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Comments of Environmental Defense Fund

In addition to our letter, you may want to also review the attached report authored by Gridworks

Additional submitted attachment is included below.

CALIFORNIA'S GAS SYSTEM IN TRANSITION

EQUITABLE, AFFORDABLE, DECARBONIZED AND SMALLER

GRIDWORKS

GRIDWORKS

This report is the outcome of discussions facilitated by Gridworks between May and August 2019. The following organizations contributed invaluable perspective through those discussions:

California Environmental Justice Alliance (CEJA),
California Independent System Operator (CAISO),
City of Palo Alto,
Coalition of California Utility Employees (CUE),
Communities for a Better Environment (CBE),
Energy and Environmental Economics (E3),
Environmental Defense Fund (EDF),
Greenlining Institute,
Inclusive Economics,
IBEW Local 1245,
Natural Resources Defense Council (NRDC),
Pacific Gas and Electric Company (PG&E),
CPUC Public Advocates Office,
Tom Beach - Principal at Crossborder Energy, and
The Utility Reform Network (TURN)

This report draws on the insights gained through those discussions, but it is the sole responsibility of Gridworks and does not necessarily reflect the views of any individual participant.

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CALIFORNIA'S GAS SYSTEM IN TRANSITION: EQUITABLE, AFFORDABLE, DECARBONIZED AND SMALLER

EXECUTIVE SUMMARY

California's energy system is undergoing a period of profound change. The state has committed to 100% clean electricity, a doubling of energy efficiency, widespread transportation electrification, and a carbon neutral economy by 2045. Given the state's adopted decarbonization objectives and air quality policies, it should come as no surprise that changes to California's gas distribution system will occur as well. The volume of gas flowing through California's gas delivery system (gas "throughput") will decline dramatically over time in response to state and local policies. The pressing question for California is how we can manage this transition to minimize societal costs and unfair burdens on the remaining gas customers, while also ensuring greenhouse gas (GHG) emission reductions, air quality improvements, and equitable outcomes among California's communities.

THE CHALLENGE

According to an analysis presented to the California Energy Commission (CEC) by the consulting firm Energy and Environmental Economics, Inc. (E3), the lowest societal cost path to reducing California's GHG emissions includes high levels of building electrification supplied from a decarbonized electric sector. For the state as a whole, this strategy is about $20 billion less expensive *per year* by 2050 than a scenario that relies on using various forms of non-fossil gas such as hydrogen and synthetic gas in buildings.[1] Looking only at the total societal costs, however, omits a critical fact: the last customers remaining on the gas system could face unreasonably high rates and potential safety issues. These groups may well be those among us who are least able to afford high rates and least able to finance the new appliances needed to convert to electricity.

Change is already on its way. Under existing laws and policies, fossil gas-fired electricity generation will be largely replaced by renewable generation, along with various forms of energy storage, demand response, energy efficiency, and other GHG-free alternatives, as California looks to meet the 100% clean electricity target laid out in Senate Bill (SB) 100.[2] Buildings are also starting on the path toward decarbonization, which includes using electricity rather than fossil gas for residential and commercial space and water heating, cooking, and clothes drying,[3] in response to state policies reflected in SB 1477[4] and Assembly Bill (AB) 3232.[5] Local governments are also indicating a preference for all-electric buildings, citing reduced GHG emissions needed to meet local climate policies, as well as lower construction costs, reduced earthquake hazards, and other non-climate related reasons.[6] E3's draft study results presented to the CEC show reductions in gas demand in every scenario considered. According to E3's presentation:

> *Even under a scenario with no building electrification, residential gas use will decline 25% by 2050 due to energy efficiency alone. Widespread electrification could result in residential gas throughput reductions of over 90% by 2050.*[7]

The simple fact is that meeting California's GHG reduction goals, a statewide priority and absolute necessity to combat climate change, inevitably means a substantial decline in gas throughput in the state.

At the same time that gas demand is projected to decline over time, the costs of operating a safe and reliable gas delivery system in California have been increasing. Southern California Gas Company (SoCalGas) has a pending general rate case awaiting decision by the California Public Utilities Commission (CPUC) that seeks a 42% nominal dollar increase in its overall gas revenue requirement by 2022, as compared to 2018.[8] Pacific Gas and Electric (PG&E) recently received approval for a cumulative 21.8% increase to its gas transmission and storage revenue requirements by 2022, as compared to 2018,[9] and has a pending gas distribution revenue requirement increase request of 26.6% for the same period.[10] These expenditures represent a continuation and expansion of recent increases to cover the cost of other long-term pipeline safety enhancements required in the wake of the 2010 San Bruno pipeline explosion, and also incorporate

1 E3, "Draft Results: Future of Natural Gas Distribution in California," presented at the California Energy Commission staff workshop on June 6, 2019, slide 17. https://ww2.energy.ca.gov/research/notices/2019-06-06_workshop/2019-06-06_Future_of_Gas_Distribution.pdf

2 Chapter 312, Statutes of 2018, SB 100 (DeLeon).

3 Building Decarbonization Roadmap, http://www.buildingdecarb.org/resources/a-roadmap-to-decarbonize-californias-buildings.

4 Chapter 373, Statutes of 2018, AB 3232 (Friedman).

5 Chapter 378, Statutes of 2018, SB 1477 (Stern).

6 See, "Berkeley becomes first U.S. city to ban natural gas in new homes," https://www.sfchronicle.com/bayarea/article/Berkeley-becomes-first-U-S-city-to-ban-natural-14102242.php.

7 E3, "Draft Results: Future of Natural Gas Distribution in California," presented at the California Energy Commission staff workshop on June 6, 2019, slide 16. https://ww2.energy.ca.gov/research/notices/2019-06-06_workshop/2019-06-06_Future_of_Gas_Distribution.pdf.

8 For information on 2020-2022 SoCalGas revenue requirements, see *Second Revised SoCalGas Direct Testimony of Jawaad A. Malik (Post-Test Year Ratemaking)*, April 6, 2018, page JAM-2. https://www.socalgas.com/regulatory/A17-10-008.shtml. For information on 2018-2019 SoCalGas revenue requirements, see 2019 General Rate Case, A.17-10-008, *Application of Southern California Gas Company*, page 1. https://www.socalgas.com/regulatory/A17-10-008.shtml.

9 CPUC Decision (D.) 19-09-025, Appendix C, Table 1 and Appendix E, Table 1. Pacific Gas and Electric Company Application 17-11-009.

10 For information on 2019-2022 PG&E revenue requirements, see Pacific Gas & Electric, 2020 General Rate Case, A.18-12-009, Exhibit 1 (PG&E-1), December 13, 2018, Chapter 2, Table 2-2, page 2-7. https://www.pge.com/en_US/about-pge/company-information/regulation/general-rate-case/materials.page. For information on 2018 PG&E revenue requirements, see CPUC D.17-05-013, Appendix A, Table 1 and Table 6. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M186/K836/186836115.pdf.

the gas storage field upgrades mandated following the Aliso Canyon methane leak.

Since most of the capital and ongoing maintenance costs of the gas delivery system do not vary much with changes in the volume of gas consumed, a decline in gas demand will typically lead directly to higher rates and potentially higher gas bills for those who continue to use gas if the gas delivery system footprint remains static.[11] And despite all this, gas utilities cannot respond by limiting expansion of the gas delivery system, due to the obligation to serve any customer interested in receiving gas service at the authorized rates.

As gas rates and bills increase, consumers able to electrify their buildings are more likely to do so and leave the gas system, further shrinking the customer base and escalating gas rates for the remaining customers. Without active planning and management, the combination of reduced gas usage, increased costs, and a declining customer base will result in exponentially higher gas rates, along with a disproportionate burden on customers unable to afford to implement electrified technologies. Given that about 25% of customers already face issues with energy insecurity,[12] this additional burden is likely to lead to more disconnections and risks to human health if the transition away from fossil gas does not minimize costs and include protections for equity, while balancing the need to retain jobs.

> *California's current trajectory could lead to residential gas rates increasing from about $1.50 per therm today to as much as $19 per therm by 2050 under what is otherwise the societal least cost scenario.*

Letting such a trend develop and continue without thoughtful planning is simply unacceptable.

But more than gas rates are at stake. California has an opportunity to demonstrate how to reduce GHG and criteria pollutant emissions from burning fossil gas while minimizing costs for all of California's communities, as well as for society as a whole. The State also has the opportunity to demonstrate how large changes in an industry can be managed to avoid and minimize impacts on gas industry workers and disadvantaged communities.

This will be a big challenge.

THE MOST PRUDENT PATH FORWARD

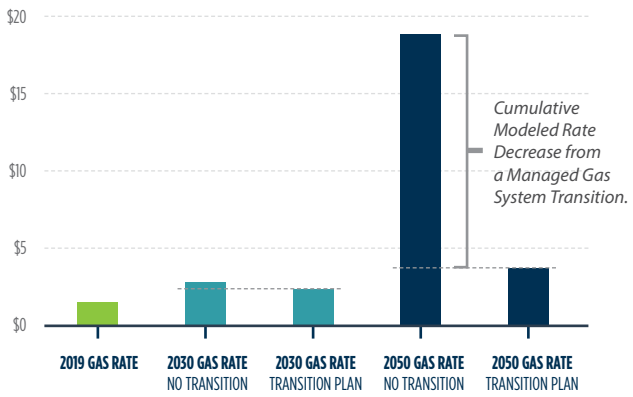
California needs to acknowledge these emerging trends and begin formulating a gas system transition plan. Prudent long-term planning and management of the gas transition will allow us to minimize and stabilize rate increases. The consequences of failing to do so would be detrimental for California's economy, causing energy cost inflation, industry destabilization, job loss, and significant hardship for the state's working families.

> *There are two paths available to California: a smart, managed path that maximizes benefits and minimizes costs for everyone, or an uncontrolled path that is reactive and costly.*

The reactive path is most likely to hurt those least likely to afford the transition: low-income residents. The smart, managed path must consider equity and protect customers from unaffordable gas bills by enabling them to electrify. Figure ES1 shows the cumulative impact that a smart, managed path can have on gas rates by 2050. In order to achieve this impact, California must start planning the gas system transition now

FIGURE ES1. *2050 Gas Rate Reductions Resulting from Proposed Solutions*

Source: E3



RECOMMENDATIONS

To achieve the managed path, policy-makers should consider the following recommendations:

1) Initiate **interagency, integrated long-term planning** for gas demand, infrastructure, and the transition of the delivery system. This long-term planning should include:
   - The institution of a **California Gas System Transition Plan**, which should be updated at least every three years;
   - The development of **improved gas demand forecasting analysis**, including consideration of building electrification that will increasingly occur due to individual consumer economics;

11 In the simplest terms, the cost of gas delivery (apart from the cost of the gas commodity itself) can be thought of as the utility's CPUC-approved cost of providing the service (the revenue requirement) divided by total system deliveries (throughput). Cost allocation among classes of customers and rate design policies complicate this simple case considerably, but the basic observation that the average rate equals the revenue requirement divided by the volumes delivered remains valid.

