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Sierra Club Comments and Support for Building Decarbonization

Additional submitted attachment is included below.

June 29, 2018

VIA ELECTRONIC SUBMISSION

California Energy Commission
Dockets Office, MS-4
1516 Ninth Street
Sacramento, CA 95814-5512

Subject: **Sierra Club and Earthjustice Comments on Achieving Zero Emission Buildings Workshop on June 14, 2018 and Building Decarbonization docket (18-IEPR-09)**

Dear Commissioners and staff:

The Sierra Club and Earthjustice appreciate the California Energy Commission's (CEC) leadership in hosting the *Achieving Zero Emission Buildings* workshop on June 14, 2018. Thank you for the opportunity to provide comments on the workshop and on the substance of the Building Decarbonization chapter in the 2018 Integrated Energy Policy Report (IEPR) Update.

The panelists at the workshop represent some of the leading experts on building decarbonization technology and program design, and clearly demonstrated that deep decarbonization of California's residential and commercial buildings via electrification is not only feasible, but can also deliver important co-benefits including lowering costs for new construction and annual energy bills, improved air quality, safety, grid harmonization, and climate resiliency.

Our comments are focused on how the Building Decarbonization chapter can help place California on a pathway to zero-emission buildings. Our comments are organized as follows:

1. The IEPR should clearly state that decarbonizing buildings with biomethane or "power-to-gas" is not a viable alternative to electrification.

2. The IEPR should affirm the cost advantages of building electrification to the state, building owners, and ratepayers, while also acknowledging the need for new rebates and tariffs to make electrification broadly accessible, especially for low-income residents.

3. The IEPR should outline the policy changes needed for California to decarbonize the buildings sector in a timely and least-cost manner. This section of our comments includes specific policy recommendations.

Discussion

1. The IEPR should clearly state that decarbonizing buildings with biomethane or "power-to-gas" is not a viable alternative to electrification.

In numerous proceedings, including in the 2018 IEPR, Southern California Gas Company (SoCalGas) has pointed to renewable natural gas (RNG) like biomethane and power-to-gas as a better *alternative* to building electrification. The gas industry claim that RNG is more affordable, scalable, reliable, and feasible is unfounded and distracts from the immediate need for California policymakers to prioritize accelerating market transformation for electric heat pumps and other advanced electric technologies.

The IEPR should affirm the inevitable need to electrify a large portion of the buildings sector to achieve California's climate goals. Lack of clarity to date on beneficial electrification from state agencies has been counterproductive to market development. California is the largest market in the U.S. for water heaters, space heaters, and other gas appliances. If regulatory agencies like the CEC states -- as agencies have already stated for electric vehicles, renewable energy, and storage -- that zero-emission appliances like electric heat pumps and induction stoves are key to deep decarbonization in California, then manufacturers, the workforce, and third party providers will rally to make available the technologies, services, and innovative programs needed to meet California's market needs. Remaining silent on beneficial electrification sends the wrong market signal, and fuels the gas industry's aggressive opposition to zero-emission buildings.

Below we recap some of the key reasons why RNG is not a viable alternative to building electrification:

a. *Limited potential supply of biomethane from waste in California*: There are numerous studies citing the limited supply of biomethane from waste in California. See the summary table below, originally included in the Prepared Testimony of James O'Dea and Rachel Golden in Proceeding No. A.17-10-

007/A.17-10-008 ("Testimony of O'Dea and Golden")[1] before the California Public Utilities Commission.

Table 1. Estimates of biomethane potential from waste in California[2]

Source	Estimate of potential biomethane from waste in California (Bcf/year)	Percentage of California's total 2015 natural gas use that biomethane could replace
UC Davis with LCFS incentives[3]	14	0.6%
American Gas Foundation ("non-aggressive" estimate)[4]	41	1.8%
Union of Concerned Scientists[5]	45	2.0%
NREL[6]	58	2.5%
UC Davis with LCFS and RFS incentives[7]	82	3.6%
American Gas Foundation ("aggressive" estimate)[8]	94	4.1%

Depending on the estimate, the table above shows biomethane could meet just 0.6% to 4.1% of California's total natural gas consumption. Even with the higher

[1] California Public Utilities Commission Docket A.17-10-007/A.17-10-008, Prepared Testimony of James O'Dea on Behalf of Union of Concerned Scientists and Rachel Golden on Behalf of Sierra Club ("Testimony of O'Dea and Golden"), (May 2018) (Attached as Exhibit 1).
[2] *Id.* p. 7.
[3] Amy Myers Jaffe et al., *The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute, Institute of Transportation Studies*, University of California, Davis, Research Report UCD-ITS-RR-16-2 (2016), https://steps.ucdavis.edu/the-feasibility-of-renewable-natural-gas-as-a-large-scale-low-carbon-substitute/.
[4] American Gas Foundation, *The Potential for Renewable Gas: Biogas Derived from Biomass Feedstocks and Upgraded to Pipeline Quality*, p. 39 (Sept. 2011), http://www.gasfoundation.org/researchstudies/agf-renewable-gas-assessment-report-110901.pdf.
[5] David Babson, *Turning Trash into Low-Carbon Treasure: The Benefits and Implications of Waste-derived Power and Fuel*, Union of Concerned Scientists (Aug. 2015), https://www.ucsusa.org/sites/default/files/attach/2015/08/Trash-to-Treasure-fact-sheet.pdf.
[6] NREL, *Biogas Potential in the United States*, p. 3 (Oct. 2013), http://www nrel.gov/docs/fy14osti/60178.pdf. The report's estimate of 1.1 million tonnes of potential biomethane in California was converted into cubic feet using methane's density of 0.0424 pounds per cubic feet at 14.73 pounds per square inch of pressure and 60 degrees Fahrenheit.
[7] Jaffe *et al.*, *supra* fn. 3, p. 76.
[8] American Gas Foundation, *supra* fn. 4, p. 40.

estimates of biomethane potential in E3's analysis, their presentation at the Achieving Zero-Emission Building workshop confirms that there is not nearly enough in-state biomethane to create a scenario where massive electrification is not needed.[9] Further, even if California's supply of biomethane is used exclusively in buildings, and not used in other sectors like electricity generation, industry, or transportation, biomethane could replace no more than 10 percent of gas demand from buildings statewide.[10] Building electrification is needed regardless of whether California's biomethane supply is successfully developed.

b. *Out-of-state credits for biomethane should not be considered as a resource to decarbonize California's buildings:* Relying on out-of-state biomethane credits to decarbonize California's buildings is not replicable or scalable by other states, and should not be a part of California's decarbonization strategy. California has by far the largest potential for biomethane compared to other states, nearly twice as much potential as the next state (Texas), and a roughly equal share of national biomethane potential (14%) compared to California's share of the national population (12%).[11] Even a report that SoCalGas commissioned in 2015 on building decarbonization finds that California would need to depend on a massive amount of out-of-state biomethane credits, which "may not reflect California's long-term emissions accounting strategy."[12] Moreover, analysis by James O'Dea, Senior Analyst at Union of Concerned Scientists, finds that even if the potential national supply of biomethane is considered, biomethane availability would be vastly insufficient to replace California's demand for natural gas.[13]

c. *Power-to-gas raises environmental concerns:* As described in Testimony of O'Dea and Golden and copied below, the Sierra Club and Union of Concerned Scientists have serious concerns with the environmental impacts of power-to-gas.

> Power-to-gas is a process by which energy is used to hydrolyze water to create hydrogen, which can then be used directly or then undergo a second process that combines the hydrogen with carbon dioxide to create methane. Methane created through this process is also referred to as synthetic natural gas . . . The production of synthetic methane is an inefficient process that could result in net increases in greenhouse gas emissions. A ratepayer-funded report commissioned by SoCalGas,

[9] E3, *Decarbonizing Pipeline Gas to Meet California's 2050 Greenhouse Gas Reduction Goal* (Jan. 2015), https://www.ethree.com/wp-content/uploads/2017/02/E3_Decarbonizing_Pipeline_01-27-2015.pdf.
[10] *See* NREL, supra fn. 6 (estimating 58 Bcf potential biomethane in California); *See* U.S. EIA, Natural Gas Consumption by End Use, https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_SCA_a.htm. (showing residential and commercial demand of 637 Bcf in 2015).
[11] *Id.*
[12] E3, *supra* fn. 9, p. 31.
[13] Ex. 1, Testimony of O'Dea and Golden, p. 7.

