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ANALYSIS OF THE ROLE OF GAS FOR A LOW-CARBON CALIFORNIA FUTURE

Executive Brief – July 17, 2018

Please see the full report to understand the assumptions and caveats underlying this analysis.

Introduction and Approach

Southern California Gas Company (SoCalGas) engaged Navigant Consulting, Inc. (Navigant) to conduct a technical analysis of the following:

- Potential greenhouse gas (GHG) emissions reductions from building electrification
- Estimated amount of renewable gas (RG) needed to match reductions under different scenarios
- Projected combined annual cost for consumer utility and appliance costs in each scenario
- Cost-effectiveness of each GHG emissions reduction strategy under different assumptions.

The scope of the analysis covers residential and commercial buildings in SoCalGas territory over the period 2018-2030 and major gas appliances for space heating, water heating, clothes drying, and commercial cooking.[1] This report quantifies the amount of RG that would need to be supplied to SoCalGas' retail customers to decarbonize gas at similar pace as the electric supply. That is, how much RG would have to be supplied so building end uses have the same GHG footprint regardless of whether they use or gas or electric appliances.[2] The current study focuses on residential and commercial buildings only and does not consider RG supply constraints, additional RG program needs, or any direct cost to electric utilities for any necessary grid infrastructure improvements.

Navigant developed a model to evaluate the potential GHG emissions reductions from appliance electrification in SoCalGas territory and to estimate RG needs under different scenarios. The scenarios represent possible electrification initiatives in California where the installed base of gas-fueled appliances in residential and commercial buildings are replaced with electricity-fueled appliances either overnight (i.e., Overnight Conversion) or at the end of their useful life (Normal Replacement).[3]

For each electrification scenario, Navigant modeled the number of gas appliances that would be replaced in each year by electric appliances and calculated their electricity consumption and GHG emissions based on the hourly load profile and hourly electricity emissions factor in each year. Navigant analyzed the economics of each GHG emissions reduction strategy by modeling the consumer utility cost[4],

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[1] Residential: furnace, water heater, clothes dryer. Commercial: furnace, water heater, space heating boiler, water heater boiler, convection oven, fryer, clothes dryer.

[2] Electric appliances include electric heat pump options where applicable (e.g., residential space and water heating, commercial rooftop units) and electric resistance options for other end-uses (e.g., commercial boilers, clothes dryers, cooking equipment).

[3] Navigant modeled Normal Replacement scenarios of 100%, 50%, and 25%, with the Normal Replacement 100% target represents the most aggressive RG scenario. By 2030, 87% of the installed base would be electric assuming 2018 as a start year.

[4] Consumer utility costs represent 2017 Integrated Energy Policy Report (IEPR) rate projections for conventional gas ($/therm) and electricity ($/kWh) and ICF projections for in-state and out-of-state RG supply; it also includes mixed in-state (25%) and out-of-state (75%) RG supply based on a May 2018 ICF memo. To reflect possible distribution, transmission, and generation needs to accommodate increased building loads, the team ran a high electricity rate projection as a bookend high electricity rate scenario.

appliance cost[5], possible electrical infrastructure cost[6], and combined annual cost (the sum of the consumer utility, appliance, and electrical infrastructure costs).