12 The Utility Reform Network (TURN), 2018, *Living Without Power: Health Impacts of Utility Shutoffs in California.*

- A statewide **assessment of existing gas infrastructure, options for infrastructure contraction and other cost reductions**, and identification of customers that have limited options for electrification;
- An initial phase with **pilot projects** that target decommissioning segments of the gas distribution system and transitioning buildings within that segment to all-electric service, or downrating local transmission lines to distribution pressure. Pilot projects should look to maximize avoided gas delivery system investments and minimize the costs of conversion to all-electric homes;
- **An assessment of the technologies** that exist to electrify residential, commercial and industrial buildings with a focus on gaps in available technologies; and
- An analysis of **financial tools and funding** that can be used to ease the transition away from fossil gas for low-income customers.

2) Consider requiring **all new residential and commercial construction to be all-electric** as quickly as possible, to mitigate future stranded gas infrastructure costs and to avoid committing to decades of future GHG emissions from gas combustion in buildings. Consider elimination of gas line extension allowances as a first step in that direction.

3) Identify **alternatives to significant new investments in the gas delivery system**, not otherwise needed to maintain system safety and reliability, such as electrifying neighborhoods to avoid replacing aging gas infrastructure or downrating local transmission lines to distribution by reducing the pressure as a means of reducing future maintenance costs.

4) Anticipate and **organize a just transition for the gas delivery system workforce** and any corresponding support services, such as customer service center staff and "call before you dig" workers.

5) Develop a **comprehensive strategy to ensure low-income and disadvantaged communities are empowered** through, benefit from, and are not left behind in the transition. This should include:
   - **Producing a study on the barriers preventing low-income customers from transitioning to all-electric buildings and residences**, conducted and completed by the CEC with input from the public and other relevant state agencies, with a focus on rental, multi-family, and existing homes. The CEC should provide recommendations on ways to address these barriers and initiate pilot projects designed to determine the best ways to reduce these barriers;
   - Conducting **meaningful engagement with and involvement of low-income and disadvantaged communities** throughout the gas transition. Meaningful engagement, at a minimum, includes outreach and education in multiple languages and coordination with community-based organizations;
   - Designing **bill protections for all low-income customers**;
   - Developing **programs and resources to enable communities to electrify**, and prioritizing resources to transition low-income and disadvantaged communities;
   - Creating **a one-stop shop for low-income customers** to allow them to pair the transition to electric technologies with other programs including energy efficiency, weatherization, and solar and storage installation; and
   - Ensuring **protections for renters** to prevent displacement, including rent stabilization and just-cause eviction protections.

6) **Clarify that a gas utility's "obligation to serve" could be met with alternative fuels** when doing so would avoid significant future investments in the gas system, reducing costs for all gas customers.

7) **Consider aligning financial recovery of new gas infrastructure investments with the time horizons determined in the integrated long-term gas infrastructure plan,** and adjust depreciation schedules for existing assets to better reflect actual "useful life" in light of changes resulting from California's decarbonization goals. **Consider securitization to mitigate the upfront rate impacts** of faster depreciation schedules and ultimate decommissioning costs. These financial tools should include protections that ensure that the bills of low-income customers will not increase.

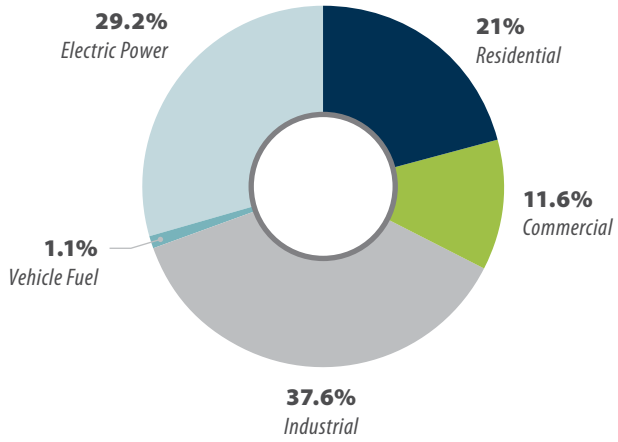
8) Consider **ratemaking adjustments** such as the following to cushion the impact of the transition on customers, particularly low-income customers:
   a) Consider **modifying the current cost allocation for the gas distribution system** to better reflect changes in users and usage patterns, mitigating some residential customer rate increases. Unless this is paired with efforts to reduce gas system costs, however, changes to cost allocation merely transfer the pain from one group of customers to another;
   b) Explore **minimum bills or fixed charges** for non-low-income customers who desire gas service, and for the 5-10% of residential premises that are vacant at any point in time and thus not paying anything toward the cost of staying connected. Alternatively, consider segmenting the residential class into full- and partial-requirements gas customers; and
   c) **Consider offering financial tools** such as pooled public funds, on-bill financing, and an increased CARE rate discount to **low-income customers to enable access to affordable energy services** throughout the gas transition.

9) **Explore external funding sources to recover gas transition costs** from sources beyond gas utility customers, such as the electric customers who benefit from increased electric load and taxpayers more broadly.

BACKGROUND ON CALIFORNIA'S GAS SYSTEM AND DECLINING THROUGHPUT

In 2016, gas deliveries in California totaled 2.1 trillion cubic feet, or an average of about 5.8 billion cubic feet (Bcf) per day, a level that has remained fairly consistent for the last decade. Usage peaks in the winter with greater residential and commercial space heating demands and also to some extent in the summer when more gas-fired electric generation is needed to meet air conditioning needs. It typically declines in the spring and fall. Gas usage is roughly split into thirds among residential and small commercial (core) users, electricity generation, and industrial uses (Figure 1).[13] However, core customers pay a much larger share of the utility revenue requirement, due to the fact that they are the primary users of the gas distribution system.

FIGURE 1. *2017 Natural Gas Demand by Sector*



The California gas utilities' combined net investment in the gas delivery system (rate base) totals between $15 and $20 billion dollars, and is continuing to grow.

Focusing in on PG&E, in 2019, that utility's gas system served about 15 million people across a 70,000 square mile service area in northern and central California. Nearly 80,000 miles of gas pipelines delivered 741 Bcf of gas, which equates to about 2 Bcf per day. In 2017, PG&E's residential and small commercial customers used about 38% of gas system throughput, but they provided around 80% of PG&E's gas revenues. Electric generation used 33% of gas throughput but contributed just 5% of revenues. These proportions again reflect the fact that virtually all residential customers are served off the extensive lower pressure distribution system, while most electric generators and many industrial customers are served directly from high-pressure transmission lines and do not use or pay for the distribution system.

While the gas system currently serves a large majority of residential and commercial space and water heating needs in California, that picture is beginning to change. For most new construction, all-electric homes are less expensive today when considering the avoided cost of gas mains, services, and meters not needed in all-electric neighborhoods.[14] Further, electrification measures can be cost-effective for existing homes in most parts of the state when:

1. Switching away from propane or heating oil,[15]
2. Replacing both a furnace and an air conditioner simultaneously,[16]
3. Bundling rooftop solar, demand response or load shifting programs, and/or time varying rates with electrification.[17]

Widespread residential electrification could threaten California's gas delivery systems with the beginning of an industry "death spiral," in which rate increases drive more customers to exit the system via electrification or other alternatives, leading to further rate increases to make up the lost revenue, and so on (Figure 2).

While state policy goals imply reducing or even eliminating the use of fossil gas in California by 2050, the gas delivery system can continue to play a useful role in supporting the decarbonization of end-uses that cannot electrify by supplying them with biomethane, hydrogen produced using renewable electricity (also called "green hydrogen"), and synthetic gas (SG) produced from green hydrogen and captured carbon dioxide. These fuels are collectively referred to as Renewable Gas (RG) in this report.

Although it has been suggested that building decarbonization could occur solely through the substitution of RG for fossil gas in the pipeline for residential and commercial applications, this appears unlikely given the limited supply of biomethane[18] and the very high current and projected future costs of hydrogen and SG.[19] There will also be competing uses for the available supply of RG, including in transportation, in hard-to-electrify industries,

13 U.S. Energy Information Administration, Natural Gas Consumption by End Use, Accessed July 24, 2019, https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_SCA_a.htm

14 TRC, November 2016, *Palo Alto Electrification Final Report*, Prepared for the City of Palo Alto, Available at: https://www.cityofpaloalto.org/civicax/filebank/documents/55069.

15 Nadel, Steven, July 2018, *Energy Savings, Consumer Economics, and Greenhouse Gas Emissions Reductions from Replacing Oil and Program Furnaces, Boilers, and Water Heaters with Air Source Heat Pumps*, Report A1803, http://aceee.org/sites/default/files/publications/researchreports/a1803.pdf

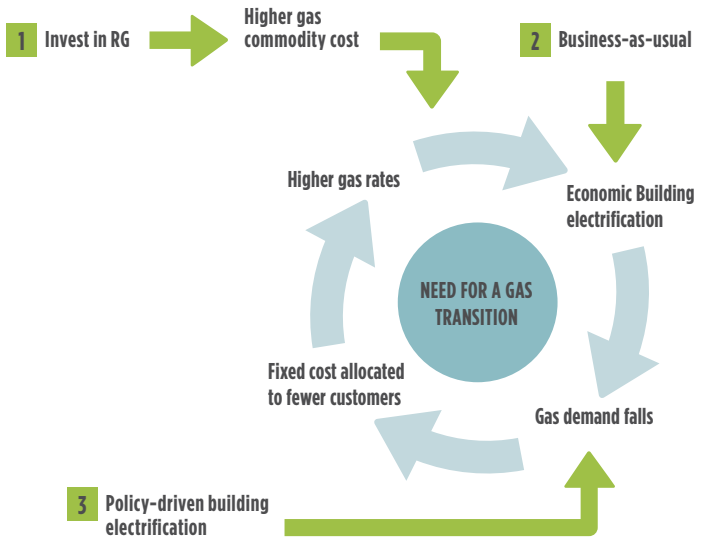
16 E3, April 2019, *Residential Building Electrification in California*, page 49.

17 Synapse Energy Economics, October 2018, *Decarbonization of Heating Energy Use in California Buildings*, page 36, https://www.synapse-energy.com/sites/default/files/Decarbonization-Heating-CA-Buildings-17-092-1.pdf.

18 Energy Future Initiative, May 2019, *Optionality, Flexibility, and Innovation: Pathways for Deep Decarbonization in California*, pages 179-180, 220-222.