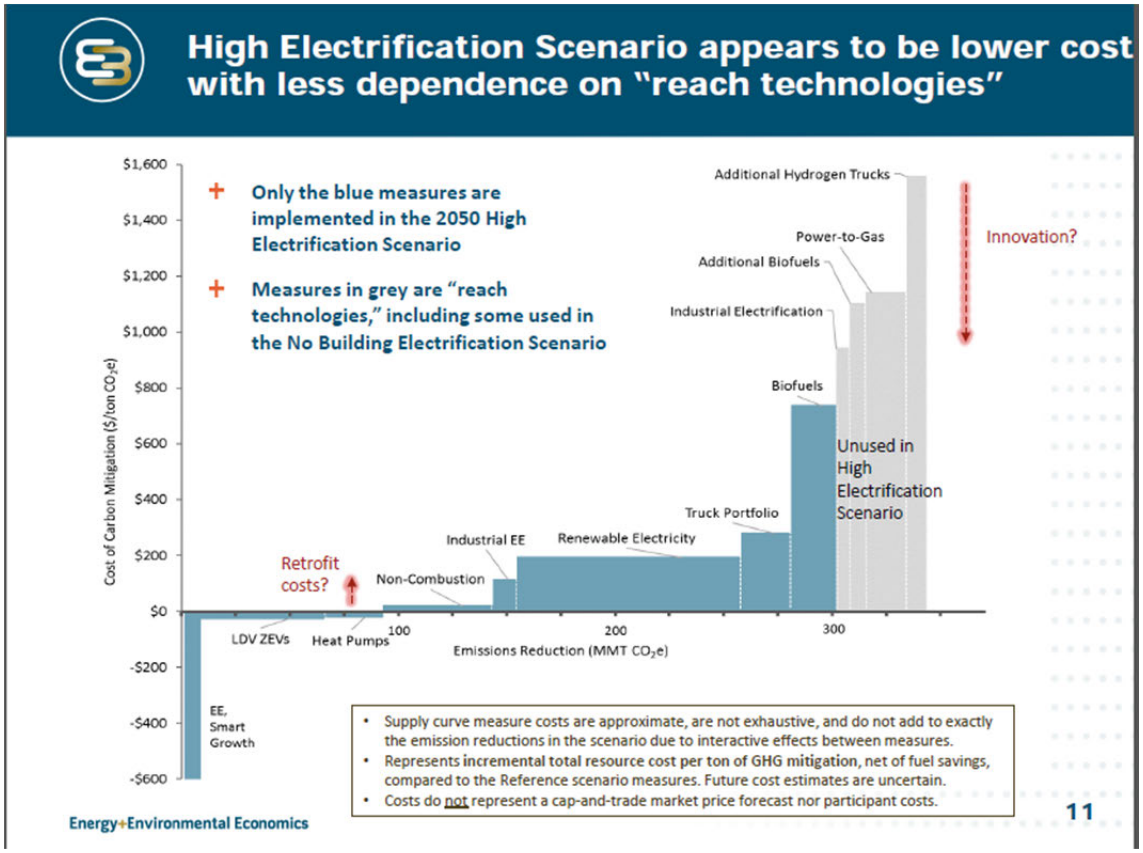
> *Decarbonizing Pipeline Gas to Help Meet California's 2050 Greenhouse Gas Reduction Goal*, estimates a current roundtrip efficiency of approximately 52 percent with the theoretical maximum roundtrip efficiency of power-to-gas technology of 63 percent. Thus, 100 MWh of electricity could create the equivalent of 52 to 63 MWh of synthetic gas to deliver to gas appliances. By contrast, using electricity directly in appliances avoids this energy loss in conversion. Were natural gas used as an electricity source to generate synthetic gas, the inefficiencies of the process would result in an increase in greenhouse gas emissions . . . Even assuming a power-to-gas facility is optimized to use surplus renewable energy, the power-to-gas process would take zero emissions energy and convert it to a high global warming pollutant that poses leakage risks in pipeline infrastructure. If methane leaks from a pipeline, it has the same global warming impact—28 to 86 times that of carbon dioxide—regardless of whether it is fossil natural gas, biomethane, or synthetic natural gas. Furthermore, SoCalGas has admitted that upon combustion, all types of methane, regardless of origin, emit essentially the same criteria air pollutants. Directing excess renewable energy to electric vehicles or electric appliances avoids the air pollution generated by methane leakage and combustion.[14]

2. The IEPR should affirm the cost advantages of building electrification to the state, building owners, and ratepayers, while also acknowledging the need for new rebates and tariffs to make electrification broadly accessible, especially for low-income residents.

Building electrification is a key least cost strategy for California to deeply decarbonize the economy. At the IEPR Workshop, E3's presentation concludes that the "High Electrification Scenario appears to be lower cost and with less dependence on 'reach technologies.'"[15] E3's carbon abatement chart (Figure 1) shows the significant GHG reductions that California can achieve in the buildings sector at lowest cost by investing in energy efficiency measures, heat pump deployment, and renewable electricity procurement.

[14] *Id.*, pp. 43-44 (footnotes omitted).
[15] CEC Docket No. 18-IEPR-09, *Long-Term Energy Scenarios In California Implications for Building Decarbonization* at IEPR Commissioners Workshop on Achieving Zero Emission Buildings , Slide #11 (June 14, 2018) .

Figure 1[16]



Leaving the climate benefits aside, electrification lowers the cost of new construction for building owners because all-electric buildings cost less to build than mixed-fuel buildings. All-electric new construction avoids gas infrastructure costs, including distribution main lines under the street, gas meter and connection to the main, gas piping within the building, and exhaust venting. Nehemiah Stone and others have described the range of gas infrastructure costs in multiple letters to the CEC through the Title 24 public comment process. As a snapshot: KB Homes and City Ventures provided the Commission with a combined-cost figure of $4500 net savings per single family home for going all-electric. Redwood Energy's experience with multifamily projects is that the net cost savings per unit for avoiding gas infrastructure ranges between $2000 and $3000 per dwelling unit.[17] All-electric new construction also saves building owners money as a single heat pump can be installed instead of a separate gas furnace and AC unit.

Electrification can also reduce total utility bills for renters, homeowners, and businesses. Andrew Brooks, Director of West Coast Operations of the Association for Energy Affordability,

[16] *Id.*
[17] CEC Docket No. 16-BSTD-06, *Letter from Nehemiah Stone, Stone Energy Associates, to CEC Re: 2019 Building Energy Efficiency Standards Development* (Apr. 4, 2017).

provided important examples of tenant bill savings that can result from electrification at the CEC IEPR workshop on May 30, 2018. In the workshop, Brooks explained that the potential for increased cost from electrification is still speculative. AEA's multifamily Low Income Weatherization Program (LIWP) projects that include electrification have resulted in lower utility bills even *before* rooftop solar was turned on and before electricity bills were adjusted to go to the all-electric heating baseline. These tenants saw bill savings with efficiency upgrades and electrification since Day One of project completion, with annual savings of at least 25%.[18] Outside of LIWP, there are numerous cases across the state of fuel-switching paired with energy efficiency and solar that led to large bill savings for low-income families. For example, tenants in the all-electric multi-family senior housing complex (26 units) in Fort Bragg saved on monthly utility bills amounting to annual bill *payback* of up to $200/year.[19] Of course, just as California has made rebates and EV-rates available for electric-vehicle owners, so should it offer special rebates and tariffs to homes and businesses that electrify. Rebates and electrification-friendly rates will be critical to incentivize and reward beneficial electrification.

3. The IEPR should outline the policy changes needed for California to decarbonize the buildings sector in a timely and least-cost manner.

Panelists at the workshop described innovative local policies, pilots, and approaches that are deeply decarbonizing homes and businesses today. To achieve scale and make zero-emission buildings accessible to all Californians, the support of state agencies -- including the CEC, CPUC, and CARB-- are vital. The IEPR Update is a key policy document to highlight the shortcomings in the current policy framework and the types of policy reform that are needed.

Our policy recommendations are as follows:

a. Establish building decarbonization targets and a joint agency action plan

Ultimately, to drive the changes needed to decarbonize the buildings sector, we recommend the CEC, PUC, CARB and other agencies, with the input of experts and stakeholders, establish (1) building decarbonization targets that align with California's climate goals, and (2) a joint agency action plan to achieve these decarbonization goals. This approach follows the model California employed with Zero Emission Vehicles, Energy Efficiency, Zero-Net Energy, and other groundbreaking initiatives. A joint agency action plan could help decision-makers identify all of the levers and resources available to accelerate building decarbonization, while also providing a framework for agencies to divide responsibilities and assign timelines. This action plan proposal,

[18] California Low Income Weatherization Program, *Tenant Electrification Results Solinas Village and Almond Court* (Attached as Exhibit 2).
[19] Kathleen Marshall and Sean Armstrong, *The Cottages at Cypress: A Zero Net-Energy Low-Income Senior Housing Development*, Home Energy Magazine (Nov./Dec. 2015).

however should *not* delay immediate actions that agencies and utilities can begin to take in the interim, such as unlocking EE incentive funding, creating electrification friendly rates, supporting electrification pilots, and improving the Building Energy Efficiency Standards.

b. Update the CPUC's Three-Prong Fuel Substitution Test to unlock ratepayer funding for beneficial electrification

California's IOU and CCA ratepayer-funded energy efficiency portfolio totals over $2 billion/year, with over $230 million/year allocated as incentives for efficiency improvements in residential and commercial buildings.[20] The rules that determine how efficiency incentives can be used are not appropriately aligned with California's overarching energy efficiency, clean energy, or climate stabilization goals. For example, the CPUC's *Three-Prong Fuel Substitution Test* subsidizes same-fuel efficiency improvements and disallows rebates for fuel-substitution and fuel-switching measures that would achieve *larger* reductions in energy use and GHGs. Figure 2 demonstrates that fuel substitution can more than double the energy savings of the most efficient gas upgrade.

[20] CPUC, *Energy Efficiency Primer* presentation, June 27, 2018

Figure 2: Sample Retrofit Savings Potential for 50 Gallon, Gas-Fired Domestic Water Heater[21]

Gas-to-Electric Fuel Substitution Measure	Annual Site BTU Savings
Existing Conditions Early Retirement (ER) to HPWH, 3.5 EF	15,006,396
Existing Conditions ER to HPWH, 3.24 EF	14,668,608
Code Minimum Replace on Burnout (ROB) to HPWH, 3.5 EF	13,606,396
Code Minimum ROB to HPWH, 3.24 EF	13,268,608
ENERGY STAR, .68 EF to HPWH, 3.5 EF	11,206,396
ENERGY STAR, .68 EF to HPWH, 3.24 EF	10,868,608
Tankless, EF .92 EF to HPWH, 3.5 EF	8,506,396
Tankless, EF .92 EF to HPWH, 3.24 EF	8,168,608
Gas-to-Gas Measure	**Annual Site BTU Savings**
Existing Conditions ER to Tankless, EF .92	6,800,000
Code Minimum ROB to Tankless, .92 EF	5,100,000
Existing Conditions ER to ENERGY STAR, .68 EF	3,800,000
ENERGY STAR, .68 EF to Tankless, .92 EF	2,700,000
Code Minimum ROB to ENERGY STAR, .68 EF	2,400,000

The Three Prong Fuel Substitution Test prevents IOUs, CCAs, and other efficiency program administrators from offering rebates for energy-saving and climate-beneficial fuel-substitution and fuel-switching. Since roughly 85% of homes in California have gas furnaces and water heaters[22] same-fuel rebates mean California is effectively supporting continued dependency on

[21] Per CPUC practice, all water heating savings calculations use DEER unit energy consumption values from the *Updated DEER DHW Calculator Workbook* available at http://deeresources.com/index.php/deer-versions/deer2019-and-june-2017-updates. Note that DEER values tend to be very conservative. For example, the projected savings value for the gas to electric measure in this example increases to 20,000,000 BTUs if unit energy consumption values from the Northwest Regional Technical Forum are used for the calculations.

