LCRI LOW-CARBON RESOURCES INITIATIVE

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EXECUTIVE SUMMARY

Regional Hydrogen Pipeline Costs for US-REGEN Model

To fully leverage the potential of hydrogen as a path to decarbonization, the development of robust and extensive hydrogen pipeline infrastructure is crucial. In addition to usual challenges faced by other energy infrastructure, such as natural gas pipelines or electric transmission lines, hydrogen pipelines present unique concerns including embrittlement and higher operating pressure. This project seeks to leverage the existing research on natural gas and hydrogen transportation and studies on regional differences in infrastructure project costs to develop assumptions and cost estimates of new hydrogen pipelines.

Material costs for new hydrogen pipelines may be 10% higher than for new natural gas pipelines, which would result in a 1.4–4.6% difference in total cost per unit inch-mile. Due to hydrogen's lower energy density, capital costs would be 14%–16% higher per unit energy flow rate for hydrogen compared to natural gas. These estimates for pipeline costs likely understate the difference because the scope did not include the compressor stations along the pipeline route, which are expected to have higher capital and operating costs for hydrogen pipelines than natural gas pipelines.

KEY RESEARCH QUESTION

- What are the capital costs of building new hydrogen pipelines?
- How do the costs vary across different regions in the United States?

RESEARCH OVERVIEW

The research methodology incorporates established research on natural gas pipeline costs. The findings are benchmarked against the EIA natural gas pipeline cost dataset and adjustment factors are applied to determine hydrogen pipeline costs. The findings and results are summarized in this report.

KEY FINDINGS

- Though hydrogen pipelines were estimated to cost only 1.4%–4.6% per unit inch-mile more than natural gas pipelines, hydrogen exhibits faster flow and lower volumetric density than natural gas, resulting in a region-dependent average net increase of 14%–16% in capital cost per unit energy flow rate for hydrogen versus natural gas transportation through pipelines.
- The capital costs of building hydrogen pipelines vary significantly across the United States, with New England exhibiting the highest costs and the Great Plains & Rocky Mountain region displaying the lowest cost for hydrogen pipelines.
- There is substantial variation in labor costs across the country, while material costs show the least variation between regions.
- Obtaining right-of-way for pipelines is comparatively less costly than the other three components including material, labor, and miscellaneous cost as defined in Oil and Gas Journal data. However, overcoming institutional barriers to obtain ROW can pose significant challenges.
- This study does not include the capital and operating costs of compressor stations. Including these costs would likely result in a greater difference between natural gas and hydrogen pipeline projects because hydrogen compressor stations are expected to have higher capital costs and energy demands.
  - This topic is covered in detail in the LCRI report, *Economic Cost, Limitations, Challenges and Opportunities of Utilizing Existing Natural Gas Compressor Systems for Transport of Hydrogen and Hydrogen Blends*, 3002028177.

WHY THIS MATTERS

The estimated costs for hydrogen pipelines are important inputs in economy-wide energy system models given hydrogen's role as a zero-carbon energy carrier with the potential to decarbonize all energy sectors. Accurately assessing the cost of hydrogen pipeline and the variation of cost across different regions is vital for conducting thorough techno-economic analyses of its potential applications in these sectors.