19 E3, "Draft Results: Future of Natural Gas Distribution in California," presented at the California Energy Commission staff workshop on June 6, 2019, slides 8-14. https://ww2.energy.ca.gov/research/notices/2019-06-06_workshop/2019-06-06_Future_of_Gas_Distribution.pdf

FIGURE 2. *Spiraling From Increasing Gas Rates to Economic Electrification.*
Source: E3



and for electric generation needed to provide reliability services on the electric grid during cold winter nights when both solar and wind availability may be low.[20] Thus, this Report concludes that while RG may play a valuable role in decarbonizing California, its uptake is unlikely to reduce or forestall the need for a gas system transition plan.

GRIDWORKS' STAKEHOLDER ENGAGEMENT PROCESS

Gridworks convened an informed and diverse group of stakeholders to engage in a series of meetings to gather information, stimulate thought, and further the conversation about the future of the gas distribution system.[21] The intent was to understand the potential impacts of declining throughput on the gas distribution system, the gas workforce, public safety, and bill affordability and to consider what solutions might be available to mitigate or address those issues.

This report was prepared by Gridworks to summarize the results of those discussions and offer suggestions for follow-up actions by stakeholders and public officials. A draft of the report was distributed among the participants for comment, and changes were made accordingly. *The final report is the sole responsibility of Gridworks, however, and does not necessarily reflect the views of any individual participant on the various issues discussed herein.*

20 E3, June 2019, *Long-Run Resource Adequacy under Deep Decarbonization Pathways for California*, pp. 30-32. https://www.ethree.com/wp-content/uploads/2019/06/ E3_Long_Run_Resource_Adequacy_CA_Deep-Decarbonization_Final.pdf.
21 As part of this initiative, PG&E engaged the services of E3 to model the impacts of its future scenarios on that utility's gas revenue requirements and customers rates. The results were presented and discussed at a meeting of the group and are referenced in this report. This work was separate from, but represents an extension and further development of, E3's work for the CEC that was summarized in the presentation at the June 6, 2019 CEC workshop, as referenced in footnote 1, above.

PROBLEM STATEMENT

The stakeholder group reached consensus on the following problem statement and scope of work for this initiative:

Given that gas delivery system throughput is likely to decline over time as part of meeting California's GHG reduction goals at the lowest cost, how can the transition be designed and managed to avoid or at least mitigate any adverse impacts on:

a. *Rates and the affordability of gas service for the remaining gas customers;*
b. *The gas workforce;*
c. *Public and worker safety and gas system reliability;*
d. *Low-income and disadvantaged communities; and*
e. *The broader state economy.*

And, when should actions to avoid or mitigate adverse impacts be undertaken?

RATES AND THE AFFORDABILITY OF GAS SERVICE FOR THE REMAINING GAS CUSTOMERS

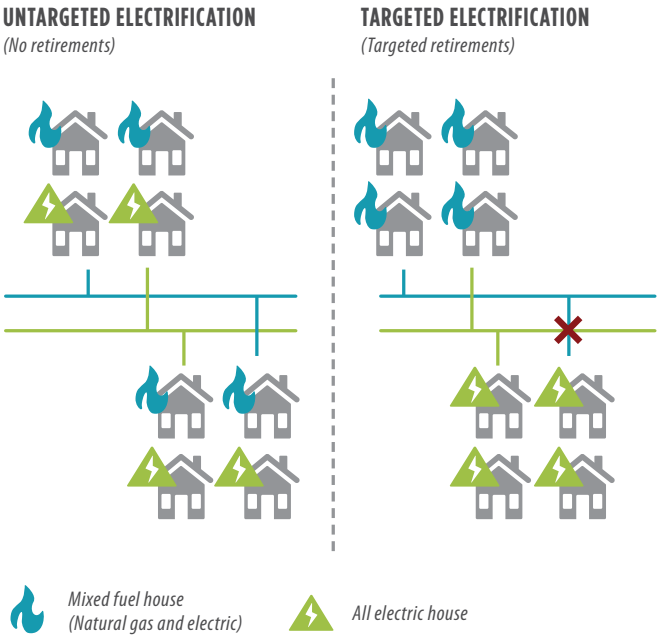
PG&E reports that most of its gas infrastructure investments today are for safety purposes (including replacement of facilities that have reached the end of their useful lives), which will increase rates regardless of future changes in gas throughput. There is very little new investment in system expansion or capacity upgrades, except for new customer connections and "work requested by others," such as reconfiguration of lines to accommodate freeway construction, high-speed rail, and other infrastructure projects. Other things remaining equal, a declining customer base will amplify rate increases for the remaining gas customers. These circumstances indicate that it will be especially important to find ways to reduce system costs as throughput declines, in order to avoid rapid rate escalation, but it will not necessarily be easy to find investments to defer. Furthermore, the obligation to serve is working at cross purposes with California's decarbonization objectives, requiring gas utilities to continue to expand the gas delivery system in response to consumer demand.

Widely dispersed building electrification in response to individual customer economics typically will not result in meaningful system cost reductions, as no new infrastructure or existing maintenance needs can be avoided. However, more systematic and planned neighborhood projects may permit some existing, preferably older, infrastructure to be retired (Figure 3). PG&E is currently in the process of mapping its system to determine locations where such infrastructure retirements may be possible. This opportunity is discussed further below, under "Infrastructure-Related Approaches to the Gas Transition."

THE GAS SYSTEM WORKFORCE

According to the most recent U.S. Economic Census (2012), there are just over 10,000 workers in gas distribution in California.[22] PG&E's gas system directly employs over 3,000 full-time employees, the majority of whom (56%) were hired in the last 10 years, and even more of whom are working in urban areas (76%).[23] SoCalGas employs about 4,000 people. SDG&E also has over 4,000 employees, but the number who work on gas specifically is not readily available.

FIGURE 3. *Approaches to Neighborhood-Level Electrification*
Source: E3



The employees of gas utilities are rightfully concerned about preserving their jobs. Their unions will not endorse any plan that would endanger those jobs. However, if there is a transition to using the gas distribution system less and replacing gas with electricity, it is important that the transition be designed and managed in collaboration with the unions to minimize the adverse impacts on gas utility employees. In addition, there will be significant work to safely decommission existing gas distribution and service lines once an area has been completely electrified. This work is likely to take some time even after the last therm in a neighborhood is consumed.

The fact that the gas transition will likely take place over a period of decades may ease the concerns of workers somewhat, particularly for those nearing retirement, but still creates some anxiety for younger employees who are looking for a long-term career and not just a job for the present day. As a dual-fuel utility, and given a multi-decade transition, PG&E could transfer its gas employees to the electrical side of the business without disruption to benefits; however, not all workers will want to transfer and certain specialized gas positions must remain filled to manage the gas system through the transition. Further, given that the gas delivery system transition will occur over several decades, a smaller workforce will still be needed over the longer term to safely maintain the system and provide reliable service.

Single-fuel utilities will be more challenged by workforce issues related to declining throughput, because there may not be another facet of the company's business to which a displaced gas employee could readily transfer. An employee who moves to another company, even with comparable pay, would lose pension, seniority and other benefits. This is an area of concern that will require further careful consideration, as discussed below under "Additional Policy and Regulatory Measures."

PUBLIC AND WORKER SAFETY AND GAS SYSTEM RELIABILITY

Regardless of the many other changes impacting the gas delivery system, it will continue to be absolutely necessary to maintain a high level of public and employee safety throughout the transition, as well as reliable service to the remaining gas customers. But if declining revenues and throughput place negative pressure on utility finances, there will be a strong incentive to cut back on workforce levels and needed safety investments in order to maintain earnings. Such an outcome must be avoided, as California has already experienced the terrible consequences of underinvestment in gas system safety.

Declining throughput need not imply declining reliability. As long as adequate pressures can be maintained across the system, reliable service may continue even at a reduced level of deliveries. In fact, reduced throughput may, in some situations, allow a segment of pipe to be operated at lower pressure, which may result in maintenance cost savings. Similarly, the decision to repair versus fully replace a section of line may be impacted by the time horizon over which the lines are expected to remain in service. These factors are discussed further below, under "Infrastructure-Related Approaches to the Gas Transition."

LOW-INCOME AND DISADVANTAGED COMMUNITIES

One third of California households do not have sufficient income to meet their basic costs of living[24] and energy insecurity affects approximately 25% of Californians today. In a survey of low-income California households conducted by The Utility Reform Network, more than 80% of respondents felt that their utility bills were too high, and 36% had cut back on buying food in order to pay their utility bill. In 2017, over 800,000 households had their electricity or gas service shut off by the investor-owned utilities, impacting 2.5 million

22 United States Census Bureau, *2012 Economic Census,* Natural Gas Distribution Number of Employees in California, NAICS code 221210, Accessed August 19, 2019 at https://www.census.gov/data/tables/2012/econ/census/retail-trade.html.
23 Statistics provided by the IBEW.

24 United Way, 2018, *Struggling to Stay Afloat: The Real Cost Measure in California 2018.*

people, many of whom were children.[25] These numbers are expected to increase as temperature fluctuations become more extreme with climate change.

For the purposes of this report, "low-income and disadvantaged communities" were not explicitly defined or identified; however, disadvantaged communities are generally considered to be the top 25% of census tracts that face disproportionate economic, health, and pollution burdens, census tracts have the highest 5% pollution burden, and tribal communities.[26] State agencies including the CPUC, CEC, and CARB rely on the CalEPA's CalEnviroScreen 3.0 tool to identify the most impacted census tracts and direct programmatic investment and activity to disadvantaged communities. The definition of "low-income" varies across programs. For example, state housing agencies rely on federal and state income limits to identify low-income communities.[27]

When thinking about how to ensure that low-income and disadvantaged communities and their residents are not left behind in the decarbonization transition, it is important to start by considering the general characteristics of these populations. According to the CEC's *Low-Income Barriers Study:*

- 33 percent of California households are classified as low-income, according to the federal poverty guidelines;
- 70 percent of California's low-income population are renters;
- 47 percent live in multi-family housing;
- 54 percent speak a primary language other than English; and
- 64 percent identify as nonwhite.[28]

Many of these general characteristics translate into barriers that can inhibit the ability of households to decarbonize and respond to escalating gas rates. These barriers include lack of capital and credit, higher energy burden, inefficient homes, lack of home ownership, and language and outreach barriers. It should be noted that there are important distinctions within low-income groups that can drive different issues in need of different solutions. For example, renters in multi-unit dwellings versus renters of single-family homes versus homeowners. Additionally, it is possible to be a low-income individual or household, but not reside in a broader "low-income community" where mitigation programs might be targeted.