[22] CEC, *2009 California Residential Appliance Saturation Study Volume 2: Results,* p. 21 (Oct. 2010).

pipeline gas -- the opposite direction of where we need to go. The efficiency rebates discourage deep decarbonization as they lower the cost of gas appliances, further tilting the scales to favor gas over cleaner electric alternatives. Funding is also needed to support ratepayers using costly and high-polluting unregulated fuels like propane to switch to cleaner and less costly electric alternatives. This is a primary entry point for electrification and improving energy access to low-income ratepayers. While we expect the CPUC will consider updating this Test in 2018, it would be helpful for the IEPR to indicate the importance of aligning energy efficiency policies with decarbonization goals and unlocking funds for fuel-substitution *and* fuel-switching.

c. CEC's Title 24 Building Energy Efficiency Standards should support all-electric new construction for both residential and non-residential buildings

New construction is the most cost-effective and easiest entry point for building electrification. New buildings will also last the longest, making them the most important to electrify to minimize long-term carbon lock-in. The Sierra Club appreciates the improvements the Commission made in the 2019 code cycle to create an electric baseline for all-electric buildings, so as not to discourage building decarbonization. However, the Commission needs to go further to align the Building Energy Efficiency Standards with California's climate goals and grid harmonization needs. Specific recommendations on how to improve Title 24 include:

- **Use GHG savings as a primary metric for code compliance.** As described in our previous comments,[23] the time dependent valuation (TDV) metric does yield building designs that optimize for GHG reductions of grid harmonization. The TDV metric is not user-friendly nor does it reflect the needs of today's grid or overarching climate goals. We agree with Commissioner's McAllister's assessment that the code should optimize for emission reductions, and should pivot from a zero-net electricity approach to zero-net *emissions.* The GHG metric should include fugitive methane emissions from out-of state fossil fuel imports as well as in-state leakage.

- **Include gas infrastructure costs.** Title 24 currently excludes gas infrastructure costs for new construction, giving false picture of the costs to build mixed-fuel buildings. Per our earlier comments, and the public comments made by several stakeholders, including Stone Energy Associates, NRDC, SMUD, and others in the Title 24 2019 code cycle docket, gas infrastructure costs should be included in code development.

[23] CEC Docket No. 16-BSTD-06, *Sierra Club Comments on the 2019 Title 24 Draft Time Dependent Valuation of Energy Updates*, (July 29, 2016).

- **Offer credits for grid-interactive electric appliances**. California is currently missing the demand response and grid harmonization benefits of grid-interactive appliances. Offering a credit for grid-interactive appliances is one lever to support deployment.

- **Update the Alternative Compliance Manual (ACM) so high-efficiency all-electric buildings can comply with the building code via the performance pathway.** Do not wait until 2022 to update the Non-Residential ACM. We support the specific recommendations made in the June 20, 2018 comment letter of Ted Tiffany, Guttmann & Blaevoet Consulting Engineers.

d. Electrification-friendly rates

The CPUC should instruct utilities to establish an optional "electrification-friendly rate" for residential and commercial customers. This rate should have super low off-peak rates in afternoon (belly of duck) to incentive use of electric appliances when there are ample renewables on the grid. The rate should also allow for a larger Tier 1 baseline allowance so as not to bump ratepayers into higher and more costly tiers as a result of electrifying end uses. Some utilities (like PG&E and SCE) have all-electric heating rates with a larger baseline allowance. This type of larger baseline allowance is key for electrification to be affordable, but currently does not allow households to use the rate if they've only electrified water heating.

e. Support innovative pilots and programs, especially for harder to reach market segments and technologies.

i. Make electrification accessible to low-income residents.

The CPUC, CEC, and CARB should increase funding for pilots and programs that support electrification of low-income single- and multi-family homes. There are numerous examples of important pilots and programs, such as the multi-family Low-Income Weatherization Program (LIWP) and Marin Clean Energy's Low-Income Family and Tenants Program, that provide critical energy efficiency and electrification upgrades to hard-to-reach markets. These programs reduce greenhouse gas emissions, lower utility bills for tenants, and improve indoor air quality and comfort. A successful transition to zero-emission buildings must be centered in energy equity and prioritize low-income residents in the transition to clean energy.

ii. Support use of demand response and grid-enabled electric appliances.

The CPUC should direct utilities to develop pilots to test the grid and economic benefits of and help inform future program design for programmable and grid-interactive electric appliances. Building electrification offers an important demand response resource that can support the integration of higher levels of renewables onto the grid and improve overall grid flexibility. Demand response programs that capitalize on programmable or grid-connected water heating are one area where California is a laggard. Utilities in Oregon, Washington, Florida for example are already employing successful hot water demand response programs.

iii. Develop a community-driven approach to electrification.

To deeply decarbonize the buildings sector, we must go beyond an "appliance by appliance" approach. Electrifying entire neighborhoods offer several key opportunities to permanently end methane leakage in a segment of the gas distribution system, reduce gas infrastructure operations and maintenance costs, and achieve economies of scale with electrification. Electrifying neighborhoods is typically lower cost than maintaining and repairing aging and leaking gas infrastructure. We support SMUD's recommendation for the CEC, CPUC, and other agencies to support "pruning the tree" pilot programs across California, and particularly in gas constrained regions such as Southern California. As SMUD describes: "This approach, with the support of the affected community, decommissions selected gas pipes in place while electric infrastructure is upgraded and homeowners receive upgraded all-electric home appliances, which result in lower utility bills. Leftover funds (i.e., avoided costs) could be spent in disadvantaged communities to reduce their utility costs."[24]

f. The California Air Resources Board should update the GHG Inventory to include out-of-state fugitive emissions, and prioritize building decarbonization in its planning.

The California Air Resources Board's GHG Inventory includes emissions from out of state electricity-generation, but not from fugitive emissions from natural gas imported

[24] CEC Docket No. 18-IEPR-09, *SMUD's Comments on IEPR Zero Emission Buildings Workshop*, (June 28, 2018).

from other states. California imports roughly 90% of the gas that we consume. Factoring in fugitive emissions from drilling, processing, and transmission can roughly double the climate impact of California's gas use. To appropriately measure the emissions of California's economy, the GHG Inventory must include out-of-state fugitive emissions associated with our gas consumption. Moreover, the emissions impact of methane leakage should not be categorically lumped into the "Industry" slice of the GHG pie, but rather be disaggregated to the sector of the economy (like buildings or power plants) which consumes the gas. We expect that including out-of-state and in-state methane leakage in the residential and commercial building categories would more accurately reflect the significant emissions from the buildings sector, and hopefully compel state agencies to prioritize building decarbonization. CARB missed an important opportunity to provide leadership on building electrification in the 2017 Updated GHG Scoping Plan. We urge the Agency to act on the Board resolution (Dec 14, 2017) to "collaborate with CEC and CPUC to evaluate and pursue strategies to increase electrification in the building sector where demonstrated to reduce GHGs and to align CARB's programs to support broader electrification across sectors where demonstrated to reduce GHGs."[25] To date, we have not seen the agency follow-through with this Board resolution.

Conclusion

In closing, the presentations at the workshop clearly demonstrated that electrification makes sense today, and will only reap larger benefits as the electricity grid gets cleaner. Delaying action to deeply decarbonize the building stock will add costs and potentially increase stranded assets. We largely have the technologies needed for deep decarbonization, and other states are already rapidly deploying and witnessing the benefits of advanced electric heat pumps.[26] Electrification is one area where California is currently a clean energy laggard. However, with some simple and timely policy reforms, California can scale local innovation to become a leading model for other states in deep building decarbonization.

Thank you for considering these comments for the Building Decarbonization chapter of the IEPR and in subsequent opportunities to improve access to clean energy.

[25] State of California Air Resources Board, *2017 Climate Change Scoping Plan Update*, Resolution 17-46, pp. 10-11 (Dec. 14, 2017).
[26] For example, David Lis from the Northeast Energy Efficiency Partnership described at the CEC workshop how ductless mini-split heat pumps comprise roughly 90% of HVAC systems being installed in homes in the Northeast.

Sincerely,

/s/ Rachel Golden

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Exhibit 1

Docket No.: A.17-10-007/A.17-10-008

Exhibit No.: Sierra Club-UCS-01

Date: May 14, 2018

Witnesses: James O'Dea

Rachel Golden

PREPARED TESTIMONY OF
JAMES O'DEA ON BEHALF OF UNION OF CONCERNED SCIENTISTS
AND RACHEL GOLDEN ON BEHALF OF SIERRA CLUB
ON THE TEST YEAR 2019 GENERAL RATE CASE APPLICATIONS OF
SAN DIEGO GAS AND ELECTRIC AND SOUTHERN CALIFORNIA GAS COMPANY

I. INTRODUCTION AND KEY FINDINGS AND RECOMMENDATIONS

This testimony focuses on several specific aspects of A.17-10-007/A.17-10-008, the Test Year 2019 General Rate Case Applications of San Diego Gas and Electric ("SDG&E") and Southern California Gas Company ("SoCalGas"). The experts sponsoring this testimony are Dr. James O'Dea, Senior Vehicles Analyst in the Clean Vehicles Program at the Union of Concerned Scientists, and Rachel Golden, a Senior Campaign Representative at the Sierra Club who focuses on building electrification. Copies of the resumes of Dr. O'Dea and Ms. Golden are included at the end of this testimony as Attachments 1 and 2, respectively. The individual sponsoring a particular section of testimony is indicated at the end of each heading or question.

The key findings and recommendations are:

1) <u>SoCalGas should not recover the costs of activities before state agencies and local governments related to the development of climate policy and greenhouse gas reduction measures.</u> (O'Dea/Golden)

   SoCalGas' fundamental business interest is the sale of a fossil fuel—natural gas—and investment in the infrastructure supporting its delivery. As SoCalGas admitted in its recent 10-K Annual Report, "increased use of renewable energy and electrification in lieu of the use of natural gas," measures that are critical to achieving California's decarbonization objectives, would have a "material adverse effect on [its] cash flows, financial condition and results of operations."[1] Consistent with its shareholder interest in maintaining reliance on fossil fuels, its Policy and Environmental Solutions Group ("Policy Group") has actively sought to impede progress on electrification of existing and potential natural gas end-uses. For example, the Policy Group has repeatedly argued before the California Energy Commission ("CEC") against building electrification and worked to inhibit the adoption of electric buses by local governments and transit agencies. SoCalGas' participation in state and local efforts to impede electrification and undermine progress on decarbonization should not be ratepayer-funded. California's greenhouse gas reduction requirements are challenging enough to achieve without the subsidization of pro-gas advocacy by Southern California ratepayers.