Summary of Key Results

- Figure 1 illustrates the results from the analysis of RG requirements and GHG emissions reductions. Under the Normal Replacement 100% scenario, the same GHG emissions reductions can be achieved by gas appliances if 46% of building gas use comes from RG by 2030.[7] This equates to 16% of total SoCalGas throughput coming from RG by 2030 (i.e., approximately 140 BCF/year based on an estimated total SoCalGas throughput of 867 BCF/year in 2030).
- Compared to the baseline and RG projections, electrification scenarios have an appliance cost[8] premium of $3 billion-$27 billion (6%-60% over baseline appliance cost) depending on whether electrical infrastructure costs are included. RG projections do not carry incremental appliance costs, because RG projections use baseline gas appliances and do not require infrastructure upgrades within the building. The appliance cost for electrification projections is largely determined by the residential water heater cost assumptions.
- Figure 2 summarizes consumer annual utility costs in 2030. [9] Each GHG emissions reduction strategy increases consumer annual utility costs in future years. In 2030, consumer annual utility costs would increase by $0.7 billion/year-$4.8 billion/year for the range of RG and electrification projections. The RG projection using a mixed supply from in-state (25%) and out-of-state (75%) RG resources ($5.3 billion/year) and the out-of-state RG projection ($4.6 billion/year) would have lower consumer annual utility costs than electrification projections ($6.6 billion/year) using IEPR electricity rates. The RG projection using in-state RG ($7.6 billion/year) has a higher consumer annual utility cost than the electrification scenario ($6.6 billion/year) using IEPR electricity rates.[10]
- When appliance and upgrade costs are annualized over 15 years[11], consumer utility costs have the largest influence on cumulative combined annual cost (sum of consumer utility cost, annualized appliance and upgrade cost). Each RG projection has lower cumulative combined annual cost ($73 billion-$87 billion) than electrification projections ($92 billion-$112 billion) over the analysis period (2018-2030). This comparison is mostly due to consumer utility cost differences, particularly for early years when RG prices are lower on the supply curve.
- Figure 3 summarizes the cost-effectiveness of each GHG emissions reduction strategy ($/mt CO2e)[12] to maintain the GHG emissions reductions with the Normal Replacement 100% scenario

[5] Appliance costs represent purchase and installation costs for existing buildings. Residential appliance cost ($ per home) estimates were based on 2016 data compiled by KPF Group based on construction invoice and budget estimates from Southern California builders and contractors. Commercial appliance cost ($ per 1,000 SF) estimates are from the CPUC Potential and Goals study.

[6] This analysis assumes that an existing building has natural gas appliances; therefore, building owners may need to upgrade at least part of their electrical infrastructure to accommodate electric appliances. Navigant evaluated economic projections assuming 0% and 50% of residential and commercial buildings would require electrical infrastructure upgrades.

[7] The total for core gas (residential, core commercial, core industrial, natural gas vehicles) is approximately the same volume as buildings (residential, core commercial, non-core commercial).

[8] Cumulative appliance costs represent the purchase, installation, and electric infrastructure upgrade costs for all appliances installed in SoCalGas territory over the 2018-2030 period.

[9] Consumer utility costs in each projection represent the annual operating cost for all residential and commercial appliances in SoCalGas territory in each year over the analysis period (2018-2030), including new and existing gas and electric appliances.

[10] Electric end-use loads with electric heat pump technologies show modest energy cost increases, whereas electric technologies using electric resistance elements show larger energy cost increases.

[11] Appliance and upgrade costs are annualized as building owners would incur the appliance purchase and upgrade cost once over the appliance's lifetime but experience utility bills on a recurring basis.

[12] These values represent the cumulative combined annual cost for GHG emissions reduction over the 2018-2030 period, including consumer annual utility cost for new and existing appliance and annualized appliance and upgrade costs for those installed since 2018. Values represent NPV assuming a 3% discount rate. Each RG and electrification option provides the same GHG emissions reductions in 2030, with some variation in earlier years due to assumptions of RG introduction timeline, grid emissions factors, and other factors.

in 2030. Using the RG cost assumptions provided for this analysis, the range of RG projections (\$46/mt CO2e-\$260/mt CO2e) are lower than the range of electrification projections (\$311/mt CO2e-\$602/mt CO2e). When annualized, the cost difference between the electrification projections is largely determined by the consumer annual utility cost rather than the cost of appliance purchase and infrastructure upgrades.

Conclusions and Recommendations

Based on RG supply availability at the costs assumed in this study, the research indicates that RG delivered to residential and commercial buildings could reach similar GHG emissions reduction targets in 2030 as appliance electrification. When comparing the cost-effectiveness of different GHG emissions reduction strategies, RG scenarios have comparable or lower costs to electrification scenarios when considering the range of possible RG and electricity rate projections, and uncertainties around appliance purchase, installation, and upgrade cost estimates.

