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**Low-Cost GHG Reductions from Higher End-Use Gas Efficiencies**

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## Overview

The potential contributions of gas fuels (natural gas, biomethane, green hydrogen) to cost-effective pathways for reaching decarbonization goals have often received inadequate attention in long-term energy system analyses. But improved end-use efficiency from existing or emerging technologies could meet near and medium-term targets for percentage reductions GHG emissions, and renewable gas from biogas or power-to-gas cycles could help fully achieve 2050 goals for deep decarbonization, at substantially lower cost than all-electric pathways. This presentation will summarize recent published work on the economics of improved gas end-use technologies in the residential sector, the expected U.S. market penetration under several assumed levels of policy support, and the resulting aggregate GHG emission reductions. The technical and economic potential for renewable gas production in the U.S. will also be summarized. Finally, the long-term unit costs of abating GHG emissions through these gas pathways will be compared to other prominent pathways.

## Methods

The study team assembled and prioritized a comprehensive inventory of emerging gas end-use technologies, drawing from gas research institutes, academic experts and industry resources around the world. Potential efficiency and GHG impacts for the high priority technologies were analysed by major residential gas end use. Technology cost reductions from increased scale were combined with adoption models adapted from NREL, to estimate residential market penetration curves in unsubsidized and subsidized cases, with temporary first cost subsidies limited to no more than avoided gas purchase costs. Aggregate U.S. GHG emission reductions and associated net costs were calculated.

## Results

U.S. residential natural gas emissions in 2040 can be cut by 24 percent through the advancement of more efficient emerging technologies, with average net savings (negative costs) of $51 per metric ton of CO2 equivalent in the low subsidies case, and by 40 percent at the modest average cost of $66 per ton in the higher subsidies case.

Higher direct-use efficiencies on the demand side can be complemented by increased use of carbon-neutral biogas and hydrogen (collectively "renewable gas") on the supply side, plus continued reductions in methane emissions along the gas delivery chain, to reduce drastically or eliminate residential GHG emissions from natural gas usage.

## Conclusions

## Widespread adoption of emerging natural gas direct-use technologies can contribute significantly to achieving public goals of deep reductions in GHG emissions in the U.S. residential sector, with much lower costs than other options under consideration. It's low hanging fruit that should be a core element considered for any responsible emissions reduction plan.

## References

This presentation will be based on two large studies on gas end use technologies conducted for the American Gas Foundation in 2018 and 2019. Primarily drawing on technology work by Gas Technology Institute and other gas R&D institutes, technology penetration models developed by NREL, and on renewable gas work by UC-Irvine, ICF, Engie and other industry sources. (Note: This material builds on information around potential gas consumption reductions per customer from improved gas end-use technologies that was presented at the Montreal IAEE conference in 2019, adding analyses of customer economics and policy impacts at the state and national levels, as well updated estimates of renewable gas production potential in the U.S.)