[1] Attachment ("Attach.") 5, Sempra Energy, SoCalGas and SDG&E Form 10-K Annual Report, p. 51 (Feb. 27, 2018).

2) SoCalGas should not recover the costs of natural gas vehicles where electric or hybrid electric options of that vehicle class are available. (O'Dea)

SoCalGas' proposed fleet procurement, which contemplates replacing petroleum and diesel vehicles with natural gas vehicles ("NGVs"), fails to assess the comparative cost and environmental benefits of electric and hybrid electric vehicle options. Electric vehicles offer superior efficiency and environmental benefits as compared to combustion technologies and are available for the majority of the SoCalGas fleet. SoCalGas has not met its burden of proof to demonstrate that continued procurement of NGVs is in the best interest of ratepayers.

3) SoCalGas and SDG&E's proposals to expand or construct new NGV refueling stations have not been justified, create significant stranded asset risk, and should not be approved. (O'Dea)

Southern California fleet operators are increasingly transitioning to electric vehicle options in lieu of NGVs. The shift toward electrification creates stranded asset risk for SoCalGas' refueling infrastructure – risks that SoCalGas itself recognized in its testimony opposing the application of Southern California Edison ("SCE") to provide electric charging infrastructure for medium- and heavy-duty vehicles. SoCalGas and SDG&E's proposals to expand or construct new NGV refueling stations will exacerbate this stranded asset risk, lock-in additional combustion-based infrastructure, and should not be approved.

4) SoCalGas should no longer implement a ratepayer-funded natural gas research and development program. (Golden)

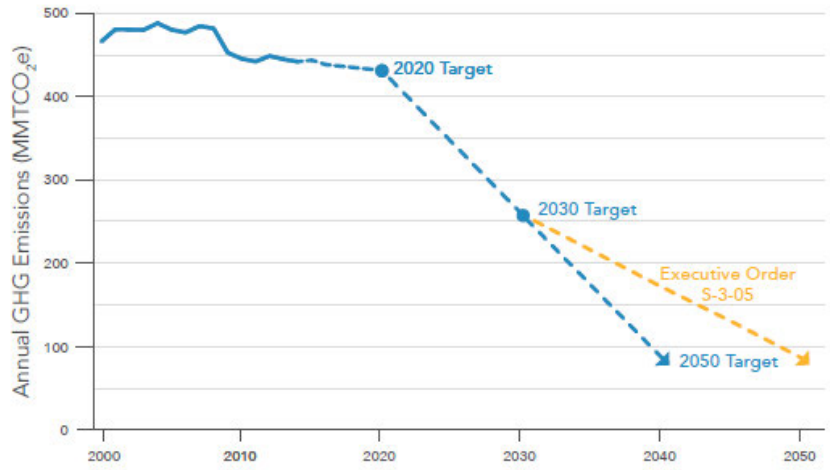
Implementation of natural gas research and development ("R&D") is best left to the CEC, which already has a ratepayer-funded natural gas R&D program. In my review of SoCalGas' administration of its R&D program, I have identified several concerns including: (1) use of R&D funding to commission studies on zero net energy homes, which SoCalGas then references to support its efforts to impede building electrification; (2) funding of projects such as power-to-gas, which can increase pollution and may not be aligned with state priorities; and (3) characterization of allocation of ratepayer-funded R&D to educational institutions as a "gift" from SoCalGas in press materials. Each of these issues would be avoided were natural gas R&D funding left to the CEC.

II. BACKGROUND: CALIFORNIA'S CLIMATE TRAJECTORY AND THE DECLINING ROLE OF NATURAL GAS (O'DEA)

Q. Please describe California's greenhouse gas reduction trajectory.

A. By law, statewide global warming emissions must be reduced to 1990 levels by 2020, and to 40 percent below 1990 levels by 2030.[2] Executive Order S-3-05 further calls for emission reductions of 80 percent below 1990 levels by 2050.[3] As illustrated in the following figure from the California Air Resources Board ("CARB") 2017 Climate Change Scoping Plan Update, California's 2030 global warming emissions standard significantly accelerates the needed pace of greenhouse gas emission reductions as compared to the reductions needed to meet the 2020 target.[4]

FIGURE 5: PLOTTING CALIFORNIA'S PATH FORWARD



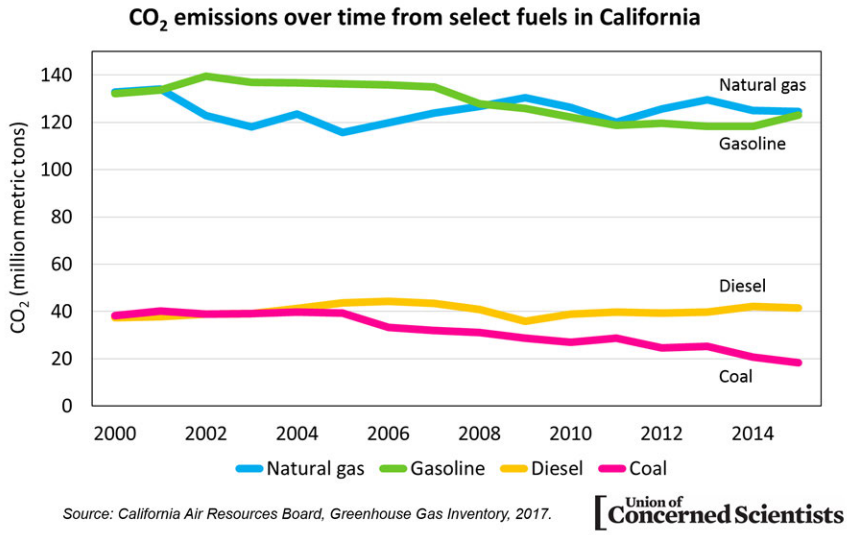
The 2030 emissions standard is not an endpoint, but a mid-term step toward meeting the 2050 goal of reducing emissions to 80 percent below 1990 levels by 2050.[5] These reductions are consistent with what scientific analyses indicate is

[2] Assembly Bill 32 (2006), http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_0001-0050/ab_32_bill_20060927_chaptered.pdf; Senate Bill 32 (2016), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32.
[3] Executive Order S-3-05 (June 1, 2005), https://web.archive.org/web/20110602181729/http:/gov.ca.gov/news.php?id=1861.
[4] CARB, *2017 Climate Change Scoping Plan*, p. 18 (Nov. 2017), https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf ("2017 Climate Change Scoping Plan").
[5] Executive Order S-3-05, *supra* fn.3; 2017 Climate Change Scoping Plan, p. 6.

necessary to limit the most severe consequences of our already warming world.[6] Indeed, the 2050 target should be viewed as conservative. Consistent with the Paris Climate Agreement, the 2017 Climate Change Scoping Plan recognizes that reaching the 2050 target sooner than called for by Executive Order S-3-05 would reduce the severity of climate impacts, finding that accelerated reductions "would have a greater chance of preventing global warming of 2°C."[7]

Q. Please describe the reductions in fossil fuel use needed to meet these climate targets.

A. As depicted in the graph below, a large percentage of the carbon emissions in California today is attributable to the combustion of natural gas.[8]



In order to meet the required reductions in global warming emissions, California must burn far less natural gas in the future than it does today.[9]

[6] 2017 Climate Change Scoping Plan, p. ES-3 (explaining that these targets "represent benchmarks, consistent with prevailing climate science, charting an appropriate trajectory forward that is in line with California's role in stabilizing global warming below dangerous thresholds"). *See also* Joeri Rogelj *et al.*, *Differences between carbon budget estimates unravelled.* Nature Climate Change, Vol. 6, pp. 245-252 (2016), https://www.nature.com/articles/nclimate2868; Intergovernmental Panel on Climate Change, Fourth Assessment Report, Section 13.3.3.3 ("Implications of regime stringency: linking goals, participation and timing"), http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch13-ens13-3-3-3.html (greenhouse gas emissions reductions below 90% of 1990 levels by 2050 necessary to avoid catastrophic climate impacts).

[7] 2017 Climate Change Scoping Plan, p. 18. *See also* United Nations, Paris Agreement, Article 2 ¶ 1(a) (2015), https://unfccc.int/sites/default/files/english_paris_agreement.pdf.

[8] Graph based on data from CARB Greenhouse Gas Emission Inventory, 2017 Edition, https://www.arb.ca.gov/cc/inventory/data/data.htm.

