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Blending hydrogen with natural gas is the wrong tool to cut building and power sector emissions

As policymakers seek the most efficient ways to cut building and power sector greenhouse gas (GHG) emissions, natural gas and electric utilities are promoting pilot projects to blend hydrogen into their existing pipeline network or power plants, with the long-term goal of switching entirely to hydrogen or blending it with other low-carbon fuels. Since hydrogen releases no GHGs when burned, it seems to offer gas and electric utilities a path to continue business-as-usual. But while utilities claim these are solutions for a carbon-free future, blending hydrogen with natural gas—funded by ratepayer dollars—could raise rates, exacerbate air pollution, and pose safety risks, all while providing few GHG reductions.

BACKGROUND

Today 95 percent of hydrogen is produced through a highly carbon-intensive process using methane (the primary component of natural gas). However, zero-carbon "green hydrogen" can be produced using renewable electricity and water, through a process called electrolysis. But even after testing and targeted pipeline upgrades, research suggests it's only possible to blend between 5 and 20 percent green hydrogen with natural gas using today's pipelines and appliances before encountering substantial obstacles. Similar blending limits exist for for gas-fired turbines before triggering the need for major retrofits. At these low blends, burning hydrogen has minimal impact on GHG emission reductions, yet significantly increases toxic air pollution. These barriers suggest hydrogen should play a far more limited role in a clean energy future, reserved for hardest to decarbonize end-uses like aviation or shipping.

HIGH CONSUMER AND INFRASTRUCTURE COSTS

At today's prices, blending green hydrogen with natural gas for use in households or power generation would increase consumer energy bills. While the cost of green hydrogen ranges widely, the fuel is currently 6 to 14 times more expensive than natural gas; even a 20 percent blend of green hydrogen with natural gas could raise the fuel price two to four times more than 100 percent natural gas.

After this initial higher cost, blending hydrogen with natural gas beyond a 20 percent threshold would require utilities to retrofit or replace most or all of the pipelines in their service territory, likely including pipes within homes and buildings. For context, there are 3 million miles of natural gas pipeline in the U.S., and there are no appliances capable of handling higher hydrogen blends currently available on the market. And even if they do become available, due to major safety risks, utilities would still need to wait for every single natural gas-burning appliance in their service area to be replaced before they could switch the system to run on a higher blend, generating massive logistical challenges and high capital costs that would be passed onto ratepayers.

HEALTH AND SAFETY RISKS

While hydrogen produces no GHGs when it is burned, it emits dangerously high levels of NOx, which can cause asthma and even premature death. Burning hydrogen in industrial settings generates NOx emissions up to six times higher than methane combustion. Blending hydrogen at natural gas-fired power plants would drive higher local pollution that disproportionately impacts low-income communities or communities of color, where the plants are typically sited. Hydrogen burned inside the home, especially for cooking, would similarly expose residents to high levels of NOx pollution.

Hydrogen burned inside buildings also poses significant safety risks because it ignites far more readily than natural gas with a higher risk of flame flashback—i.e., when a flame travels from a burner back into the gas line—in appliances designed to run on natural gas. And unlike natural gas, no known odorants are compatible with hydrogen so any room where pipes or appliances are delivering a high-hydrogen blend would require a hydrogen detector with an alarm, lest an accumulating gas leak cause an explosion.

PLANET-HEATING EMISSIONS

Because hydrogen produces less energy than methane when burned, the current upper limit of a 20 percent blend only achieves six to seven percent GHG emissions reductions. Hydrogen itself is an indirect greenhouse gas, and is 5.8 times more potent than CO_2. Thus, hydrogen leaks will still contribute to warming even if no CO_2 is produced from its combustion. Time spent testing and upgrading natural gas infrastructure and appliances in pursuit of small emissions reductions delays action on other available and proven building decarbonization measures, like electrification.

EFFICIENT ELECTRIFICATION

Electrification is substantially less disruptive than hydrogen for reducing emissions from buildings. In the U.S., 25 percent of homes use only electricity and almost half of single-family homes are appropriately wired for all-electric appliances. Equipment and appliance replacements can occur incrementally using existing electrical infrastructure and many buildings have sufficient electrical capacity to switch to all-electric appliances today. Electric appliances are readily available and pose none of the abovementioned public safety or health risks, and customers with electric heating already have lower energy bills on average than those heating with natural gas. When comparing green hydrogen for heating versus direct electrification, energy-efficient electric equipment and appliances hold an insurmountable advantage due to green hydrogen's significant efficiency losses during electrolysis and burning for heat.

STATE POLICYMAKERS CAN AVOID HYDROGEN'S COST, SAFETY, AND EMISSIONS RISKS THROUGH FOUR STEPS:

1. Before approving green hydrogen proposals, utility regulators should first consider proven methods utilities can use to cut GHG emissions in the buildings and power sectors such as efficiency, electrification, and renewable energy.
2. As utilities stand to increase profits through hydrogen, regulators should exercise skepticism when considering ratepayer-funded utility proposals to blend it with natural gas for pipeline distribution or in power plants, and place a high burden of proof on utilities to demonstrate how their actions serve the public interest and achieve relevant climate and clean energy goals.
3. If ratepayer funded projects are underway, regulators should clearly define how success is determined, as well as concrete metrics. Regulators evaluating proposed pilots for technological research of hydrogen should consider whether the utility is the best-suited for such research, as opposed to federal or private entities.
4. Policymakers should consider reserving green hydrogen for use in the hardest-to-decarbonize sectors of the economy, such as industrial feedstocks, aviation, and marine shipping. However, decarbonizing these sectors would not benefit from utilities blending hydrogen into natural gas pipelines.