Thoughtful Pathways

Examining the Cost Implications of Policy Driven-Residential Electrification

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September 11, 2018

Main Questions the Study Addresses

AGA Study

- **Will residential electrification actually reduce emissions?**
- **How will residential electrification impact natural gas utility customers?**
- **What are the impacts on the Power Sector and Transmission infrastructure?**
- **What is the overall cost of residential electrification?**
- **https://www.aga.org/research/reports/implications-of-policy-driven-residential-electrification/**

Initial Findings from Study

1. **Natural gas is a critical residential energy source: Residential natural gas demand in January is more than twice electricity demand in July**

2. **Total GHG reduction potential from policy-driven residential electrification is small: Ranging from 1.0 to 1.5 % of U.S. GHG emission in 2035.**

3. **Policy-Driven Electrification will be burdensome to customers: average residential household energy costs (utility bills and equipment/renovation costs) increase by 38 to 46 %.**

Implications of Policy-Driven Electrification of Residential Gas Use, AGA, July 2018.

Initial Findings from Study

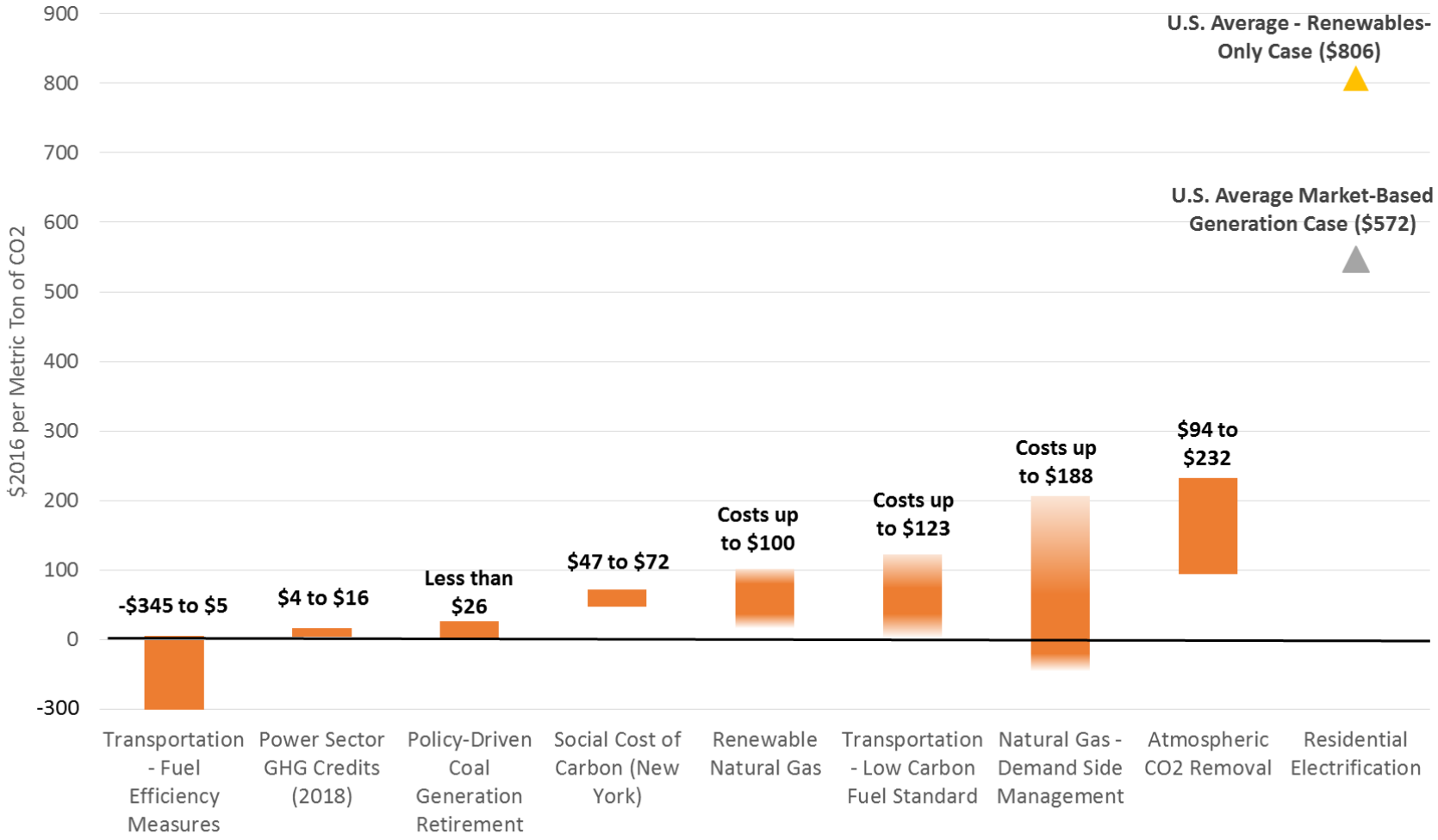
4. A policy-driven residential space and water heating strategy is expensive to the economy - $590 Billion to $1.2 Trillion in total incremental energy costs.