All independent studies I am aware of analyzing how California can achieve its 2050 greenhouse gas reduction targets agree that it will require widespread electrification of end uses of energy—such as transportation or space and water heating—that currently use natural gas and other fossil fuels.[10] For example, the report *Policy Implications of Deep Decarbonization in the United States*, by Energy and Environmental Economics ("E3") and the Deep Decarbonization Pathways Project, found that reducing emissions to 80 percent below 1990 levels requires three transitions: (1) highly efficient end use of energy in buildings, transportation, and industry; (2) decarbonization of electricity; and (3) fuel switching of end uses from high-carbon to low-carbon supplies, "primarily electrification."[11] A study conducted by Lawrence Berkeley National Laboratory similarly concluded that electrification of passenger vehicles and building heating was an essential component of reaching the 2050 climate goal.[12] As California Public Utilities Commission ("CPUC") President Michael Picker stated at an En Banc meeting last year: "We can get to 100 percent [clean] electricity across the state but . . . we don't get to our greenhouse gas goal unless we start to supplant gas and transportation fuel with clean electricity as our first fuel."[13]

Q. What is the potential to meet our climate targets by substituting fossil gas with biomethane?

A. Biomethane is methane generated from the decomposition of organic material, most commonly from landfills, wastewater, and animal manure. There is little biomethane produced in California today. As I explain below, if potential sources

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[9] *See, e.g.*, 2017 Climate Change Scoping Plan, p. 66 ("Moving forward, reducing use of fossil natural gas wherever possible will be critical to achieving the State's long-term climate goals.").
[10] As discussed in Section III of this testimony, below, SoCalGas did commission a consultant report intended to demonstrate that biomethane and power-to-gas projects could replace sufficient fossil gas to meet California's carbon goals. *See* E3, *Decarbonizing Pipeline Gas to Meet California's 2050 Greenhouse Gas Reduction Goal* (Jan. 2015), https://www.ethree.com/wp-content/uploads/2017/02/E3_Decarbonizing_Pipeline_01-27-2015.pdf ("Decarbonized Gas Report"); Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-01, Q.21; Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-05, Q.3.
[11] E3 and the Deep Decarbonization Pathways Project, *Policy Implications of Deep Decarbonization in the United States*, pp. 49-50 (Nov. 2015), http://usddpp.org/downloads/2015-report-on-policy-implications.pdf.
[12] Max Wei *et al.*, *Scenarios for Meeting California's 2050 Climate Goals*, University of California, Berkeley and Lawrence Berkeley National Laboratory (Sept. 2013), http://www.energy.ca.gov/2014publications/CEC-500-2014-108/CEC-500-2014-108.pdf.
[13] CPUC's En Banc hearing on Community Choice Aggregator ("CCA") Issues held Feb. 1, 2017, http://www.adminmonitor.com/ca/cpuc/en_banc/20170201/ (quoting from Part 2, at minutes 13:15 and 19:10).

of biomethane from waste were fully developed, this fuel could meet only a fraction of California's current demand for natural gas.

The U.S. Energy Information Administration ("EIA") estimates total natural gas consumption in California in 2015 was 2,301 billion cubic feet ("Bcf").[14] Estimates of biomethane potential in California are much lower: The National Renewable Energy Laboratory ("NREL") estimates that there are potentially 58 Bcf of biomethane available per year in California from landfills, wastewater, animal manure, and other sources of waste.[15] A research team at the University of California, Davis estimates the state's economically viable biomethane production potential to be 14 Bcf annually through 2030, assuming a $120 per credit incentive under the Low Carbon Fuel Standard ("LCFS"). If significant additional incentives were provided, the researchers estimate 82 Bcf of biomethane could be captured annually in California.[16]

Estimates of biomethane vary due to assumptions of feedstock availability and efficiencies for converting the feedstock to biomethane.[17] NREL's analysis represents a middle-of-the-road estimate among many analyses (see Table 1 below) and shows biomethane from sources of waste in California could meet approximately 2.5 percent of the state's current demand for natural gas.

[14] *See* U.S. EIA, *Natural Gas Consumption by End Use,* https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_SCA_a.htm.

[15] NREL, *Biogas Potential in the United States*, p. 3 (Oct. 2013), http://www.nrel.gov/docs/fy14osti/60178.pdf. The report's estimate of 1.1 million tonnes of potential biomethane in California was converted into cubic feet using methane's density of 0.0424 pounds per cubic feet at 14.73 pounds per square inch of pressure and 60 degrees Fahrenheit.

[16] Amy Myers Jaffe *et al*., *The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute*, Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-16-2 (2016), https://steps.ucdavis.edu/the-feasibility-of-renewable-natural-gas-as-a-large-scale-low-carbon-substitute/.

[17] While it is technically feasible to convert additional sources of biomass such as wood or dedicated energy crops into synthetic biomethane, these sources are markedly different in terms of cost-effectiveness and climate benefits compared to biomethane from landfills, dairies, and wastewater. Thus, these resources are not included in the inventory of biomethane potential.

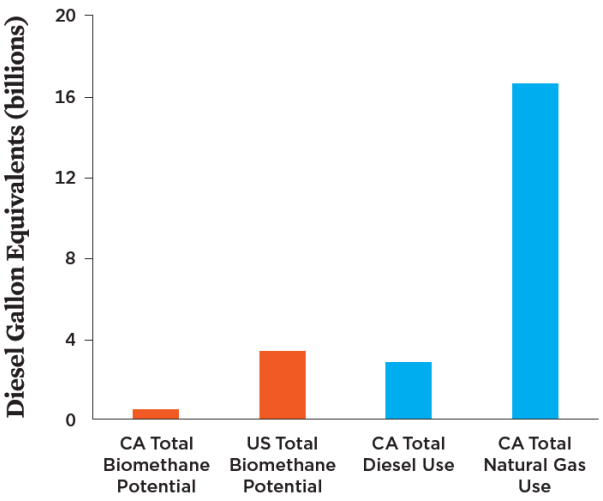
Table 1. Estimates of biomethane potential from waste in California

Source	Estimate of potential biomethane from waste in California (Bcf/year)	Percentage of California's total 2015 natural gas use that biomethane could replace
UC Davis with LCFS incentives[18]	14	0.6%
American Gas Foundation ("non-aggressive" estimate)[19]	41	1.8%
Union of Concerned Scientists[20]	45	2.0%
NREL[21]	58	2.5%
UC Davis with LCFS and RFS incentives[22]	82	3.6%
American Gas Foundation ("aggressive" estimate)[23]	94	4.1%

Even if the potential national supply of biomethane is considered, biomethane availability would be insufficient to replace California's demand for natural gas. As illustrated in the graph below, replacing only current diesel use in California would require commandeering almost the entire nationwide potential of biomethane from waste.[24]

[18] Jaffe *et al.*, *supra* fn.16.
[19] American Gas Foundation, *The Potential for Renewable Gas: Biogas Derived from Biomass Feedstocks and Upgraded to Pipeline Quality,* p. 39 (Sept. 2011), http://www.gasfoundation.org/researchstudies/agf-renewable-gas-assessment-report-110901.pdf.
[20] David Babson, *Turning Trash into Low-Carbon Treasure: The Benefits and Implications of Waste-derived Power and Fuel*, Union of Concerned Scientists (Aug. 2015), https://www.ucsusa.org/sites/default/files/attach/2015/08/Trash-to-Treasure-fact-sheet.pdf.
[21] NREL, *supra* fn.15.
[22] Jaffe *et al.*, *supra* fn. 16, p. 76.
[23] American Gas Foundation, *supra* fn. 19, p. 40.
[24] Graph from Attach. 3, Union of Concerned Scientists, *The Promises and Limits of Biomethane as a Transportation Fuel*, p. 2 (May 2017) ("UCS 2017").

FIGURE 1. Availability of Biomethane from Waste Compared with Diesel and Natural Gas Use in California



The amount of biomethane potentially available in California is much smaller than the amount of diesel and natural gas used in the state.

Accordingly, while capturing biomethane can displace a small amount of fossil gas consumption, significant additional reductions in natural gas use must occur to achieve California's greenhouse gas reduction objectives.

III. SOCALGAS' PROPOSED RATE-BASED ACTIVITY RELATED TO STATE AND LOCAL CLIMATE POLICY AND GREENHOUSE GAS REDUCTION MEASURES

Q. What is your understanding of climate-related policy activities for which SoCalGas is seeking cost recovery? (O'Dea/Golden)

A. My understanding, based on my review of the Direct Testimony of Lisa L. Alexander (Exh. SCG-21) is that this activity falls within the Policy and Environmental Solutions Group ("Policy Group") and includes both shared and non-shared services.

Non-shared services of the Policy Group, according to SoCalGas' testimony, include work related to franchise agreements with municipalities and also "analysis, strategy and implementation on local sustainability planning and on other local and regional planning initiatives."[25] SoCalGas has stated it does not track costs between these two categories of activities.[26] With regard to the second category, local sustainability planning, SoCalGas asserts that "[a]bsent SoCalGas'

[25] Exh. SCG-21, Direct Testimony of Lisa L. Alexander, p. LLA-21:6-7 (Oct. 6, 2017) ("Alexander Direct").
[26] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-02, Q.4.

involvement in these planning activities, communities may fall short of attaining state emission reduction goals."[27] SoCalGas requests $897,000 for its non-shared environmental and policy solutions for test year ("TY") 2019, a $130,000 increase from 2016.[28] The increase is attributable to the addition of a full-time equivalent ("FTE"), up from five to six.[29]

The shared services performed by the Policy Group, according to SoCalGas' testimony, include engaging with "local and state regulatory organizations as they develop rules and regulations on air quality, climate change and energy utilization."[30] This work includes "providing analysis and evidence to support the efficient use of natural gas in support of state policy."[31] SoCalGas provides examples of the Policy Group's work before CARB, the CEC, and air districts, including "attendance at meetings and workshops, evaluation of technologies and monitoring systems, preparation of comments, and education of customers."[32] SoCalGas has asserted that it is entitled to rate recovery for all letters and comments the Policy Group submits to CARB, the CEC, and all air districts because all letters and comments "serve to protect the interests of customers."[33] SoCalGas requests a funding increase of $0.482 million for Policy Group shared services, an increase from $2.026 million to $2.508 million for TY 2019. The increase is due to requested growth in staff from 10.6 to 11.8 FTEs "to respond to a substantial increase in energy and environmental legislative, policy and regulatory activities, as well as an increase in customer need for compliance assistance."[34]

Q. Do you believe ratepayers should bear the cost of the Policy Group's climate-related advocacy? (O'Dea/Golden)

A. No. SoCalGas has acknowledged its shareholder interest in maintaining demand for natural gas and the potential impact of policies that reduce gas demand on its financial condition. Its most recent 10-K Annual Report, filed on February 27, 2018, states:

[27] Exh. SCG-21, Alexander Direct, p. LLA-21:15-17.
[28] *Id.* at p. LLA-20, Table LLA-11.
[29] *Id.* at p. LLA-22:5-7.
[30] *Id.* at p. LLA-25:3-7.
[31] *Id.* at p. LLA-25:8-10. *See also id.* at p. LLA-21:8-9.
[32] Exh. SCG-21, Alexander Direct, pp. LLA-27:26 - 28:5.
[33] *Id.* at p. LLA-27:26-27; Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-02, Q.6.
[34] Exh. SCG-21, Alexander Direct, p. LLA-25:21-26.

