INDEPENDENCE INSTITUTE.ORG

ISSUE BRIEF

IB-A-2024 | ENERGY & ENVIRONMENTAL POLICY | JUNE 2024

Colorado Energy Office's Economic Hindenburg: The Ballooning Costs of the Hydrogen Transition

By Trevor Lewis

Introduction

In October 2023, the Biden Administration awarded $7 billion of taxpayer dollars to kickstart the development of regional hydrogen hubs. These hydrogen hubs will independently explore new ways to lower the cost of producing so-called clean hydrogen and find new and innovative uses for hydrogen fuel. While Colorado's proposal for a Western Interstate Hydrogen Hub was not selected for funding, Colorado regulators, legislators, and utilities still see hydrogen playing a significant role in helping the state reduce carbon dioxide (CO2) emissions from its electricity sector and in-home appliances. Despite promises of a clean hydrogen-powered future, hydrogen production and distribution are still avant-garde technologies. Retooling the economy to prematurely run on hydrogen will cost Coloradans dearly. Building hydrogen's infrastructure could cost Colorado households as much as $4,800 per year for the next fifteen years.

"Despite promises of a clean hydrogen-powered future, hydrogen production and distribution are still avant-garde technologies. Retooling the economy to prematurely run on hydrogen will cost Coloradans dearly."

The Cost of Hydrogen Power in Colorado

On April 17, 2024, the Colorado Energy Office released Pathways to Deep Decarbonization report. The report's lowest cost plan for completely decarbonizing Colorado's electricity sector (OT100) used wind, solar, and clean – made from renewable power – hydrogen. OT100 will add 6 GW of hydrogen-fired power by 2040, costing $51.6 billion over 15 years to implement. Most of this will be spent on the wind and solar farms needed to power Colorado and to produce clean hydrogen. These costs will likely be passed onto Coloradans as the utilities responsible for building new generation will recover the costs of the hydrogen transition directly from their ratepayers. Under OT100, Coloradans could be paying as much as $1,272.31 more per year in electric utility service charges (See Table 1).

Anticipating that the adoption of hydrogen could be delayed, the report also included a limited hydrogen scenario. The absence of 4 MW of hydrogen turbines is offset by additional renewable power, costing ratepayers an extra $1,333.96 per year.

Table 1 distributes the costs accrued to Colorado's 2,534,755 electricity ratepayers when Colorado's natural gas plants are replaced with avant-garde hydrogen-fired turbines. Estimates for customers obtained from Colorado Energy Office.

Table 1: Hydrogen is the Colorado Energy Office's "Cheapest" Way to Completely Decarbonize the Power Sector

Hydrogen Scenarios	OT100	H2Lim
Decarbonization Price Tag	$51,600,000,000	$54,100,000,000
Number of Colorado Ratepayers	2,534,755	
Ratepayer's burden	$20,357.00	$21,343.29
Per Year cost	$1,272.31	$1,333.96

Hydrogen Pipelines

As utilities face increased scrutiny from environmental regulators and pressure to reduce emissions from ESG investors, utilities are increasingly considering blending hydrogen into natural gas pipelines. Xcel Energy—Colorado's largest electric utility—on April 11, 2023, announced plans to blend hydrogen into Hudson, Colorado's natural gas supply. While local opposition successfully stalled Xcel's plans, the utility continues to emphasize hydrogen's role in reducing carbon dioxide emissions from the sale of natural gas used in household appliances. Utilities are playing with fire, as blending hydrogen into residential fuel lines is not as safe as burning hydrogen in gas turbines. There are legitimate safety concerns as blending hydrogen with natural gas has only been done in a handful of places and at a small scale.

> "Utilities are playing with fire, as blending hydrogen into residential fuel lines is not as safe as burning hydrogen in gas turbines."

The leading examples of hydrogen-blended natural gas come from isolated communities with limited access to affordable natural gas. Prior to 1970, homes in western Australia used coal and oil to produce a mixture of combustible gases for in-home and industrial use. Hydrogen comprised 50 percent of the "town gas" mixture. Since the 1970s, 70,000 natural gas customers have relied on naphtha – a CO2-intensive fossil fuel refining byproduct – for half of their hydrogen needs. The hydrogen content of Hawai'i's synthetic gas mixture ranges between 12 – 15 percent hydrogen. While these instances prove hydrogen blending can be done on a small scale, hydrogen blending on a larger scale comes with safety concerns and risks.

> "hydrogen blending on a larger scale comes with safety concerns and risks."

A report on hydrogen blending from the National Renewable Energy Laboratory (NREL) found that most of the research regarding the safety of hydrogen blending was conducted on pipeline segments made after 1990. Given how most of America's natural gas pipelines were placed into service over fifty years ago, NREL concluded:

"Additional fatigue and fracture testing of vintage steels used in the U.S. natural gas pipeline system is needed to identify limiting behavior in hydrogen environments, especially for vintage seam welds and hard spots, and any existing pipelines under consideration for blending must be inspected for defect."

