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BACK POCKET INSIGHT

P178 RESOURCE PLANNING FOR ELECTRIC POWER SYSTEMS

Impact of Uncertain Hydrogen Technology Futures on Long-Term Electric Company Investment Portfolios

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KEY INSIGHTS

- Investment in hydrogen (H_2) generation capacity is driven primarily by fuel availability, a zero-CO_2 target, the source of fuel production, and the initial assignment of candidate technologies.
- Adding H_2-fired generation as a candidate resource may lower total system costs in a low-carbon resource plan when technology options are limited, and H_2 is produced exogenously.
- Hydrogen generation capacity investment decisions are highly sensitive to the availability of H_2 fuel–small interruptions of H_2 delivery significantly decreases the optimal investment in H_2-fired generation.
- Hydrogen technology capital and fuel cost uncertainty has limited impact on investment and operating decisions.

Research Overview

Recent advances in the development of hydrogen (H_2) for power generation have spurred interest in using this technology to support electric company resource portfolio decarbonization. However, uncertainty in the costs of fuel and capital, commercialization timelines of both H_2-enabled turbines and supporting infrastructure, and availability of delivered H_2 fuel impact the level of confidence electric companies have when incorporating H_2 into their resource plans.

This research uses a capacity expansion planning model to investigate incorporating H_2-fired generation technology into an example long-term resource plan. Hydrogen generation is modeled similarly to a dispatchable gas turbine, and a sensitivity analysis explores the impact of uncertainties related to fuel costs, capital costs, commercialization timing of infrastructure and availability of delivered fuel. Findings provide insights about the conditions under which H_2 investment appears as part of a least-cost resource plan.

Summary of Findings

- Investment in H_2-fired generation capacity may lower total system costs in a system with a zero-CO_2 target in place. All modeled scenarios (i.e., alternative H_2 technology futures) in this study have lower total system costs than the base scenario with no H_2 investment option (Figure 1).
- This cost differential is driven by (1) H_2 units providing more firm, non-emitting capacity than the wind and solar units in the system, and (2) the related offset of otherwise significant capital investments in other zero-emitting technologies (i.e., wind and solar).

Figure 1: Cumulative System Cost by H_2 Technology Future Scenario

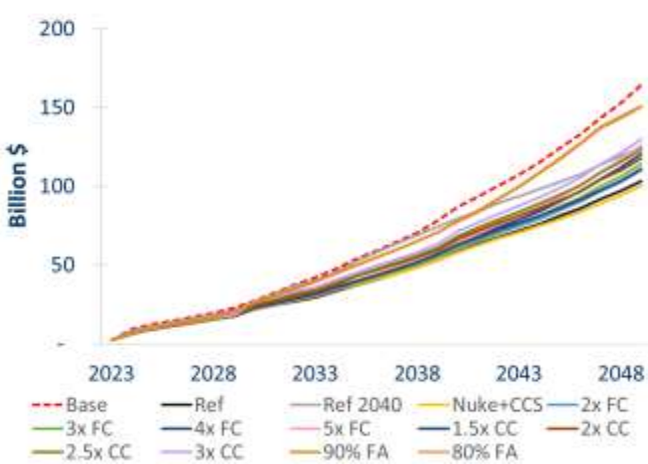
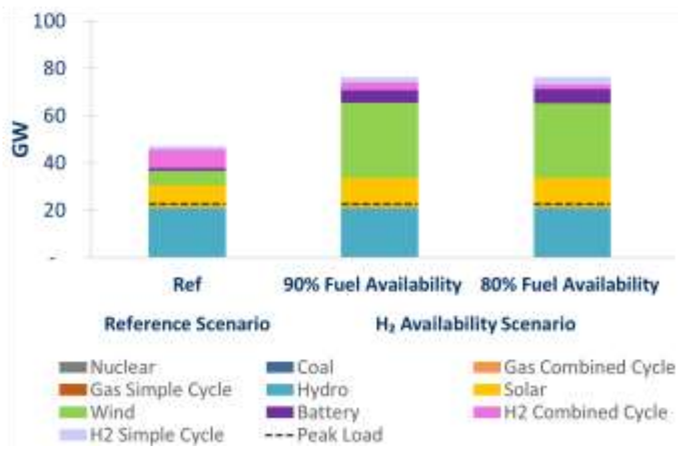


Figure 2: Total Generation Capacity by Technology and H_2 Fuel Availability Scenario (2050)



- Availability of H_2 fuel plays a crucial role in determining the optimal generation capacity for a system. When H_2 fuel is restricted, modeled results show a 43% decrease in H_2 investment and a 181% increase in wind and solar investment in the resource plan.
- Results are influenced by the modeling assumptions, including a zero-CO_2 target, external H_2 fuel production, and a requirement for the modeled system to meet its own load.
- Future research may explore more complex methods of modeling H_2 in long-term resource plans, including H_2 production through electrolysis and evaluating system operations using a production cost model.

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