> California legislators and stakeholder, advocacy and activist groups have expressed a desire to further limit or eliminate reliance on natural gas as an energy source by advocating increased use of renewable energy and electrification in lieu of the use of natural gas. A substantial reduction or the elimination of natural gas as an energy source in California, could have a material adverse effect on SDG&E's, SoCalGas' and Sempra Energy's cash flows, financial condition and results of operations.[35]

As set forth in Section II of this testimony, achievement of California's climate objectives requires substantial reduction in natural gas consumption. Accordingly, there is conflict between SoCalGas' financial interest in maintaining reliance on natural gas as a fuel source and the aggressive reductions in fossil fuel use needed to meet state greenhouse gas reduction requirements.

SoCalGas' conduct with regard to efficiency standards for residential furnaces is instructive. In opposing the U.S. Department of Energy's ("DOE") proposed new efficiency standard for residential furnaces, a position at odds with California's other investor-owned utilities ("IOUs") and the CEC, the Office of Ratepayer Advocates ("ORA") discovered "internal emails among SoCalGas managers discussing the potential for the proposed standards to raise the cost of some gas furnaces and thereby encourage fuel switching away from natural gas" and detailed "several situations in which SoCalGas appears to have frustrated the other IOUs' efforts to advance higher standards, including backing out of drafting a joint letter just one day before the response deadline to a 2017 DOE request for information (despite having decided a week earlier that they would not sign on)."[36] Upon review of the evidence presented by ORA, a Proposed Decision in this CPUC proceeding found:

> We are nevertheless convinced that there is a potential for SoCalGas to misuse ratepayer funds authorized for codes and standards advocacy, such that we find it reasonable to limit SoCalGas's involvement in codes and standards advocacy as ORA recommends. SoCalGas shall have no role in statewide code and standards advocacy other than to transfer funds to the statewide codes and standards lead for program implementation.[37]

[35] Attach. 5, Sempra Energy, SoCalGas and SDG&E Form 10-K Annual Report, p. 51.
[36] A.17-01-013 *et al.*, *Proposed Decision Addressing Energy Efficiency Business Plans*, pp. 139-40 (Apr. 4, 2018). A final vote on the Proposed Decision was pending at the time this testimony was submitted.
[37] *Id.* at p. 143.

This same potential misuse of ratepayer funds occurs with regard to SoCalGas' climate-related advocacy for which it now seeks cost recovery. Like its efforts to block efficiency standards that could encourage fuel switching away from natural gas, the Policy Group has aggressively sought to block measures by state agencies and local governments that would reduce reliance on fossil fuels by replacing natural gas end uses with electric options.

Many of SoCalGas' comments in agency proceedings focus on retention of gas end uses in lieu of electrification. Its comments fail to provide key information to decision makers, such as information on the limited potential of biomethane to displace natural gas. In my opinion, SoCalGas' participation in state and local efforts to reduce greenhouse gas pollution impedes progress on decarbonization, is not in ratepayers' interests, and should therefore not be ratepayer-funded. California's greenhouse gas reduction requirements are challenging enough to achieve without the subsidization of pro-gas advocacy by Southern California ratepayers.

Q. Please provide examples related to SoCalGas' advocacy on the use of natural gas in buildings. (Golden)

A. At the CEC, SoCalGas' ratepayer-funded Policy Group has repeatedly argued against including electrification of building energy use in CEC policy recommendations or targets. For example, one comment letter from SoCalGas to the CEC contains the bolded heading "**Electrification of Final End-Uses Impedes Implementation of Climate Goals**."[38] SoCalGas separately argued, again at ratepayer expense, that electrification of final end-uses would "*decelerate* achievement of the state's climate goals."[39] SoCalGas' rationale for these assertions is that electrification "may preclude implementing California's goals to increase the use of renewable gas in the transportation and building sectors."[40] These SoCalGas comment letters provided no further analysis explaining how electrification of end-uses would limit use of renewable gas.

[38] Attach. 6(i), CEC Docket No. 17-IEPR-06, SoCalGas, *Comments on the IEPR Staff Workshop on 2030 Energy Efficiency Targets*, p. 3 (June 30, 2017).
[39] Attach. 6(j), CEC Docket No. 17-IEPR-06, SoCalGas, *Comments on CEC Staff's Two Draft Papers on SB 350 Energy Efficiency Savings Doubling Targets*, p. 2 (Aug. 3, 2017) (emphasis added).
[40] Attach. 6(i), SoCalGas, CEC Docket No. 17-IEPR-06, *Comments on the IEPR Staff Workshop on 2030 Energy Efficiency Targets* (June 30, 2017); *see also* Attach. 6(f), CEC Docket No. 17-IEPR-06, SoCalGas, *Comments on the Joint Agency IEPR Workshop on 2030 Energy Efficiency Target*s (Feb. 15, 2017).

Given the limited supply of biomethane, as discussed above in Section II of this testimony, the argument that electrification will preclude its use is specious. Even if California's supply of biomethane is used exclusively in buildings, and not used in other sectors like electricity generation or transportation, biomethane could replace no more than 10 percent of gas demand from buildings statewide.[41] Electrification is needed regardless of whether California's biomethane supply is successfully developed.

Q. What are other examples of problematic arguments made by SoCalGas in opposition to building electrification? (Golden)

A. SoCalGas has also raised unsupported technical arguments to oppose building electrification. For example, in comments to the CEC on building efficiency standards, and again in subsequent comments on doubling energy efficiency standards, SoCalGas argued that electrification would worsen the duck curve, claiming:

> [M]any have asserted that the best path to achieve [greenhouse gas reduction] goals is through widespread electrification [of all end-uses]. However, when appropriate analyses are conducted, it raises concerns around grid reliability and harmonization. This issue has been recognized through what is commonly known in California as "the duck curve."[42]

The duck curve is a red herring. SoCalGas provides no support for its statement that building electrification will cause grid reliability issues or worsen the duck curve.[43] In fact, entities such as the California Independent System Operator ("CAISO") have recognized that electrification of heating can unlock "the 'dividend' from California's investment in renewables" by using surplus daytime renewable generation.[44] Numerous utilities are testing the use of programmable

[41] *See* NREL, *supra* fn.15 (estimating 58 Bcf potential biomethane in California); U.S. EIA, *supra* fn.14 (showing residential and commercial demand of 637 Bcf in 2015).
[42] Attach. 6(k), CEC Docket No. 17-BSTD-01, SoCalGas, *August 22, 2017 Proposed 2019 Building Energy Efficiency Standards ZNE Strategy Presentation Comment Letter*, p. 2 (Sept. 6, 2017); *see also* Attach. 6(l), CEC Docket No. 17-IEPR-06, SoCalGas, *Comments on CEC Draft Commission Report on SB 350: Doubling Energy Efficiency Savings by 2030*, p. 3 (Sept. 21, 2017).
[43] In both aforementioned letters to the CEC, SoCalGas provides three citations for the quoted statement. While all three sources discuss the duck curve, none mention electrification of load or suggest electrification will worsen the duck curve.
[44] Attach. 7, CAISO, *CEC IEPR Workshop Presentation, Renewable Integration*, Slide 26 (May 12, 2017).

or grid-interactive heat pump water heaters that can act as storage to soak up excess solar and decrease evening ramp.[45]

SoCalGas has also argued against electrification by making selective arguments about the cost. Although a study commissioned by SoCalGas concluded that Zero Net Energy ("ZNE") homes that continue to use natural gas have "higher annual utility costs" than all-electric homes, when SoCalGas referred to this study in comments to the CEC, it stated the opposite: that that the study found "modest homeowner annual cost savings" for natural gas.[46]

In the same set of comments, SoCalGas cited to a study by the City of Palo Alto to argue that upgrading existing homes to electric heat pumps is not cost-effective and should not be used as an energy efficiency technology to meet Senate Bill 350 goals.[47] However, the City of Palo Alto study also found that "as policies and rates change over time, electrification may become more cost effective" and that as heat pump space and water heating "products proliferate, market forces will drive down prices and improve the cost effectiveness of electrification."[48]

Building electrification is critical to substantially reducing reliance on fossil fuels. Much like when rooftop solar was in its infancy, the solution to improving cost-effectiveness is not to walk away, but to remove barriers and provide incentives that drive down cost and create a self-sustaining market. SoCalGas efforts to impede progress on removing barriers to electrification and delay fuel switching serve only to make achieving California's climate goals more expensive for ratepayers in the long run: delayed action on transitioning space and water heating

[45] *See, e.g.*, Bonneville Power Administration, *Emerging Technology Field Test: Smart Water Heater Pilot*, https://www.bpa.gov/EE/Technology/EE-emerging-technologies/Projects-Reports-Archives/Field-Tests/Pages/Smart-Water-Heater-Pilot.aspx (last visited May 10, 2018); Duke Energy, *Heat Pump Water Heaters for Demand Response* (Feb. 28, 2016), http://aceee.org/sites/default/files/pdf/conferences/hwf/2017/Gurlaskie_Session7A_HWF17_2.28.17.pdf. *See also* Jim Lazar, *Teaching the "Duck" to Fly*, The Regulatory Assistance Project, pp. 19-21 (Feb. 2016), http://www.raponline.org/document/download/id/7956 (describing strategy for using electric water heaters to reduce peak demand).

[46] Attach. 6(m), CEC Docket No. 17-IEPR-01, SoCalGas, *Comments on the Draft 2017 Integrated Energy Policy Report*, p. 5, fn. 21 (Nov. 13, 2017) (citing Navigant Consulting, *Strategy and Impact Evaluation of Zero-Net-Energy Regulations on Gas-Fired Appliances* (March 7, 2017) ("Navigant Study")). *Compare with* Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-05, Q.2 Attachment, Navigant Study, p. 1.

[47] Attach. 6(m), CEC Docket No. 17-IEPR-01, SoCalGas, *Comments on the Draft 2017 Integrated Energy Policy Report*, p. 2 (Nov. 13, 2017) (citing City of Palo Alto, TRC Energy Services, *Palo Alto Electrification Final Report* (Nov. 16, 2016), https://www.cityofpaloalto.org/civicax/filebank/documents/55069).

[48] City of Palo Alto, TRC Energy Services, *Palo Alto Electrification Final Report*, pp. 2, 21 (Nov. 16, 2016), https://www.cityofpaloalto.org/civicax/filebank/documents/55069.

to electricity will increase both the total cost of the transition and the cumulative emissions.[49] Yet as SoCalGas acknowledged in its 10-K Annual Report filing, the resulting reductions in gas demand could have a materially adverse effect on its cash flows and financial condition. SoCalGas' arguments against building electrification are fundamentally a shareholder concern, and the costs of its policy advocacy should therefore be borne by its shareholders.

