# Winter Ends

*Julian Silk*[a]

Many views of electric vehicle adoption focus on the reduction in greenhouse gas emissions (GGEs). But there are significant problems that are overlooked in this sole focus: the cost to consumers, the ongoing need for recharging the batteries, the significant environmental and political opposition to the increase in mining and production that will be necessary, and the vast amount of stranded assets in fossil fuels that the wholesale switch (without modification) will produce. The most wealthy countries can afford this, whether they choose to or not, and others that do not rely primarily on markets, such as China, may also achieve this. Poorer countries may not, and there are valid reasons to expect battery prices to remain high, financing the Salton Sea lithium project not least.

Hydrogen fuel-cell vehicles (HFCVs) are an alternative that can help meet GGEs reduction goals, and HFCV technologies, which can be combined with much reduced fossil-fuel consumption, or reduced need for batteries, may have lower costs. Conditions in Brazil and India that may be conducive to such alternatives, are discussed, as are carbon tariffs, which are imminent in Europe, and may be politically feasible in the U.S. Photovoltaic (PV) cells, as an addition for transport, can also play a significant role. Some "colors" of hydrogen production are discussed. A new category of hydrogen, "jade" hydrogen, renewable production of hydrogen from fossil fuel substrates, and renewable transportation, is proposed. Jade hydrogen could also reduce the stranded asset problem (including infrastructure) and increase political feasibility.

Alternative battery technologies, including but not solely lithium-ion, are likely to dominate market for GGE-reducing transport in the near future. But these advantages for HFCVs may come to play a larger role than expected thereafter.

a I am a consultant with Kapur Energy Environment Economics (KEEE). The opinions expressed here, and all errors, are solely my own, and do not represent KEEE in any way. KEEE does not endorse any technology or any specific government policy. Thanks to William Halal, Daniella Taveau, Rafael Herzberg, Aaron Krol, and two anonymous referees for helpful comments.