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Can remote green hydrogen production play a key role in decarbonizing Europe? A cradle to gate LCA of hydrogen production in Austria, Belgium and Iceland.

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There has been a global spike in interest in using hydrogen as an energy carrier to decarbonize hard-to-abate sectors. From a European perspective, with the interest in greater use of hydrogen for this purpose, EU member states are considering varied means to either produce hydrogen nationally or to import remotely-produced H2. However, the mitigation potential of hydrogen is heavily dependent on how the hydrogen is produced (i.e. steam methane reforming or electrolysis) and under what conditions (i.e. using CCS technologies or for electrolysis the source of the electricity used). Thus, a variety of studies have considered the life cycle impacts of different hydrogen production conditions, taking into account different sources of electricity during electrolysis, operating hours (i.e. for when using intermittent renewable energy technologies), and transportation of the hydrogen. However, these different conditions are often studied in isolation, making cross-comparisons needed to assess the environmental trade-offs of locally produced versus imported hydrogen difficult. Therefore, to allow for such an assessment in this study, we consider the life cycle impacts of H2 production temporally and spatially, at three different locations in Iceland, Austria, and Belgium using locally available renewable energy sources, as well as the local grids in each location. Our cradle to gate life cycle assessment includes the transport from the production site to the final utilization site at potential gates in Europe. Our results indicate that the carbon footprint of H2 production depends primarily on the energy mix, while transportation of H2 generates a minor impact.