Q. To your knowledge, are other sources of SoCalGas ratepayer funds used to oppose electrification? (Golden)

A. Yes. In addition to the activities of the Policy Group, it appears SoCalGas also funds anti-electrification activities through its ratepayer-funded Operations and Maintenance ("O&M") budget. For example, a recent op-ed in the Sacramento Bee by SoCalGas Regional Vice President George Minter lobbied public opinion against pending legislation, writing, "Assembly Bill 3232 would drive up energy bills, make housing more expensive and stall innovation."[50] The editorial states without basis that electrification of home energy use would "drive us deeper into the affordable housing and homelessness crises we're facing" and implies that the legislation would "forc[e] families already struggling with the high cost of housing and rising transportation costs to swap out their perfectly good appliances for all electric alternatives," which is not true.[51] SoCalGas states that the "cost of preparing the opinion piece was categorized as GRC ratepayer-funded operations and maintenance (O&M) expense."[52]

Additionally, in 2015, SoCalGas commissioned a study using O&M funds that was intended to demonstrate that biomethane and power-to-gas projects could replace sufficient fossil gas to make electrification unnecessary.[53] However, the report ultimately underscores that a climate solution using pipeline gas instead of electrification is not feasible because it is not compatible with California climate strategy. In order to generate enough "decarbonized" gas, the report assumes paper transactions for massive quantities of biomethane credits, where the biomethane is produced from biomass on the East Coast. As the report

[49] Attach. 8, Imran A. Sheikh, *Lowest cost reduction of space and water heating emissions in California* (Nov. 2017).
[50] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-08, Q.4 (attaching George Minter, *Most of us can't afford to go all-electric. Here's a fairer way to curb climate change*, Sacramento Bee (Apr. 20, 2018)).
[51] *Id.*
[52] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-08, Q.4.
[53] Decarbonized Gas Report, *supra* fn.10*;* Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-01, Q.21; Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCGa-05, Q.3.

acknowledges, a system where California "would take credit for assumed emissions reductions associated with these biofuels, regardless of where the fuel is actually produced," "may not reflect California's long-term emissions accounting strategy."[54]

Sierra Club and UCS learned of these two O&M expenditures through direct inquiries. There may be other instances of similar ratepayer-funded advocacy against building electrification of which we are unaware. Going forward, no ratepayer money should be used to fund SoCalGas' efforts to oppose building electrification. SoCalGas' advocacy in this area serves only to obstruct adoption of this essential transition to low-carbon energy use serves the interests of its shareholders, not its ratepayers.

Q. Please provide additional examples of the Policy Group's advocacy related to natural gas as a transportation fuel. (O'Dea)

A. SoCalGas has advocated against investments in electric vehicles before regional agencies and local governments. For example, SoCalGas has told regional planning entities and local governments that buses powered by renewable natural gas have emissions lower than electric buses.[55] This statement is false, viewed both when considering vehicle tailpipe emissions and viewed from a life cycle basis.

Electric buses have no tailpipe emissions while compressed natural gas ("CNG") buses have significant tailpipe emissions regardless of whether the bus is "fueled" by biomethane or not. If biomethane were used directly in a vehicle, its tailpipe emissions of carbon dioxide, carbon monoxide, sulfur dioxide, nitrogen oxides ("NO_x"), and particulate matter would be virtually identical to using fossil natural gas. However, most vehicles today that claim to be "fueled" by biomethane are not actually using biomethane but paying for biomethane to be injected into a natural gas pipeline where it is mixed with an overwhelming majority of fossil natural gas.[56] SoCalGas has stated that none of its existing natural gas vehicles are supplied by renewable natural gas.[57]

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[54] Decarbonized Gas Report, *supra* fn.10, p. 31.
[55] Attach. 6(a), SoCalGas, *Comments to Southern California Association of Governments on the Regional Transportation Plan/Sustainable Communities Strategy*, p. 3 (Feb. 1, 2016); *see also* Attach. 6(b), SoCalGas and SDG&E, *Written Comments to CARB on the 2030 Target Scoping Plan Update Concept Paper*, p. 5 (July 8, 2016).
[56] *See* CARB, *Low Carbon Fuel Standard Pathways*, https://www.arb.ca.gov/fuels/lcfs/fuelpathways/current-pathways_all.xlsx.
[57] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-01, Q.3(i).

On behalf of the Union of Concerned Scientists, I coauthored a study that analyzed the life cycle emissions from transit buses as a representative example of heavy-duty vehicles.[58] Buses resemble other heavy-duty vehicles in many ways, including weight, size, fuel efficiency, emissions, urban routes, and central vehicle depots. The analysis found that battery electric vehicles on today's grid in California provide significant emission benefits compared to other technologies and fuels, even compared to low-NO_x natural gas vehicles fueled with biomethane from landfills.

The analysis considered both tailpipe emissions and "upstream" emissions from producing the fuel. Upstream emissions were based on fuels and electricity used in California. It is important to consider both upstream and tailpipe emissions in policymaking to not inadvertently shift pollution from one community to another. The analysis included global warming emissions, NO_x emissions, and particulate matter emissions for different fuel types, and found the following:

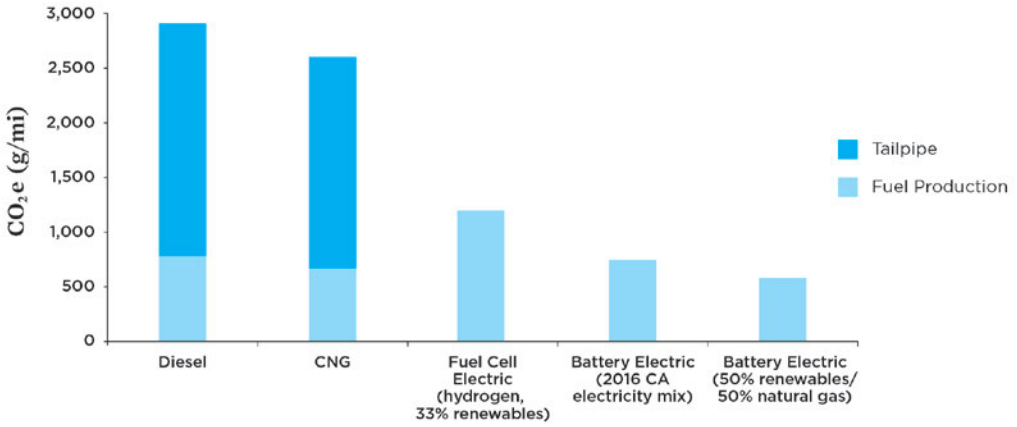
- CNG buses fueled with fossil natural gas offer minimal reductions in global warming emissions compared to diesel buses, confirming findings of other studies (See Figures 1 and 2).[59]

- Life cycle global warming emissions from battery electric buses on today's grid in California (2016) are more than 70 percent lower than both CNG and diesel buses (See Figure 1).

[58] Attach. 9, Sara Chandler, Joel Espino, and Jimmy O'Dea, *Delivering Opportunity: How Electric Buses and Trucks Can Create Jobs and Improve Public Health in California*, Union of Concerned Scientists and The Greenlining Institute (May 2017), www.ucsusa.org/sites/default/files/attach/2016/10/UCS-Electric-Buses-Report.pdf ("Delivering Opportunity Study").

[59] *See* Daniel S. Cohan and Shayak Sengupta, *Net greenhouse gas emissions savings from natural gas substitutions in vehicles, furnaces, and power plants*, International Journal of Global Warming 9(2):254-74 (2016); Jonathan R. Camuzeaux *et al.*, *Influence of methane emissions and vehicle efficiency on the climate implications of heavy-duty natural gas trucks*, Environmental Science & Technology 49(11):6402-10 (2015); Fan Tong *et al.*, *Comparison of life cycle greenhouse gases from natural gas pathways for medium and heavy-duty vehicles*, Environmental Science & Technology 49(12):7123-33 (2015).

Figure 1. Life cycle global warming emissions of transit buses powered by diesel, natural gas, biomethane, electricity, and hydrogen.[60]



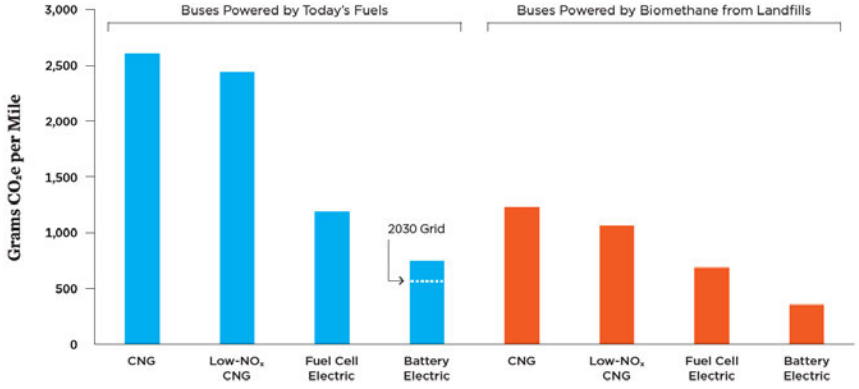
Life cycle global warming emissions from diesel and compressed natural gas (CNG) buses are far higher than those from fuel cell electric buses (fueled by hydrogen, H_2) or battery electric buses.

Note: Comparison based on emissions from 40-foot transit buses. CO_2e stands for carbon dioxide equivalent.