A primary issue affecting low-income and disadvantaged communities discussed in our stakeholder engagement was that the high upfront cost to convert to all-electric service may force low-income and otherwise vulnerable customers to remain on the gas distribution system and, as wealthier customers electrify and leave the gas system, those left behind would face ever-increasing gas rates. While it may prove cost-effective in the long-run for low-income customers to convert to electric technologies, many of these individuals simply do not have the upfront capital needed to capture the financial savings and other benefits of electrification. Additionally, the expected increases in the cost of gas service, even in the absence of significant electrification, would fall especially harshly on low-income consumers.

Disadvantaged communities are also disproportionately impacted by the criteria pollutants related to fossil fuel combustion - whether in power plants, industrial facilities, vehicle transportation, or even in homes, since indoor air quality suffers from the in-home combustion of gas for cooking and other end uses.[29] California is home to some of the worst air quality in the country with seven of the top-ten worst cities for ozone, six of the ten worst cities for year-round particulate pollution, and four of the top-ten worst cities for short-term particulate pollution.[30] No other state has as many polluted cities. Additionally, many parts of California are not attaining protective health standards for ground ozone and particulate matter.[31] NOx, which is emitted when gas is burned, is a precursor for both fine particulate matter and ground level ozone. Thus, reducing NOx from both electric generation and buildings is likely to be an important way for California to come into attainment with health protective standards.

At the neighborhood level, about half of California's gas power plants, including baseload, peaker, and cogeneration plants, are located in disadvantaged communities.[32] As the share of renewable-generated electricity increases and gas-fired electricity generation declines, closing these plants will have clear environmental benefits for the neighborhoods where they are located. For communities where gas plants stay open, however, the gas plants may be run intermittently to meet ramping or other grid-balancing needs and, as a result of increased start-stop cycles, short-term localized pollution could increase even as statewide air quality improves.[33, 34]

25 The Utility Reform Network (TURN), 2018, *Living Without Power: Health Impacts of Utility Shutoffs in California.*

26 See https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf (describing methodology for identifying disadvantaged communities).

27 See California Department of Housing and Community Development State Income Limits for 2019, http://www.hcd.ca.gov/grants-funding/income-limits/state-and-federal-income-limits/docs/Income-Limits-2019.pdf.

28 California Energy Commission, December 2016, *Low-Income Barriers Study, Part A: Overcoming Barriers to Energy Efficiency and Renewables for Low-Income Customers and Small Business Contracting Opportunities in Disadvantaged Communities*, page 12.

29 See, e.g., U.S. EPA, Sources of Combustion Products: An Introduction to Indoor Air Quality, https://www.epa.gov/indoor-air-quality-iaq/sources-combustion-products-introduction-indoor-air-quality; Wendee Nicole, Cooking Up Indoor Air Pollution: Emissions from Natural Gas Stoves, 122 Envtl. Health Perspectives (Jan. 1, 2014), https://doi.org/10.1289/ehp.122-A27.

30 American Lung Association, State of the Air 2017, http://www.lung.org/our-initiatives/healthy-air/sota/key-findings/.

31 CARB, Air Quality Standards, https://ww3.arb.ca.gov/research/aaqs/aaqs2.pdf.

32 Physicians, Scientists, and Engineers for Healthy Energy, April 2017, *Natural gas power plants in California's disadvantaged communities*, https://www.psehealthyenergy.org/wp-content/uploads/2017/04/CA.EJ_.Gas_.Plants.pdf.

33 Energy Future Initiative, May 2019, Optionality, *Flexibility, and Innovation: Pathways for Deep Decarbonization in California*, page 52.

34 Aspen Environmental Group, July 2016, Senate Bill 350 Study Volume IX: Environmental Study, prepared for the California ISO, page 100.

THE BROADER STATE ECONOMY

Perhaps the most important macroeconomic concern in the context of decarbonizing the California economy is to achieve the necessary GHG reductions at the lowest overall cost. In a June 2018 report to the CEC, E3 concluded that:

> . . . the High Electrification scenario, . . . is one of the lower-cost, lower-risk mitigation scenarios. This scenario includes high levels of energy efficiency and conservation, renewable electricity, and electrification of buildings and transportation, with reliance on biomethane in the pipeline to serve mainly industrial end uses. The High Electrification scenario assumes a transition of the state's buildings from using natural gas to low-carbon electricity for heating demands.[35]

Likewise, E3's draft study results presented to the CEC on June 6, 2019, found that the high electrification scenario would cost the state *about $20 billion less per year* by 2050 than a scenario that relies on burning various forms of non-fossil gas such as hydrogen and synthetic gas in buildings, using a conservative estimate of the future cost of those alternative fuels. Even in an "optimistic" scenario that assumed aggressively lower-cost hydrogen and SG in the future, the high electrification scenario would still cost $6 billion less per year.[36] This cost quantification does not include the significant value of the health benefits that result from a reduction in criteria pollutants both outdoors and indoors due to electrification. Inclusion of these benefits would make the high electrification scenario even more beneficial.

However, as E3's work for the CEC also indicates, high levels of building electrification could create equity issues within California's broader economy.[37] This paper explores that inherent tension and endeavors to offer near- and medium-term recommendations for how to mitigate them.

FUTURE GAS THROUGHPUT AND RATE SCENARIOS

During the transition away from fossil gas, the gas delivery system will still exist to support some amount of electric generation, high-heat industrial uses, and dual-fuel homes and businesses for customers that continue to use both gas and electricity.[38]

This initiative leveraged E3's PATHWAYS model to look at several future GHG reduction scenarios as they relate to building electrification, renewable gas use, transportation electrification, and relative economy-wide costs, as described in the accompanying table. E3 also developed a gas utility revenue requirement tool to estimate PG&E gas rates though 2050 under the different scenarios.[39]

35 E3, June 2018, Deep Decarbonization in a High Renewables Future, page 3. https://ww2.energy.ca.gov/2018publications/CEC-500-2018-012/CEC-500-2018-012.pdf
36 E3, "Draft Results: Future of Natural Gas Distribution in California," presented at the California Energy Commission staff workshop on June 6, 2019, slide 17. https://ww2.energy.ca.gov/research/notices/2019-06-06_workshop/2019-06-06_Future_of_Gas_Distribution.pdf
37 *Ibid*, slide 23-24
38 *Ibid*, slide 24
39 As part of this initiative, PG&E engaged the services of E3 to model the impacts of its future scenarios on that utility's gas revenue requirements and customers rates. The results were presented and discussed at a meeting of the group and are referenced in this report. This work was separate from, but represents an extension and further development of, E3's work for the CEC that was summarized in the presentation at the June 6, 2019 CEC workshop, as referenced in footnote 1, above.

SCENARIO	ACHIEVES 2030 AND 2050 GHG REDUCTION GOALS	ELECTRIC HEAT PUMP TECHNOLOGY IN BUILDINGS	RENEWABLE GAS USE	TRANSPORTATION ELECTRIFICATION	2050 ANNUAL INCREMENTAL SOCIETAL COST RELATIVE TO REFERENCE SCENARIO	PG&E 2050 AVERAGE RESIDENTIAL GAS RATE PER THERM (2018 $)
Current Policy Reference Scenario[41]	NO	limited	limited	5M vehicles by 2030	N/A	$3
High Building Electrification (no transition strategy)	YES	50% of sales by 2030, 100% by 2040	Biomethane and liquid biofuels primarily serve industry and compressed gas trucks	High electrification of Light Duty Vehicles (LDV)	+$13B	$19
Slower Building Electrification	YES	20% of sales by 2030, 68% by 2050	All available biomethane and hydrogen blend	LDV plus medium- and heavy-duty trucks	+$18B	$5.70
No Building Electrification	YES	none	All biomethane, hydrogen blend, synthetic gas, and 56% fossil blend in pipeline	LDV and more zero emission trucks	Ranges from +$19B to +$32B depending on Renewable Gas cost assumed	$5.50

In the "Current Policy Reference" case, which does not meet the state's GHG goals but was presented as a baseline for comparison purposes, total gas system throughput declines by about a quarter by 2050, primarily due to reduced gas use in electric generation. In the "High Building Electrification" case, total gas use declines by about two-thirds. With "No Building Electrification," gas use still declines by over one-third by 2050.[40]

A few striking outcomes resulted from E3's modeling work:

- Meeting California's 2030 and 2050 GHG reduction goals via the "High Building Electrification" scenario has an economy-wide net incremental annual cost of about $13 billion (in 2018 dollars) by 2050 relative to the Current Policy Reference case.
- In contrast, the "No Building Electrification" case shows net incremental annual costs of over $32 billion due to the use of expensive hydrogen and SG, using E3's conservative assumptions regarding the cost of these fuels. With aggressively optimistic hydrogen and SG cost assumptions, the annual net incremental cost is still about $19 billion.
- Even under the "Current Policy Reference" scenario, gas rates are projected to double by 2050 to approximately $3/therm (in 2018 $) from around $1.50/therm today, as system throughput declines and capital is reinvested in the system to replace assets that have reached the end of their useful lives.[42]

With "No Building Electrification" (85% of residences remain dual-fuel), monthly bills increase for all customers, but they increase more for dual-fuel customers. This will tend to drive individual customers toward economic electrification.

> ***E3 estimates that in 2050 average electric rates would have to rise from less than $0.20/kWh today to $0.55/kWh (2018 $) in order to reach a break-even utility bill between all-electric and dual-fuel customers.***

With any average electricity rate below $0.55/kWh in 2050, all-electric homes would enjoy a lower total utility bill. Of course if electricity rates actually rose to that level there would be significant affordability challenges for all customers, economic dislocations, and a risk of mass shut-offs, especially for those that already face difficulties affording their bills and those that live in inefficient buildings.

The relationship between reductions in residential gas demand and gas rates is initially fairly linear (a 10% reduction in demand increases rates by about 10%), but if demand falls by more than 40% residential rates start to increase much more rapidly -- a quintessential train wreck unfolding in slow motion (Figure 4). These scenarios assume business-as-usual ratemaking with no implementation of gas transition strategies and no change in the gas commodity price relative to the Reference case.

The very high gas rates seen in E3's "High Building Electrification" scenario in the 2040's (which would only apply to the relatively few customers remaining on the gas system) became the key focus for scoping out a potential gas transition strategy. Such a strategy should seek to decrease system costs relative to the current trajectory for gas delivery system spending, while increasing revenues to avoid stranded gas system costs. E3 determined that if the gas rates calculated under the Current Policy Reference scenario were held constant (i.e., lower) under the "High Building Electrification" scenario, the lower throughput in the "High Building Electrification" case would produce a $26 billion NPV

40 E3, "Draft Results: Future of Natural Gas Distribution in California," presented at the California Energy Commission staff workshop on June 6, 2019, slide 16, https://ww2.energy.ca.gov/research/notices/2019-06-06_workshop/2019-06-06_Future_of_Gas_Distribution.pdf.