5. Such a policy may require infrastructure investments of $150 to $425 Billion for generation capacity and transmission.

6. Policy-driven electrification of the residential sector is an expensive tool for greenhouse gas emissions reductions - $572 to $806 per ton CO2.

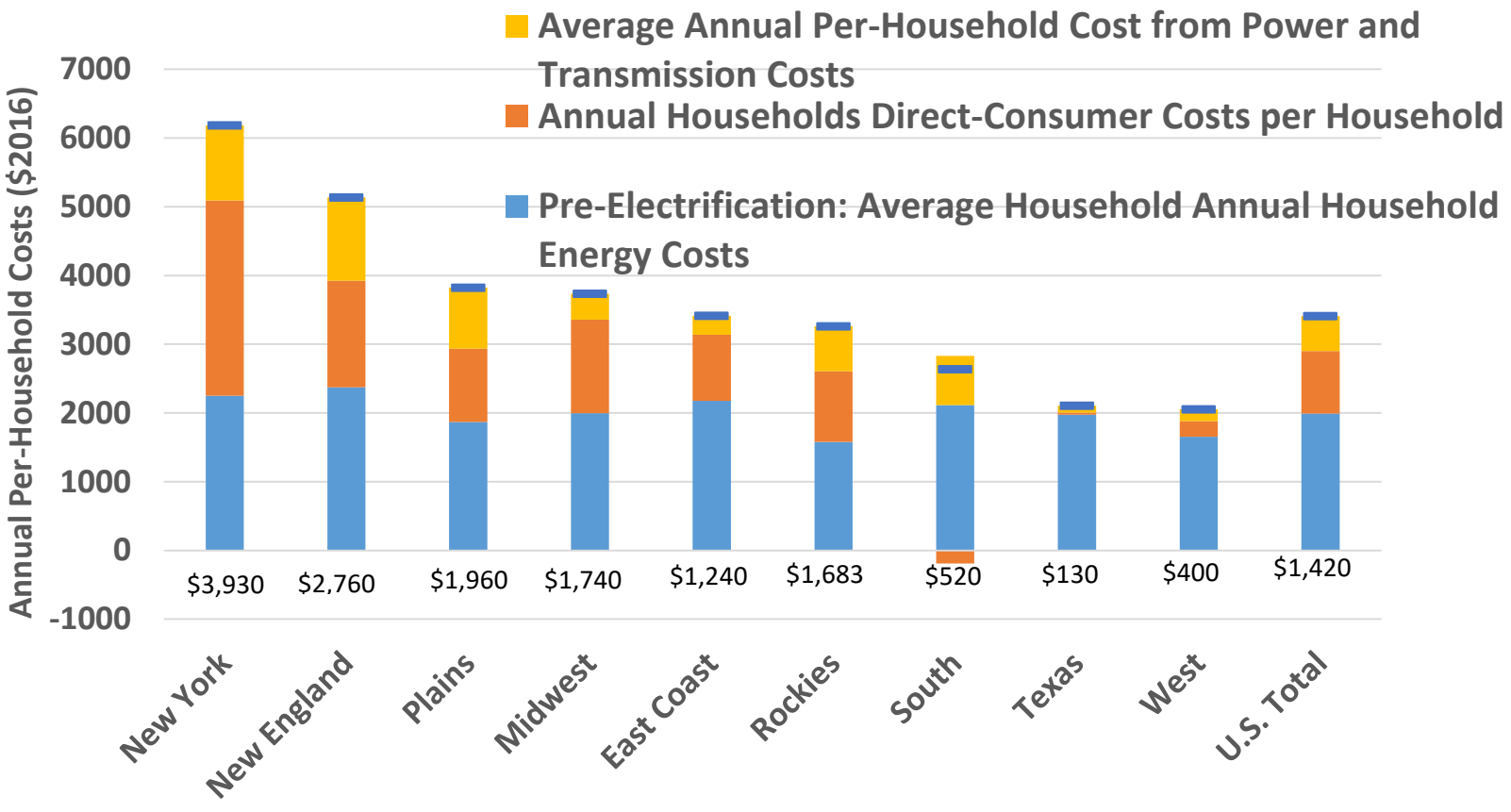
Implications of Policy-Driven Electrification of Residential Gas Use, AGA, July 2018.

