CMI Best Paper Award for Doctoral Students

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"Minimizing Emissions From Grid-Based Hydrogen Production in the United States"

Clean hydrogen has been proposed as a solution to many of the stickier challenges of economy-wide decarbonization, and the US recently introduced a large subsidy to encourage its production. However, qualification for this subsidy depends on achieving extremely low embodied emissions rates, and the US Treasury has not yet provided guidance on how these rates should be calculated. Our recent study found that Treasury's decision on this matter will be incredibly consequential, and that this ostensibly clean subsidy could actually increase CO_2 emissions by a substantial amount if implemented poorly.

Our study used an electricity system optimization model to assess the cost and emissions impacts of various possible implementations of the Inflation Reduction Act's clean hydrogen production tax credit. We found that without robust requirements for clean electricity procurement, embodied emissions from grid-connected hydrogen production subsidized by the IRA could be worse than those of conventional 'grey' hydrogen produced from fossil methane. Furthermore, we found that traditional means of demonstrating clean energy use, such as simple purchases of Renewable Energy Certificates, did nothing to reduce this effective emissions rate. Only **tight time-matching** of hydrogen's electricity consumption with generation of **physically-deliverable** clean electricity from **newly-built** resources was found to be an effective means of reducing emissions to acceptable levels. Together (and only together), these three requirements can enable massive reductions in hydrogen's embodied emissions at very little added cost.

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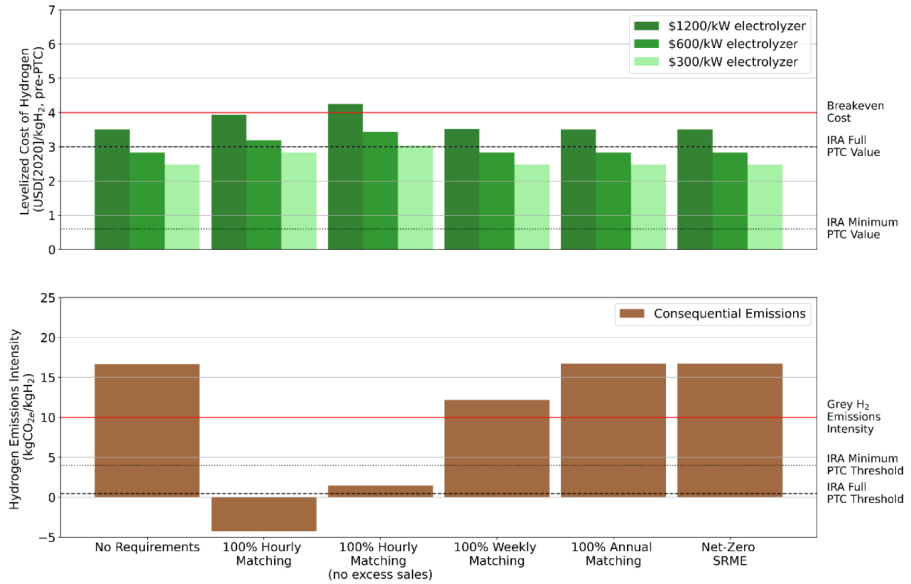

Figure: Cost (top) and emissions (bottom) outcomes from grid-connected hydrogen production in the US Pacific Northwest under multiple possible implementations of the clean hydrogen PTC (columns left to right). Emissions impacts are high when no clean energy procurement requirements are placed on hydrogen producers, and are eliminated by an hourly matching requirement. Other policies are ineffective at reducing real emissions. Meanwhile, hourly matching increases the overall cost of hydrogen production by 0.2-0.5 $/kg.

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