41 This scenario does not meet California's 2030 and 2050 GHG goals. It reflects the energy efficiency goals of Senate Bill (SB) 350, the CARB Short-Lived Climate Pollutant Strategy, the CARB Mobile Source Strategy, and other known policy commitments included in the 2017 Scoping Plan Update [CARB, 2017], as well as a "zero-carbon retail sales" interpretation of SB 100. Besides SB 100, additional updates from the 2018 published "Current Policy Scenario," based on recent trends and legal challenges, include assuming reduced progress in improving fuel economy of new vehicles and lowering vehicle miles traveled (VMT). Only very high efficiency natural gas furnaces and water heaters are installed by 2025.

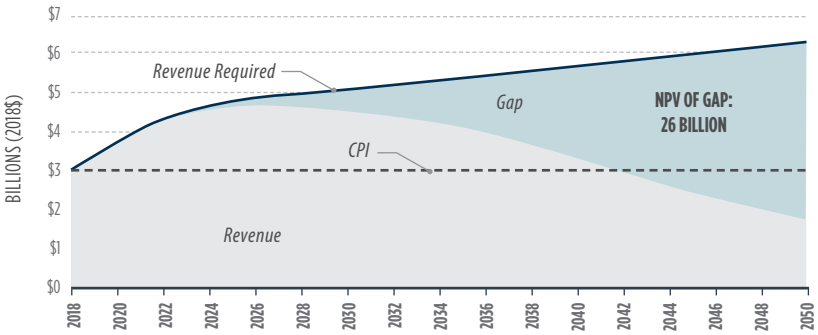
42 Only about $0.15 of this increase is attributable to assumed higher gas commodity costs.

FIGURE 4. *Impacts of Decline in Gas Demand on Rates*
Source: E3

gap between the revenues collected at those lower rates and the Reference case revenue requirement over the 2020 through 2050 period (Figure 5).

The potential solutions discussed below were developed with an eye toward beginning to reduce that gap. The magnitude of the challenge indicates clearly that a sense of urgency must be brought to this effort, and that every year of delay will only make the problem that much worse.

FIGURE 5. *Net Present Value of Revenue Gap Between Reference and High Electrification Scenarios with No Gas Transition*
Source: E3



GUIDING PRINCIPLES FOR SOLUTIONS

While there are many unknowns and uncertainties about the future of California's gas delivery systems over the next three decades, it is clear that change is coming and the impacts will only become more difficult to manage if action is delayed. Those impacts will occur at both the individual and societal levels, which means solutions will also need to consider distributional issues among groups of customers, as well as the big picture of what is best for the state as a whole. Our participants discussed the following guiding principles to target solutions that achieve shared goals:

- Manage the transition away from gas to support the state's GHG and criteria pollutant reduction goals and prevent emissions leakage.
- Avoid making gas service unaffordable or uneconomic for those who continue to use gas for essential energy services.
- Ensure that customers who move off gas have access to essential energy services at affordable costs.
- Provide a just transition for displaced gas workers.
- Improve conditions for disadvantaged communities in terms of affordability, resilience, air quality, safety, and access to new technologies.
- Avoid any increased gas safety risks and assure continued reliability of gas service.
- Mitigate any adverse economic impacts in terms of increasing the cost of living in California, favoring out-of-state electric generation, and/or other forms of emissions leakage.
- Maintain a financially viable gas utility during the transition. The utility still needs to maintain the system and is a critical partner in the transition, since it has all the data about the system, how to run it, and which parts might be targeted for retirement or prioritized for safety upgrades.

These principles shape the following infrastructure-related and financial approaches to transitioning the gas delivery system.

INFRASTRUCTURE-RELATED APPROACHES TO THE GAS TRANSITION

Given the likelihood that gas system throughput will be declining in future years, one of the key strategies needed to mitigate the resulting rate increases will be to reduce the level of additional investment into the system while still ensuring gas system safety and reliability. This will not be easy, but there are some promising avenues that merit careful consideration by public officials and the utilities themselves.

LEADERSHIP FROM CITIES AND COUNTIES

Local governments across California are pursuing reach codes to encourage electrification and maximize building efficiency. The City of Berkeley recently became the first city in the nation to ban the installation of natural gas lines to new single-family homes, townhomes, and small apartment buildings, beginning in 2020. In the City of Palo Alto, which operates a municipal gas and electricity utility, the city's building code has included an all-electric option since 2016 and heat pump water heater incentives have been available since 2017. The City of Palo Alto is also offering a pilot low-income heat pump space heating program using a grant from the Bay Area Air Quality Management District.

Further south, the City of Carlsbad in San Diego County adopted a water heating emissions reduction ordinance that will promote the installation of solar thermal and heat pump water heaters in homes. The County of Los Angeles, and the cities of Santa Monica, San Luis Obispo, San Jose, San Francisco and dozens of local governments across the state are considering options to accelerate the decarbonization of their buildings, beginning with ordinances covering new construction. In total, over 30 local governments are already pursuing or actively considering electric-preferred or all-electric buildings. Given the state's climate goals, more local governments may act to require all-electric buildings.

LIMIT FURTHER EXPANSION OF THE GAS SYSTEM

Every time a new customer is added to the gas system, the utility must expend new capital to install the physical connection of that customer to the existing system. In the case of in-fill development where a gas distribution system already exists, this may only involve the construction of a new service line and the installation of a new meter and regulator at the customer site. In the case of a new residential or commercial development, however, the existing system may have to be extended by some distance, and new mains installed throughout the newly-developed area. Once constructed, these facilities become a sunk cost to the system, and are typically depreciated over an expected service life of 50 to 60 years. Given that the state's carbon neutrality goal is within 30 years, the costs of these new connections could easily become "stranded" well before the end of their useful lives.[43]

Furthermore, work by both E3 and the California Codes and Standards Reach Codes Program, indicate that all-electric new construction is cost-effective for consumers in most instances due to the avoided gas infrastructure and plumbing costs.[44]

RECOMMENDATION | *Consider requiring all new residential and commercial construction to be all-electric as quickly as possible to mitigate future stranded gas infrastructure costs and to avoid committing to decades of future GHG emissions from gas combustion in buildings. Consider elimination of gas line extension allowances as a first step in that direction.*

Limiting future gas main and service extensions appears to be a logical first target for California public policy. This goal could be pursued through state or local mandate and/or through changes to the PUC's line extension policies to better reflect the useful life of new assets in light of California's decarbonization objectives and the associated forecasted utilization rates.[45] Notably, more than $150 million dollars of new utility capital could be saved every year by eliminating the gas line extension allowance.[46]

In addition to focusing on new buildings, there should be an emphasis on enabling customers who use alternative fuels such as propane and wood to electrify. These efforts should include education, outreach, and funding modeled after the outreach and education work done in the CPUC's San Joaquin Valley proceeding implementing AB 2672.[47]

Limitations on new gas connections should be paired with efforts to ensure affordable access to the electric grid. For existing buildings not yet connected to the electric grid, options might include deploying microgrids or increasing the current electric line extension allowance, among others. PG&E's electric tariffs provide an allowance of $2,154 per meter or new residential dwelling unit, while the comparable figure for Southern California Edison is $3,084. The increased electric load of an all-electric new home may justify a larger allowance for such dwellings.

43 Environmental Defense Fund, 2019, Managing the Transition: Proactive Solutions for Stranded Gas Asset Risk in California.
44 See: https://localenergycodes.com/ and https://www.ethree.com/wp-content/uploads/2019/04/ E3_Residential_Building_Electrification_in_California_April_2019.pdf
45 Any changes to the line extension rules must comply with the process established in Public Utilities Code Section 783.
46 PG&E's gas tariff Rules 15 and 16 provide a free allowance of $1,727 for a new home with gas space and water heating, a gas oven/range, and a gas dryer stub. For SoCalGas, under Rules 20 and 21, the allowance is $1,567 for a similarly equipped home, with an additional $1,066 available for a new home with gas air conditioning. The $150 million figure assumes that about 100,000 new homes are constructed per year in California.
47 Chapter 616, Statutes of 2014, AB 2672 (Perea).

MINIMIZE REINVESTMENT, TARGET RETIREMENTS

While safety and reliability must take precedence, the utilities should consider the state's long-term GHG reduction goals in deciding between shorter-term repair versus complete replacement of lines in need of upgrading, including non-pipeline alternatives. If the eventual phase-out of gas service is assumed, less costly repairs or alternative approaches (e.g., operating at lower pressure and down-rating pipelines) may be sufficient in the near- to medium term rather than full replacement of aging infrastructure.

RECOMMENDATION | ***Identify alternatives to significant new investments in the gas delivery system, not otherwise needed to maintain system safety and reliability.***

The utilities are currently considering the replacement of the more brittle types of Aldyl-A piping in their distribution systems over time.[48] Since the installation of Aldyl-A was generally concentrated in certain geographic clusters, it may be advisable to design pilots to convert neighborhoods with Aldyl-A piping to all-electric service, rather than replacing the existing gas system. The avoided costs of gas system replacement could be viewed as a pool of funds to convert to all-electric service. Of course, the decision to convert to all-electric rather than continue to reinvest in the gas distribution system depends in part upon the willingness of the impacted customers, and it may be necessary to address the gas utility's "obligation to serve" through legislation, as discussed further below.

Aldyl-A replacement is not the only opportunity of this nature. Any part of the distribution system that is in need of significant costly upgrades could be targeted for potential electrification as an alternative to sinking more capital into a gas system with declining usage. Likewise, declining consumption may reduce the pressure requirements in certain portions of the system, allowing for the downrating of local transmission lines to distribution lines and further potential cost avoidance. The CPUC should require the gas utilities to begin designing pilot projects that test various approaches to achieving such cost reductions. However, it should be noted that if an asset is decommissioned before the end of its depreciation schedule, the remaining cost of the asset would then be paid for by remaining gas customers.

Additionally, there are sometimes significant costs associated with decommissioning an asset, particularly if it needs to be removed rather than abandoned in place and/or if it is in an urban area. Future policy should determine how to appropriately allocate those costs without again burdening the remaining gas customers.

For illustrative purposes, E3 modeled a reduced system reinvestment scenario in which a combination of conversions to all-electric service and other capital cost reduction strategies reduce reinvestment in the gas distribution system by 50% beginning in 2030. This is a very aggressive assumption, and achieving such a reduction in capital reinvestment would require significant coordination among key policymakers and stakeholders and likely require legal and regulatory changes. This step reduced the $26 billion NPV gap from Figure 5 by $9 billion NPV relative to the Reference case (Figure 6), and lowered the projected 2050 residential gas rate from $19 per therm to about $13 per therm, a price level that still appears unsustainable (Figure 7).

