particular the transition of the transport sector. We are experts in forecasting rapid change. Most other forecasters in energy are experts in forecasting the same thing year in year out.

For **\$4,600** we will give you access to every report, webinar and podcast we produce in the next 12 months, as well as from the last 12, for you and everyone in your company. We will also throw in an annual subscription to our Weekly Analysis, our podcasts and our webinar program

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About Rethink Technology Research

Rethink is a thought leader in quadruple play, renewable energy, and 5G wireless. It offers consulting, advisory services, research papers, webinars, plus three weekly research services; Wireless Watch, a major influence among wireless operators and equipment makers; Faultline, which tracks disruption in the video ecosystem, and OTT video, Rethink Energy, which monitors investment opportunities in the changing energy landscape.



"Forecasting technology markets, whether they are growing or shrinking."

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