The study concludes that RG is worth further consideration as part of the low-carbon buildings strategy, including in-state RG resources, out-of-state RG resources, and incremental energy efficiency. Given the uncertainties in assumptions for RG and electrification projections, further research is necessary to determine the best pathways to achieve California's ambitious GHG goals.

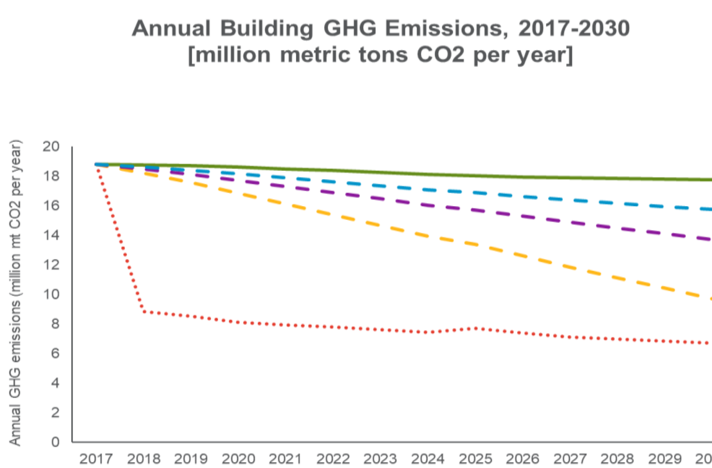
Navigant recommends SoCalGas and other stakeholders pursue the following activities to further investigate the potential for RG as a part of California's low-carbon future.

1. Include and further explore RG as an option to meet GHG emissions targets for buildings in 2030 and beyond, including developing a common set of assumptions with respect to RG resource and infrastructure availability and cost, and advancing RG policies.
2. Conduct further research to estimate how appliance electrification could affect electric utilities and consumers, particularly related to a common set of assumptions for appliance installation costs, and upgrade costs for building and grid infrastructure.
3. Evaluate opportunities to foster greater RG supply within California and with regional stakeholders.

Please see the full report to understand the assumptions and caveats underlying this analysis.

Key Figures

Figure 1. Annual GHG Emissions Reductions and Required RG Percentage Under Different Electrification Scenarios



Renewable Gas Scenario

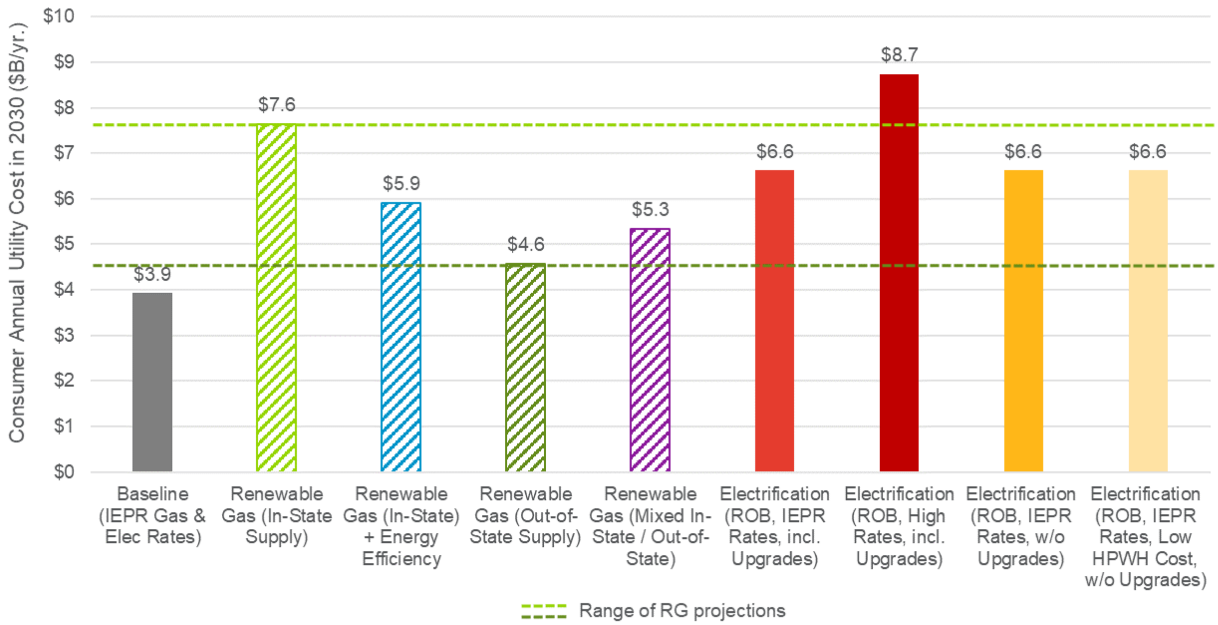
Proportion of RG required to achieve the same GHG emissions reductions by 2030