FIGURE 6. *Net Present Value of Revenue Gap Between Reference and High Electrification, with 50% reduction in capital costs from retiring infrastructure*
Source: E3

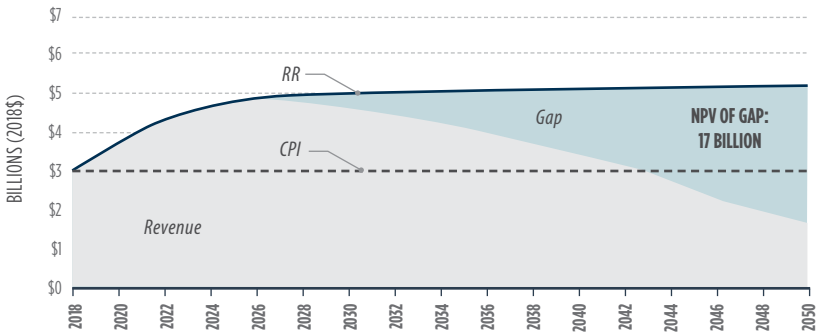
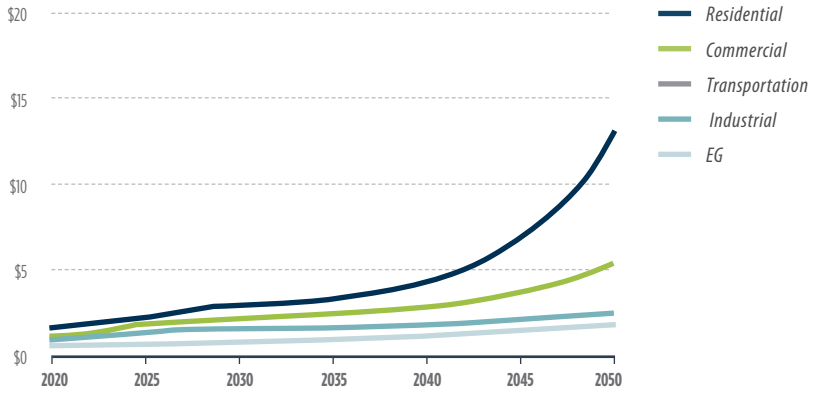


FIGURE 7. *Projected Gas Rates with Reduction in Gas System Expenditures*
Source: E3



48 For a description of the Aldyl-A issue see: Steven Haine, P.E, CPUC, "Hazard Analysis & Mitigation Report on Aldyl-A Polyethylene Gas Pipelines in California," 2014. https://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=8947.

FINANCIAL APPROACHES TO THE GAS TRANSITION

ADJUST DEPRECIATION SCHEDULES FOR GAS DELIVERY INFRASTRUCTURE

Ratemaking for the gas distribution system incorporates long depreciation lives for assets in the ground — often as long as 50 to 60 years. Historically, the depreciation schedules match the expected useful lives of these assets and spread costs out as long as possible to make the investments affordable for customers, and to apportion costs to those who benefit from the assets. These lengthy asset lives keep customer rates low in the near term, because only around 2% of an asset's costs are recovered in rates each year. But ratepayers also pay a rate of return and associated income taxes on the undepreciated value of these investments, so over the long term customers incur significant carrying costs as the price for extending the asset cost recovery timeline.

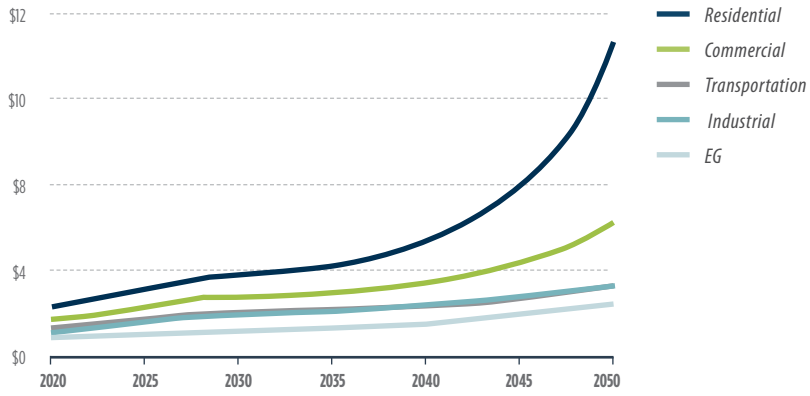
RECOMMENDATION | *Consider aligning financial recovery of new investments with the time horizons determined in the integrated long-term plan, and adjust depreciation schedules for existing assets to better reflect actual "useful life" in light of changes resulting from California's decarbonization goals.*

One method for addressing this situation would be to shorten the regulatory depreciation lives for gas assets, to reflect the expected decline in system use over time. Such changes should also recognize the amount of money needed to decommission the asset at the end of its useful life. This would increase rates in the near term, but save consumers the long-term return and taxes that they would otherwise pay if the assets were depreciated more slowly.

Such a shift would not necessarily be popular, since it would add to the existing increasing rate pressure due to the utilities' recent large investments in pipeline and gas storage field safety. Nonetheless, spreading the pain of potential stranded asset costs over a larger number of customers, before those customers begin leaving the system in large numbers, may be more equitable than forcing a reduced number of future customers that are unable to electrify to face even larger rate increases as system throughput declines over time. This solution should include bill-protections for low-income customers who would still experience elevated gas rates in the near-term.

E3's modeling estimated the impact of reducing the depreciation lives of PG&E's gas system assets by one-half, starting in the year 2020, combined with the reduction in distribution capital reinvestments discussed above. The analysis showed that rates would increase only slightly in 2030 as a result of such a policy shift, but would be dramatically lower in later years when there was lower gas consumption and fewer customers from whom to recover these costs. If reduced gas system expenditures are combined with accelerated depreciation, the projected $19 per therm residential gas rate in 2050 would be reduced to $11 per therm (Figure 8).

FIGURE 8. *Projected Gas Rates with 50% Reduction in Gas System Expenditures and Accelerated Depreciation*
Source: E3



SECURITIZATION OF GAS ASSETS EXPECTED TO BECOME UNDERUTILIZED

Securitization offers a financial technique for reducing the burden of potential future stranded asset costs for gas ratepayers.[49] With securitization legislation, utility costs are recovered through a bond financing that is secured by an irrevocable state pledge that the debt service will be recovered through a secure revenue stream, typically a dedicated rate component. Because the revenue stream is highly secure, such bond issuances usually achieve very high ratings and the lowest possible interest rates. Ratepayers benefit because the interest rate on the bonds is lower, often significantly, than the carrying costs of utility rate base.

RECOMMENDATION | *Consider securitization to mitigate the upfront rate impacts of faster depreciation schedules.*

When combined with accelerated depreciation, securitization of the accelerated portion of the asset cost recovery could partially mitigate the near-term rate impacts of the acceleration. Rather than continuing to pay the full rate of return on the utility's entire rate base, a portion of that rate base (potentially as much as 50% if depreciation lives were cut in half) would be bought down with bond proceeds, which ratepayers would pay off over time at the lowest possible interest rate. In other words, the utility's rate base would be reduced by the amount of the bond proceeds, lowering rates to offset to some degree the impact

49 For a more thorough discussion of securitization in this context, see Environmental Defense Fund, "Managing the Transition: Proactive Solutions for Stranded Gas Asset Risk in California," 2019. https://www.edf.org/sites/default/files/documents/Managing_the_Transition_new.pdf

of the faster capital recovery. The costs for ensuring the safety, reliability and management of end-of-life gas systems could also be included in the securitized amount, creating in essence a "gas system decommissioning trust fund."

It may also be possible to spread the cost of the bond payments even more broadly, by establishing a dedicated rate component in electric rates as well as gas rates. This has not been done in the past to our knowledge, but such a policy would recognize the benefits of higher demand for electricity as a result of electrification and decarbonization, which will likely have the effect of spreading electric system fixed costs over a broader sales base. Such an approach could help to arrest a potential death spiral for gas rates, while also allowing recovery of stranded gas system costs from customers who have left the gas system in whole or in part, and thus helped contribute to the stranding of gas system assets. The use of funds derived from outside the gas customer base is discussed further below.

CHANGES TO GAS COST ALLOCATION

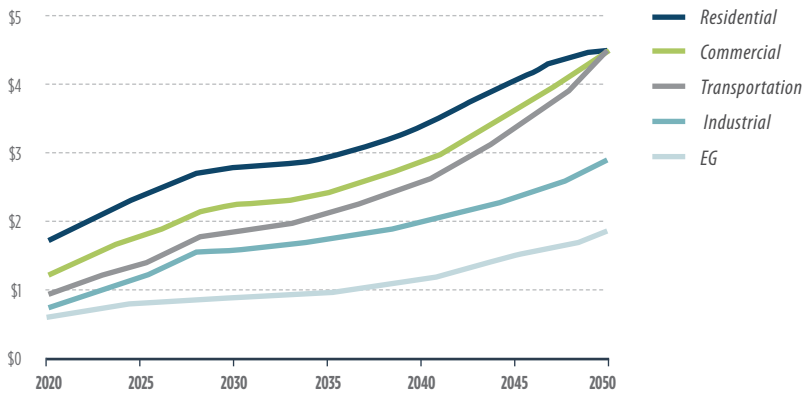
Current cost allocation policies for the gas utilities allocate distribution system costs by a measure of peak day demand on the system, which tends to assign the largest share of these costs to residential and small business customers, whose usage peaks in the winter and is not subject to curtailment under adverse weather conditions. The rationale for this approach is typically cost causation, in the sense that the system was designed to serve the peak loads of these customers, while larger customers may be subject to service interruption under the worst peak weather conditions. In practice, however, such service curtailments are quite rare.

As throughput on the gas delivery system declines, the utilities' ability to provide uninterrupted service to all customers regardless of weather conditions will only improve, perhaps substantially. This raises the question of whether cost allocation policy for gas distribution should evolve more in the direction of a usage-based allocation factor, as opposed to a peak-day factor. Such a policy would tend to soften the impact of increasing rates due to throughput decline on the residential class, with corresponding increases to the rates for larger commercial customers, who pay a smaller share of distribution costs today. Of course those larger gas customers will also be facing higher rates as throughput declines, so it is a zero sum game, because the total costs of operating the gas delivery system do not change very much. This is why changes to cost allocation must be paired with reductions in the total cost of operating the gas delivery system moving forward. Whether or not to make such a change will be a policy decision for the CPUC in its periodic gas cost allocation proceedings.

RECOMMENDATION | *Consider modifying the current cost allocation for gas distribution to better reflect evolving cost causation and service reliability, mitigating some residential customer rate increases.*

E3 modeled the impact of shifting from a peak-day to a usage-based distribution cost allocation for PG&E. When combined with reduced gas system expenditures and changes to asset depreciation schedules, the residential gas rate declined to $4.49/therm in 2050 (2018 $), with corresponding increases in rates for the larger distribution-level customers in the transportation and commercial sectors (Figure 9). It is important to acknowledge that $4.50/therm residential gas rates are still unsustainable. This would likely drive economic electrification and hardships for gas customers who cannot electrify.