Colorado's utilities will need to inspect over 35,000 miles of distribution pipelines to ensure that hydrogen can be blended safely. Gathering immense amounts of data on the health of pipeline steel, composition, and friability and brittleness requires costly survey technologies and data analysis. Smart pipeline inspection gauges (PIGs) are the leading tool for gathering pipeline data. But they're not cheap. "Pigging" a natural gas line costs roughly $35,000 per mile. Surveying all of Colorado's distribution pipelines would cost $1.25 billion – or roughly $610 per natural gas customer (See Table 2).

> "Colorado's utilities will need to inspect over 35,000 miles of distribution pipelines to ensure that hydrogen can be blended safely. "

Table 2 presents an estimated costs of using a SMART pig to survey all of Colorado's natural gas distribution lines.

Once the surveys are complete, utilities will need to retrofit and replace the old pipe in order to bring the pipelines up to code to transport the hydrogen.

> "Surveying all of Colorado's distribution pipelines would cost $1.25 billion - or roughly $610 per natural gas customer..."

Table 2

Pigging Cost per mile	Miles surveyed	Total Cost	Ratepayer Burden
$35,000	35,859	$1,255,065,000	$610.30

Table 3

Percentage of line needing replacement	Miles of Pipeline in need of replacement	Pipeline Diameter (Inches)	
		24	36
10%	3585.9	$19,622,044,800	$29,433,067,200
20%	7171.8	$39,244,089,600	$58,866,134,400
30%	10757.7	$58,866,134,400	$88,299,201,600
40%	14343.6	$78,488,179,200	$117,732,268,800
50%	17929.5	$98,110,224,000	$147,165,336,000

Table 4

	Pipeline Diameter (Inches)	
Percent of Lines replaced	24	36
10%	$9,542	$14,312
20%	$19,083	$28,625
30%	$28,625	$42,937
40%	$38,166	$57,250
50%	$47,708	$71,562

Determining the repair and replacement costs using some basic estimates based on distribution pipeline sizes and the Environmental Protection Agency's estimated cost of $228,000 per-inch-diameter-per-mile, replacing Colorado's non-hydrogen compliant pipelines will cost a fortune. Depending on the percentage of the distribution lines that need replacing, preparing Colorado's pipelines for hydrogen blending could cost anywhere between $19 billion and $147 billion. Table 3 shows the potential costs in greater detail.

"Colorado's utility companies will inevitably pass the cost of upgrading their pipelines on to their customers."

Table 3 shows the costs based on the percentage of pipeline needing replacement and the cost to replace it based on pipeline diameter. Estimates for the milage of distribution pipelines were taken from API.

Colorado's utility companies will inevitably pass the cost of upgrading their pipelines on to their customers. If hydrogen blending occurs concurrently with the decarbonization of the power sector, Colorado's 2.05 million natural gas-using households, businesses, and manufacturers will inevitably need to pay an additional $9,500 to $71,000 over the next 15 years (Table 4). And these costs only assume Colorado's public utilities will need to replace at most 50 percent of the existing pipelines. Should transporting hydrogen require an entirely new pipeline network, construction costs could soar well into the hundreds of billions, cresting into the trillions.

Table 4 shows the costs presented in Table 3 spread evenly over Colorado's 2.05 million natural gas customers.

And that's just for large distribution pipelines. Colorado has an additional 19,844 miles of service lines that will likely need to be replaced at homeowners' and businesses' expense.

NREL's report also stressed the limited number of studies on hydrogen's impact on polyethylene pipes – the type of pipe used for residential service lines – insufficiently vet hydrogen blended natural gas for use in PVC pipes. But more concerning, most appliances were not designed to handle hydrogen. Burning hydrogen in water heaters, dryers, and cooktops may lead to insurance companies voiding warranties in anticipation of component or premature failures.

"Burning hydrogen in water heaters, dryers, and cooktops may lead to insurance companies voiding warranties in anticipation of component or premature failures."

Policy Recommendations:

Policymakers are not receiving a full picture of the costs and risks of hydrogen. Overly zealous promoters of the hydrogen economy are advocating for a slapdash adoption of a technology without providing accurate appraisals of costs or with sufficient safety guidelines. Before Colorado can act on hydrogen, lawmakers need to do the following:

1. Require a complete benefit-cost analysis accurately appraising all costs incurred to the economy

While the Colorado Energy Office's Pathways to Deep Decarbonization included the cost of building out the hydrogen-burning turbines, renewables, and nuclear power plants required to completely decarbonize Colorado, the costs accrued to customers and an estimated per Kilowatt-hour cost were not provided. Without this information, legislators have no way of knowing how the hydrogen economy will financially harm families and businesses in their districts. This assessment should also be repeated for blending hydrogen in pipelines and fuel cell production and distribution projects.

2. Establish best practices for hydrogen development

The primary problem with hydrogen is a policy one and not a technical one. Federal and state policies subsidizing and encouraging the blind expansion of hydrogen before its prime is, at best, a waste of financial and material resources, and at worst a detriment to Coloradans' health and safety. Hydrogen may play some role in improving power generation efficiency or as a storage medium for storing excess wind and solar power. However, discovering those use cases should be left to the private sector to find. When their dollar is on the line and not recoverable through ratepayers' monthly bills, utilities will find the most cost-effective means of researching and developing a plan to integrate hydrogen into the economy in situations where it makes financial sense to do so.

Trevor Lewis is a Fellow with Always On Energy Research.