	As a % of buildings gas use	As a % of total gas throughput[1]
Baseline	0%	0%
Normal Replacement (25%)	12%	4%
Normal Replacement (50%)	23%	8%
Normal Replacement (100%)	46%	16%
Overnight Conversion	63%	22%

1. Calculated from % of buildings gas use, assuming that building consumption represents 34% of SoCalGas's total gas throughput in 2030

Source: Navigant analysis

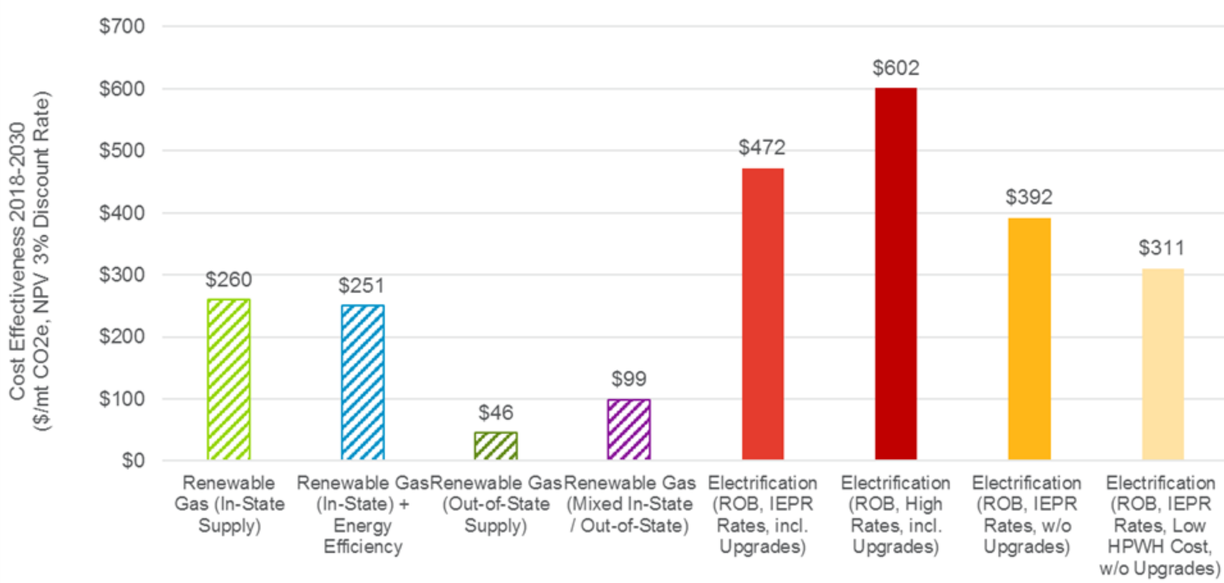
Figure 2. Consumer Annual Utility Cost in 2030 for RG and Electrification Projections (New and Existing Appliances)



Represents energy consumption costs for all appliances (new and existing).

Source: Navigant analysis

Figure 3. Cost-Effectiveness of GHG Emissions Reduction Strategies: 2018-2030 (Cumulative Cost and GHG Emissions Reduction with Normal Replacement 100% Scenario, NPV 3% Discount Rate)



Incremental costs include sum of energy consumption costs for all appliances (new and existing) and annualized appliance and upgrade cost (over 15 years) in 2030. Costs represent NPV with 3% discount rate.

Source: Navigant analysis