FIGURE 9. *Projected Gas Rates with 50% Reduction in Gas System Expenditures, Accelerated Depreciation, and Change in Cost Allocation*
Source: E3



This discussion is limited to cost allocation changes that would impact only gas distribution rates. It is also possible, of course, to change cost allocation for the larger-diameter gas transmission pipelines that serve all gas customers, including large industrial and electric generation customers. Changes in the cost allocation for gas transmission would need to be carefully considered, as they are likely to have other consequences, such as raising electricity rates and possibly shifting gas-fired electric generation from in-state plants to out-of-state plants, raising greenhouse gas emission "leakage" concerns. Any such evaluation of a change in gas cost allocation should include protections for low-income customers.

MINIMUM BILL OR FIXED CHARGE FOR VERY SMALL GAS USERS

To date the CPUC and consumer advocates have generally been reluctant to impose significant minimum bills or fixed customer charges on residential gas customers due to efficiency and equity considerations. While these points may retain their validity for some time to come, some

customers who electrify their space and water heating end uses may continue to use small amounts of gas for cooking, pool and spa heating, fireplace inserts, and other "lifestyle" end uses, as opposed to the more essential end uses of space and water heating. If such a trend in fact develops, it may become more politically acceptable to impose higher minimum bills or fixed charges on very small, non-low-income gas customers in order to reduce the cost burden on those who continue to use gas for space and water heating, who may also be those least able to afford electrification. Additionally, at any given moment there are tens of thousands of residential premises that are unoccupied, and over the course of the year more than 10% are unoccupied for a month or more. Some are vacant for more than a year at a time. The owners of these premises are currently not contributing toward the fixed cost of their service connections.

Another alternative might be to segment the residential gas tariff into two classes — those who use gas for all the major end uses, including space and water heating, and those who use only modest amounts of gas as a matter of lifestyle choice. Imposing a higher minimum bill, a higher fixed charge, and/or lower baseline quantities on the latter group is unlikely to raise the same equity concerns as a change to the generally-applicable residential tariff.

RECOMMENDATION | *Explore Minimum Bills or Fixed Charges for non-low-income customers who desire gas service. Alternatively, consider segmenting the residential class into full- and partial-requirements gas customers.*

E3 modeled the impact of adopting a $15 per month fixed charge for gas service. The volumetric gas rate in 2050 would be reduced by about $0.70/therm (2018 $), but small users would see higher bills due to the addition of the fixed charge.

FINANCIAL ASSISTANCE FOR LOW-INCOME CUSTOMERS

One of the greatest equity concerns that arises in the context of declining use of the gas system is that economically disadvantaged customers could be "left behind" and remain dependent on increasingly expensive gas service due to an inability to afford the cost of new electric appliances or the electric panel upgrades that may be required in older homes. A pool of public funding should be developed to assist such customers in converting to all-electric service, using money from the Greenhouse Gas Reduction Fund as well as other sources, such as weatherization assistance funds, public health agencies, low-income housing assistance programs, and/or the air quality management districts. This funding should not come from gas utility customers, because it could further exacerbate gas affordability issues. On-bill financing should also be offered to assist low-income and disadvantaged customers with initial capital expenses.

Even if conversion funding is made available, there will likely be a residual group of gas-dependent customers who will require further help. For a set of unique historical reasons, the CARE discount for qualifying low income gas customers has remained at 20% for many years, while the discount for similarly-situated electric customers is currently set at 30-35%.[50] If gas rates in fact escalate dramatically in the future, an increase in the gas CARE discount may be necessary. Of course such an increase would translate into even higher rates for non-CARE gas customers, which could accelerate economic electrification for those customers financially able to convert. A larger CARE discount might also weaken the incentive for CARE customers themselves to convert. Whether the latter presents a real policy concern may depend on the extent of the resources and funding available to support conversion by low-income gas customers; all financial tools and available funds should be explored.

RECOMMENDATION | *Consider offering financial tools such as pooled public funds, on-bill financing, and an increased CARE rate discount to low-income customers to enable access to affordable energy services throughout the gas transition.*

An alternative might be a higher electric CARE rate discount, perhaps temporary, for those customers who do fully convert to electrification, but the viability of that option likely depends upon the level of financial support available to such customers for conversion. Higher electric baseline allowances that fully recognize the increased usage of all-electric homes is also an option worth exploring.

EXTERNAL FUNDING SOURCES

Even with a 50% reduction in gas distribution reinvestment, changes to asset depreciation schedules, and changes to the cost allocation methodology, residential gas rates will still be unsustainable in 2050 if extensive building electrification occurs on a large scale. E3 estimates that keeping gas affordable for PG&E customers alone will require an additional $426 million in external funds (i.e., money not collected from gas utility customers) starting in 2030, growing to $1 billion per year between 2041 and 2050 (a simple sum of $16 billion).

One possible component of such funding could be analogous to an "exit fee" for those leaving the system. Rather than imposing such a fee on the individual departing customer, which would discourage electrification, this approach would assess the exit fee on the overall customer base of the electric utility to whom the customer switches its gas end uses, in recognition of the benefits of increased electric load in lowering overall electric rate levels. Questions would have to be addressed as to what degree of electrification would be required to trigger the fee, because if only full electrification customers incurred the charge, such an approach could actually encourage customers to maintain minimal gas use (e.g., for cooking) and produce a counter-productive result. Still, the concept is one of many that may need to be considered in the future to help

50 Public Utilities Code Section 739.1(c)(1).

keep gas rates affordable for customers unable to electrify. It seems unlikely, however, that the electric sector could support the majority of this external funding mechanism if electric rates are to remain low enough to incentivize transportation and building electrification. Other taxpayer funded sources like the Greenhouse Gas Reduction Fund should also be considered.

RECOMMENDATION | *Explore external funding sources to recover gas transition costs from sources beyond gas utility customers, such as the electric customers who benefit from increased electric load and taxpayers more broadly.*

ADDITIONAL POLICY AND REGULATORY MEASURES

MORE ROBUST LONG-TERM STATE PLANNING FOR THE GAS SYSTEM

There is a troubling dearth of state planning and analysis with respect to the long-term future of California's gas system. On the electric side we have the Integrated Resource Planning (IRP) process at the CPUC, the Integrated Energy Policy Report (IEPR) and related long-term demand forecasting efforts at the CEC, and the Transmission Planning Process (TPP) at the CAISO, all of which are well-coordinated and share the resulting analysis and data. In sharp contrast, there is no regular forum anywhere in state government that routinely considers integrated long-term planning for the gas system, save for what is typically a single chapter in the IEPR. The CPUC considers gas planning issues episodically in rate cases and rulemakings as particular questions arise, but there is nothing resembling an IRP for the gas system. For disadvantaged and low-income communities, the CEC has completed a barriers analysis for solar and energy efficiency deployment, but no such analysis has been completed in relation to building decarbonization.

There is an urgent need for the state to develop a California Gas System Transition Plan, which should be updated at least every three years. The plan should include a statewide assessment of the existing gas infrastructure, options for infrastructure contraction and other cost reductions, and identification of customers that have limited options for electrification. There is also a compelling need for an analysis of financial tools and funding that can be used to ease the transition away from fossil gas for low-income customers.

The CEC, CPUC and CARB would all have roles to play in the development of such a plan, which need not be a single document but perhaps a coordinated set of documents from each agency, with consultation and feedback as occurs with the IRP/IEPR/TPP.

Some of the relevant tasks for CARB would include

coordination with overall statewide GHG emission reductions efforts and emission tracking, including those resulting from methane leakage.

From the CEC, there is a need for an independent long-term gas demand forecasting effort, separate from the industry-sponsored California Gas Report, which has yet to incorporate the coming reductions in gas system throughput due to its reliance on existing laws and regulations for planning purposes. This forecast should include consideration of the impacts of building electrification that will increasingly occur as a result of individual economics. The CEC should also conduct a study of the barriers to electrification for low-income and disadvantaged communities, with a focus on rental, multi-family, and existing homes; provide recommendations on ways to address these barriers; and initiate pilot projects designed to determine the best ways of reducing these barriers.

The CEC should of course continue to update the state's building code. In addition, it should assess the technologies that exist to electrify residential, commercial, and industrial facilities, with a focus on gaps in available technologies; and assess the likely costs, availability, and environmental impacts of biomethane, green hydrogen, and synthetic gas derived from renewable sources, as substitutes for and/or complements to fossil gas over time. Finally, the CEC should be well-positioned to coordinate building (and transportation) electrification efforts and assess their likely impacts on electric supply and demand, as well as the gas system itself. All of this work could be considered as a replacement or enhancement of the gas chapter of the IEPR.

The CPUC will be primarily responsible for gas system financial planning, including gas utility investment policies and their trajectory, as well as system safety records and assessments. It will continue to set rates for gas customers and assess utility financial health, and consider issues such as accelerated depreciation and securitization. But the CPUC must begin to develop a longer-term view of the gas system and analyze the impact on customers of the transition. The CPUC should require the development of pilot projects that target decommissioning segments of the gas distribution grid and transitioning buildings within that segment to all-electric service, as well as the potential for downrating local transmission lines to distribution pressure. Pilot projects should look to maximize avoided gas delivery system investments and minimize the costs of conversion to all-electric homes. At the outset, the CPUC must develop a list of priority issues for consideration in gas utility rate cases, including closer examination of gas distribution system planning and potential opportunities for conversions of gas customers to electric service.

In addition, the very detailed Residential Appliance Saturation Survey (RASS) that is now conducted every decade should be performed every four years. The survey provides in-depth insight into the type and age of appliances in a sample of residential premises. Given the importance of understanding the changing energy dynamics of existing homes, this study is absolutely needed on a more frequent basis to inform forecasting and policy making.

RECOMMENDATION | *Initiate interagency, integrated long-term planning for gas demand, infrastructure, and the transition of the delivery system.*

There are data gaps and shortcomings in analytical capabilities that will need to be addressed in the relatively near term. We need better data on the costs to electrify homes to identify and evaluate opportunities for different customer segments. We need better planning tools, such as longer-term rate impact models and more precise gas system infrastructure maps that overlay various system characteristics (age and condition of pipes, leakage rates, presence of Aldyl-A pipe, location of hard-to-electrify industrial customers) that can be used to identify preferred locations for larger scale electrification efforts. PG&E has made real progress in some of these areas in the course of this project, but the CPUC needs to come up to speed on these tools and develop its own internal capabilities, as it has done on the electric side.

The other gas utilities should follow PG&E's lead and begin an effort to "map" or inventory their distribution systems to identify those areas where conversion to all-electric service would have the greatest impact in terms of reducing future capital investment in gas infrastructure. Such a system mapping exercise could become a key element of a new statewide gas distribution system planning effort, to parallel the distribution resource planning currently underway for the electric utilities.