Emissions Reductions Costs for Alternative Approaches to Reducing CO2 Emissions



Source: Implications of Policy-Driven Electrification of Residential Gas Use, AGA, July 2018.

Costs to Consumers By Region



Source: Implications of Policy-Driven Electrification of Residential Gas Use, AGA, July 2018.

Emerging gas technologies can make substantial and cost-effective contributions to GHG reduction goals

~100

Innovative Gas Technologies for Residential / Small Commercial identified in our global search

25-40%

GHG reduction potential on a customer basis by integration of these technologies and other efficiency practices

60-80%

GHG reduction – sufficient to meet COP 21 goals – with inclusion of future CHP technologies and Renewable Gas

- Policy goals for sustainable energy can be achieved at significantly lower consumer cost through integrating innovative gas solutions into long-term resource planning, while offering customers more choice and improved affordability, reliability and comfort.
- Gas technologies can enhance energy system reliability (system-wide and as a local backup) and efficiency, while reducing the need for new electric generation and T&D infrastructure and preserving the future value of gas infrastructure.
- Electric technologies will also improve, and are supported by incentives, but their GHG impacts depend on the generation fuel mix. In some regions electrification may increase GHG emissions through the 2030s.

Enovation Partners, May 2018.

Innovative technologies were assessed, prioritized and aligned with relevant end use pathways

High priority technologies by major end use, Enovation Partners, May 2018

- Low-cost residential gas absorption heat pump (GAHP) combination
- Condensing furnace
- Transport Membrane Humidifier (TMH)

- Tankless water heater - Maintenance-free approaches for tankless water heaters
- Solar-assisted heating - PV assisted domestic hot water heater (potable)
- Unplugged power burners - Two-Phase Thermo-Syphoning (TPTS) technology
- Combined Space and Water Heating Systems*

- Ozone and cold water washing

- High production fryers
- Boilerless steamer - Multistacked convention steamer for high volume cooking
- Combination steam and heat oven

- IoT thermostats (i.e. Nest, Honeywell)
- Building envelope (insulation, windows, building materials)
- Demand controls for HW systems
- Thermostatically controlled low flow shower head

- Solid oxide fuel cells*
- Micro CHP – gas recip, sterling engine*

- Fuel cell electric vehicles (hydrogen)
- Commercial CNG vehicles

Note: All technologies were independently evaluated and scored by several SMEs; evaluation criteria primarily considered GHG impact and time to market; aggregated scores were consistent among experts and robust against multiple weightings; * designates technology with multiple end-uses, but listed only once

Questions?

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