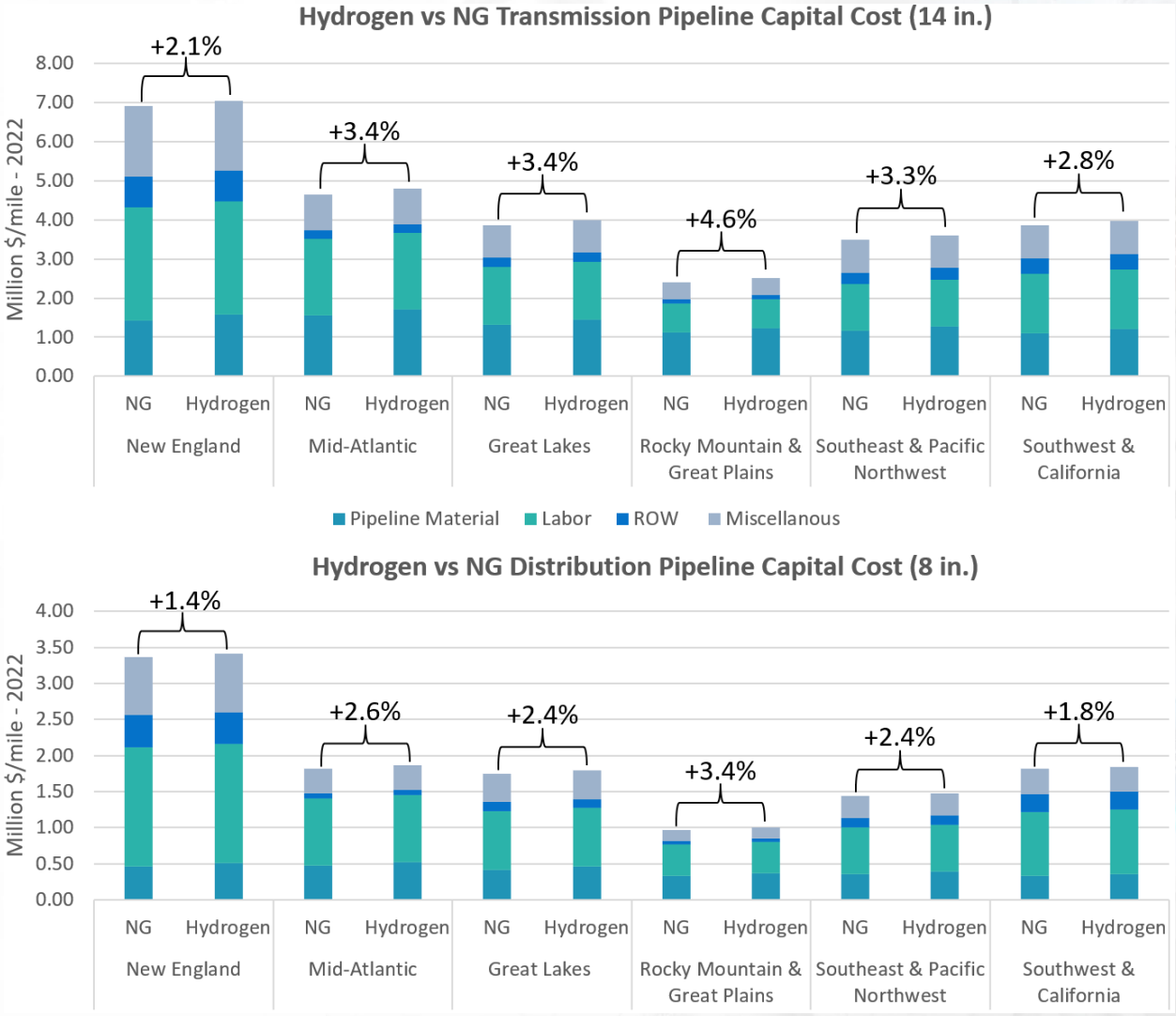
HOW TO APPLY RESULTS

The data tables in the full report can be exported and used in internal analyses. The report also contains high-level takeaways to consider in techno-economic analysis of hydrogen transportation.

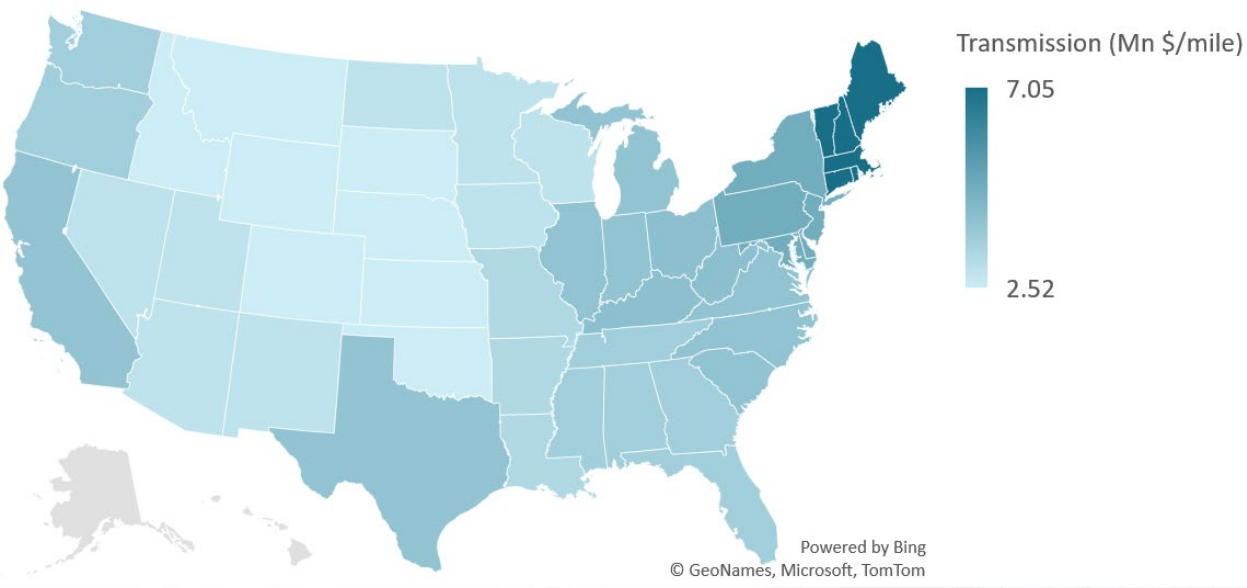
LEARNING AND ENGAGEMENT OPPORTUNITIES

- More information on the LCRI Technical Subcommittee on Integrated Energy System Analysis and the LCRI US-REGEN model can be found at the website: lcri-vision.epri.com/content/portfolio-modeling-analysis.html.

The following graphs depict the estimated costs for transmission and distribution pipelines for natural gas and hydrogen of the same diameter, with the estimated capital expense premium for hydrogen pipelines superimposed.



The geographic variation is also shown on this map of hydrogen transmission pipeline costs by region.



The full report contains greater detail on the methodology and the full final data set of regional costs.

THE LOW-CARBON RESOURCES INITIATIVE

This report was published under the Low-Carbon Resources Initiative (LCRI), a joint effort of EPRI and GTI Energy addressing the need to accelerate development and deployment of low- and zero-carbon energy technologies. The LCRI is targeting advances in the production, distribution, and application of low-carbon energy carriers and the cross-cutting technologies that enable their integration at scale. These energy carriers, which include hydrogen, ammonia, synthetic fuels, and biofuels, are needed to enable affordable pathways to economy-wide decarbonization by mid-century. For more information, visit www.LowCarbonLCRI.com.

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