ADDRESS THE UTILITY "OBLIGATION TO SERVE" THROUGH LEGISLATION

As discussed above, there may be a need for legislative clarification of the utility's obligation to serve in the context of potential building electrification efforts.

A planned and coordinated approach to electrification could convert an entire neighborhood to all-electric service in the same time frame, avoiding investment in assets that might later prove to be underutilized or stranded entirely. But it will be exceedingly challenging to accomplish such coordinated electrification if unanimous agreement by all impacted customers is required.

RECOMMENDATION | *Clarify that a gas utility's "obligation to serve" could be met with alternative fuels when doing so would avoid significant future investments in the gas system, reducing costs for all gas customers.*

Does the utility's obligation to serve imply that an existing gas customer may be entitled to continued gas service in perpetuity, regardless of the costs and consequences to all gas customers? Or are there equivalent energy services that could be considered appropriate substitutions? This

legal question will certainly arise and could be addressed preemptively through clarifying legislation. Financial incentives for conversion will help to ease the path, but the threat of a single customer or small group of objectors holding out or demanding excessive compensation is real and undeniable. While it is not the purpose of this paper to suggest any particular language, perhaps the legislation could qualify the obligation by allowing for the provision of propane service as an alternative to continued pipeline fossil gas consumption, or provide that an offer of reasonable compensation for the cost of conversion to electricity triggers an end to the obligation.

PROVIDE A JUST TRANSITION FOR THE GAS WORKFORCE

The transition of the gas system will not happen overnight, or even over a single decade, but it is imperative that the existing skilled workforce in the industry be thoroughly informed and consulted regarding the changes that will be occurring. A well-planned and executed transition strategy will be necessary. The plan developed by PG&E around the expected closure of the Diablo Canyon nuclear plant may serve as a model in this regard.

RECOMMENDATION | *Anticipate and organize a just transition for the gas delivery system workforce and any corresponding support services.*

As fossil gas used for industrial, commercial, residential, and electric generation purposes declines, we must nevertheless keep the gas transmission and distribution systems operating safely for as long as they are used. California will continue to require an adequately sized and trained utility workforce, even as the workforce's future job prospects and security diminishes. California must keep highly skilled people working until the end, incent the senior workers to retire at the right time, and retrain junior workers. This will require a prolonged effort tailored to each gas utility that considers both geography and workforce demographics and will need several different approaches to be successful.

The following components should be considered by gas utilities, workers and their unions in developing a comprehensive transition plan. The costs of the gas workforce transition should be recoverable in rates.

- Establish bridge or buyout programs for the current retirement systems to get those over 50 years old to full retirement.
- Establish creative severance packages including provisions to add or extend the amount of time over which the severance package is available to accept; offer a version of the PG&E/IBEW Local 1245 severance package extension to those willing to stay and or move to a different geography in the system.
- Establish a cross crafting/job description committee to decide what would be best practice to safely deal with a shrinking workforce and possible added job duties.
- Provide wage protection for cross-crafting, retraining and internal job changes.
- Provide moving allowances and housing per diems to incent needed workers to move into areas where the gas infrastructure is still being maintained.
- Guarantee a position in a dual commodity utility to those workers who decide to continue working in gas until the system is retired or they are no longer needed.
- Provide preferential transfer/bidding rights to those displaced by gas infrastructure loss in dual commodity utilities.
- Provide preferential training and re-training to those displaced by gas infrastructure loss in dual commodity utilities.
- Provide funding for workers to leave the gas business and be trained, re-trained, or up trained into other crafts.
- Offer other energy utilities or water utilities credit/cost recovery for hiring displaced workers from California gas-only companies.

Undoubtedly such a transition will be easier to accomplish for dual-fuel utilities like PG&E and SDG&E than for single-fuel utilities, but it will be critical to devote care and attention to the circumstances confronting the employees of single-fuel companies and provide resources to facilitate their own transitions as well, perhaps including some form of preferential hiring by electric and water utilities. Absent a well-developed and funded effort, these employees will logically resist the transition and make the path to decarbonization that much more challenging.

DEVELOP A COMPREHENSIVE STRATEGY TO MEANINGFULLY ENGAGE AND UPLIFT LOW-INCOME AND DISADVANTAGED COMMUNITIES

To ensure that low-income and disadvantaged communities are not left behind in the transition, the development of a comprehensive strategy is imperative. One of the first steps in this strategy includes meaningful engagement with low-income and disadvantaged communities regarding the gas transition. Meaningful engagement is accessible in multiple languages, includes outreach and education, and involves community-based organizations that have built community trust and relationships. Meaningful engagement is important because it is the communities themselves that need to have opportunities to participate and voice their concerns related to the future of the gas distribution system and help devise solutions. State agencies, including the CPUC, CEC, and CARB, are making more focused efforts to engage communities and community-based organizations to discuss impacts and solutions related to climate change policies,[51] but those efforts must be enhanced.

In addition to ensuring meaningful engagement, a core set of policies is needed now, especially those that would

51 Disadvantaged Communities Advisory Group, https://ww2.energy.ca.gov/sb350/DCAG/.

protect the bills of low-income customers to ensure that bills do not become unaffordable.

Concrete steps should also be taken to enable low-income customers to electrify. A first step would be to develop pilot programs and resources to enable communities to electrify, and prioritize resources to transition low-income and disadvantaged communities. These resources may include funds related to the air quality, public health, and climate benefits that result from decarbonization. These funding sources can be used to develop rebates and incentives to help low-income customers to electrify. In addition to targeted incentives, financial tools can be developed such as on-bill financing to assist low-income customers with the initial capital expenses.

Since many low-income residents live in rental homes, protections such as rent stabilization and just cause for evictions need to be developed to ensure that benefits pass to renters and that renters are not displaced as a result of upgrades to their dwellings.

Another concern is that many low-income residences are energy inefficient. This creates a need for pairing electrification programs with other programs such as energy efficiency and weatherization. Pairing retrofits with other programs is an essential way to offset potential bill increases.[52]

RECOMMENDATION | *Develop a comprehensive strategy to ensure that low-income and disadvantaged communities are empowered through, benefit from, and are not left behind in the transition.*

Experience gained through the San Joaquin Valley pilots may offer a model for community engagement to increase access to affordable energy options, subject to community feedback on the successes and areas for improvement of that process. At a minimum, community engagement should include adequate notice and outreach, accommodations for working people's schedules, language access, physical and transportation accessibility, making presentations and content understandable for people without technical knowledge, and meeting or workshop formats that facilitate dialogue.[53]

Funds should be set aside to support this transition, leveraging resources from a diverse set of agencies including those overseeing air quality, public health, and energy. AB 1550[54] requires that 25% of Greenhouse Gas Reduction Fund revenues be spent on projects within and benefitting disadvantaged communities, and an additional 10% be spent for low-income households or communities. A portion of that funding could be directed toward gas transition efforts including electrification equipment and installation incentives, bill credits, energy efficiency upgrades, community education and outreach resources, and grants for community-based organizations to participate in energy decision-making. Ultimately, there is no one solution for all communities but communities must be enabled to participate in the transition.

BRINGING AFFORDABLE ENERGY OPTIONS TO THE SAN JOAQUIN VALLEY

In December 2018, the CPUC approved a $56 million investment for pilot projects in 11 disadvantaged communities in the San Joaquin Valley area, which includes the counties of Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare. The pilots will support the electrification of more than 1,600 homes and natural gas connections in more than 200 additional homes. The pilots come as a result of Assembly Bill 2672 (Perea, 2014), which requires the CPUC to explore how to bring different affordable energy options to underserved residents in the San Joaquin Valley area where access to the natural gas distribution system may be cost prohibitive. Bill implementation has included a series of Community Energy Option Assessment Workshops, as well as workshops to address split incentives between property owners and tenants, bill protections, and affordability. All pilot communities also have access to the Community Energy Navigator, an education and outreach effort intended to assist residents in understanding their energy options and assure community participation and engagement in pilot projects. Experience gained through the pilots will help to inform how to address affordable energy access more broadly in the region.

52 See, e.g., Rocky Mountain Institute, The Economics of Electrifying Buildings: How Electric Space and Water Heating Supports Decarbonization of Residential Buildings (2018), www.rmi.org/insights/reports/economics-electrifying-buildings/
53 California Environmental Justice Alliance, *Environmental Justice Agency Assessment 2018*, page 7.
54 Chapter 369, Statutes of 2016, AB 1550 (Gomez).

CONCLUSION

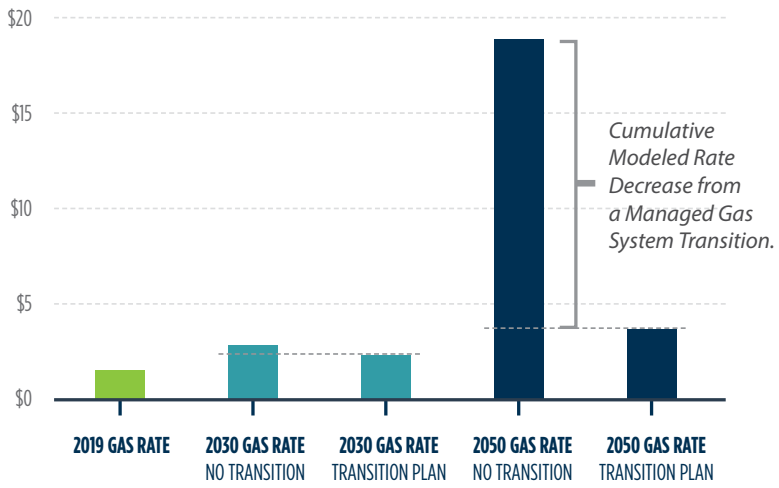
The long-term outlook for the gas distribution system in California is challenging, and if left entirely to unmanaged market forces, could prove to be highly inequitable for customers, especially those in low-income and disadvantaged communities, as well as future generations. California cannot meet its GHG reduction goals without a significant reduction in the combustion of fossil gas, and such a reduction will, without forceful action, almost assuredly drive up gas rates to unsustainable levels over time.

This report identifies a number of promising strategies that, if combined into a well-developed state gas transition plan, could mitigate the worst outcomes, reduce projected 2050 gas rates significantly, and improve the situation markedly (Figure 10). However, since the worst impacts are still a decade or more away, there is a real risk that the public and policymakers will not take the necessary actions in the near term that would help enormously in the longer term.

We urge leaders throughout California to recognize the challenge identified in this report, to draw confidence that the solutions suggested by this report, informed by the diverse and motivated organizations that contributed to their development, can substantially address this challenge, and to pursue the recommendations provided in the Executive Summary with a sense of urgency.

FIGURE 10. *2050 Gas Rate Reductions Resulting from Proposed Solutions*

Source: E3



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