- Electric buses have 30 percent lower emissions than buses fueled with biomethane from landfills (the predominant and most cost-effective source of biomethane) on a life cycle basis (Figure 2).[61] However, a true apples-to-apples comparison of electric and natural gas buses would compare electricity grid emissions to natural gas "grid" emissions—that is, the carbon intensity of all gas in the natural gas pipeline, whether biomethane or fossil natural gas, just as the electric grid consists of electricity from renewable resources, combustion power plants, and other sources. About 0.6 percent of the natural gas procured by volume in California is biomethane,[62] while fossil natural gas makes up the remaining 99.4 percent. Accounting for this distribution reduces the carbon intensity of the natural gas grid by just 0.3 percent.[63]

[60] Attach. 9, Delivering Opportunity Study, p. 16.
[61] Claims that biomethane has lower global warming emissions can be traced to a narrow focus on biomethane from dairies, which has a much lower carbon intensity than biomethane from landfills but contributes much smaller amounts to supplies of biomethane, largely due to much greater costs for dairy biomethane. Jaffe *et al.*, *supra* fn.16, p.73.
[62] Biomethane usage in 2016 was 88 million diesel gallon equivalent ("dge") (12 Bcf). CARB, *Low Carbon Fuel Standard*, https://www.arb.ca.gov/fuels/lcfs/dashboard/quarterlysummary/quarterlysummary_031618.xlsx ("Fuels" tab, sum of cells W48 through Z48 and W49 through Z49). Statewide use of natural gas was 15,700 dge (2,177 Bcf). U.S. EIA, *supra* fn.14.
[63] Fossil natural gas produces 2,606 g CO_2e/mi on a life cycle basis compared to the biomethane volume weighted average of 2,597 g CO_2e/mi. *See* Attach. 9, Delivering Opportunity Study.

Figure 2. Life cycle global warming emissions of transit buses powered by diesel, natural gas, biomethane, electricity, and hydrogen.[64]

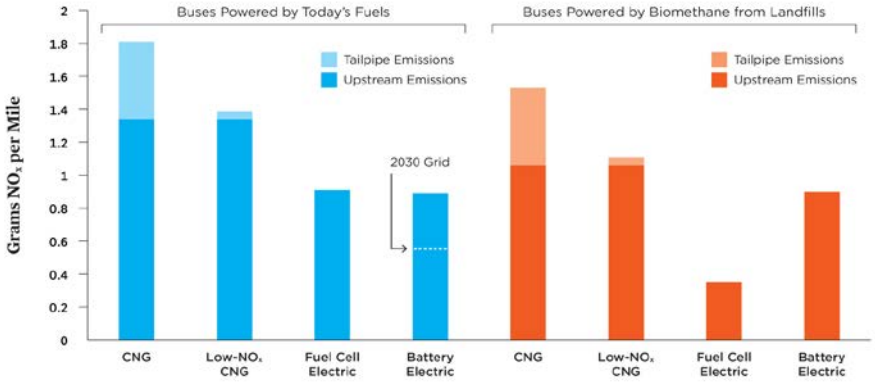


Biomethane generates the lowest carbon emissions when used to produce electricity or hydrogen for battery and fuel cell electric vehicles. Battery electric vehicles on today's grid also have lower global warming emissions than low-NO_x CNG vehicles fueled with biomethane.

Notes: CO_2e stands for carbon dioxide equivalent. Bus-related emissions are a representative example of emissions from other heavy-duty vehicles. Electricity emissions are based on the 2016 grid mix in California; hydrogen emissions assume 33 percent is generated using renewable energy (per Senate Bill 1505). Biomethane emissions are based on landfill gas, as it is the predominant source of biomethane consumed in California (CARB 2017b). The dashed line indicates emissions from a battery electric bus using an estimate of California's grid mix in 2030; it assumes 50 percent of electricity comes from renewable energy (per Senate Bill 350) and 50 percent of electricity comes from natural gas power plants. This represents a conservative estimate of California's future sources of electricity. Life cycle emissions include those from fuel production ("upstream") and fuel consumption ("tailpipe").

- Battery electric vehicles powered by today's grid provide 20 percent lower NO_x emissions than low-NO_x CNG vehicles fueled with biomethane from landfills (Figure 3).[65]

Figure 3. Life cycle NOx emissions of transit buses powered by diesel, natural gas, biomethane, electricity, and hydrogen.[66]



The lowest life cycle emissions of nitrogen oxides (NO_x) from biomethane results from generating electricity or hydrogen for use in battery or fuel cell electric vehicles.

Notes: Bus-related emissions are a representative example of emissions from other heavy-duty vehicles. Electricity emissions are based on the 2016 grid mix in California; hydrogen emissions assume 33 percent is generated using renewable energy. Biomethane emissions are based on landfill gas, as it is the predominant source of biomethane consumed in California (CARB 2017b). The dashed line indicates emissions from a battery electric bus using an estimate of California's electricity sources in 2030 and assumes 50 percent of electricity comes from renewable energy (per Senate Bill 350) and 50 percent of electricity comes from natural gas power plants. This represents a conservative estimate of California's future sources of electricity.

[64] Attach. 3, UCS 2017, p. 6.
[65] Attach. 9, Delivering Opportunity Study; CEC Docket No. 17-IEPR-10, Don Anair, Jeremy Martin, and Jimmy O'Dea, *Union of Concerned Scientists Comments on Renewable Gas* (July 14, 2017), http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR-10/TN220161_20170714T105011_Jimmy_O'Dea_Comments_Union_of_Concerned_Scientists_Comments_on.pdf.
[66] Attach. 3, UCS 2017, p. 7.

Since the release of the report in October 2016, we have updated our analysis to reflect the final grid emissions in California for 2016.[67] The updated numbers show battery electric buses have 77 percent lower global warming emissions than diesel and CNG buses (compared to 70 percent lower in our original analysis). We have also updated our analysis of emissions from biomethane used in CNG vehicles to reflect the volume-weighted average lower carbon intensity of biomethane used in California in 2016 (36 g CO_2e/MJ)[68] rather than just the average carbon intensity of biomethane from landfills as used in the original analysis (40 g CO_2e/MJ). Using these updated numbers, and considering a CNG vehicle with the latest NO_x emission controls, a battery electric vehicle on today's grid has 41 percent lower life cycle global warming emissions than a CNG vehicle fueled with biomethane (compared to 30 percent lower in our original analysis). The updated numbers reflect that California's electricity grid is getting cleaner every year.

SoCalGas' policy advocacy before state agencies and local governments does not represent the relative emissions of gas and electric buses accurately. For example, in the SB 350 Transportation Electrification proceeding, SoCalGas testified that "on a 'well to wheel' basis, 'low NO_X' natural gas buses and RNG provide greater GHG emission reductions."[69] This testimony misinterprets a Ramboll study that in fact found electric buses have lower emissions per vehicle than CNG with biomethane from landfills. SoCalGas' false statement that CNG buses fueled by biomethane have lower greenhouse gas emissions than electric buses is not based on a vehicle-to-vehicle comparison, but instead relies on an arbitrary selection of scenarios looking at cumulative emissions over the next 40 years where CNG buses fueled with biomethane are fully deployed in 2018 compared to full deployment of electric vehicles in 2038. The 20-year head start for CNG buses allows this scenario to generate overall lower emissions.[70] The Policy Group even created a series of fact sheets in an attempt to dissuade LA Metro from

[67] Updated electricity emissions in California in 2016 (297 g CO_2e/kWh) come from the U.S. Environmental Protection Agency's eGRID database. *See* U.S. Environmental Protection Agency, *Emissions & Generation Resource Integrated Database (eGRiD)*, https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid.

[68] Personal communication with Stephen d'Esterhazy, CARB (June 20, 2017).

[69] Attach. 10, A.17-01-021, Direct Testimony of Edwin T. Harte on Behalf of SoCalGas, p. 13 (Aug. 1, 2017).

[70] M.J. Bradley & Associates and Ramboll Environ., *Zero Emission Bus Options: Analysis of 2015-20155 Fleet Costs and Emissions* (Sept. 29, 2016), http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR-10/TN220202_20170714T152616_SoCalGas_Comments_Zero_Emission_Bus_Options_Analysis_of_2015205.pdf.

committing to phase-out natural gas buses that are based on the same misinterpretation of the Ramboll study results.[71]

Q. What other comments has SoCalGas made against transportation electrification? (O'Dea)

A. SoCalGas also misstates the current state of electric bus technology. For example, in comments written in 2017 on the CEC's Integrated Energy Policy Report, SoCalGas claims, "We can do this [transition to natural gas buses] in the next several years and not wait 20 years – a generation – before we begin to realize these emission reductions."[72] Similarly, SoCalGas stated in a letter regarding the City of Indio's General Plan Update that natural gas is a better fuel option when "electrification is either not a readily economically feasible option or has a long timeline projection for development. Such is the case, currently, for . . . buses."[73] These statements about the current feasibility of electric buses are false.

Electric buses are readily available today, with 22 models offered from eight manufacturers.[74] Over 100 electric buses have been deployed in California and more than 300 additional electric buses are on order.[75] An additional 285 zero-emission transit buses were recently awarded to California transit agencies from the California State Transportation Agency.[76] CARB's proposal for allocating the Volkswagen Environmental Mitigation Trust will fund another 425 zero-emission transit and school buses, if approved at the May 25, 2018 CARB Board meeting.[77]

Furthermore, in urging against policies that would increase electric bus adoption, SoCalGas misrepresents current options – for example, stating that the "use of

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[71] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-06, Q.7 (with attached fact sheets).
[72] Attach. 6(a), SoCalGas, *Comments to Southern California Association of Governments on the Regional Transportation Plan/Sustainable Communities Strategy*, p. 3 (Feb. 1, 2016).
[73] Attach. 6(p), SoCalGas, *Letter to Leila Namvar, Assistant Planner, City of Indio, Re: Indio General Plan Update*, p. 2 (undated).
[74] CARB, *Innovative Clean Transit*, Slide 12 (Dec. 15, 2017), https://arb.ca.gov/msprog/ict/meeting/mt171215/171215presentation.pdf.
[75] *Id.* at Slide 10.
[76] California State Transportation Agency, *Transportation Agency Awards $2.6 Billion in Funding to Support Transit and Intercity Rail* (Apr. 26, 2018), https://calsta.ca.gov/2018/04/26/transportation-agency-awards-2-6-billion-in-funding-to-support-transit-and-intercity-rail/.
[77] CARB, *Proposed Beneficiary Mitigation Plan for the Volkswagen Environmental Mitigation Trust,* p. 21 (Apr. 20, 2018) https://www.arb.ca.gov/msprog/vw_info/vsi/vw-mititrust/meetings/proposed_bmp.pdf.

electric buses in lieu of other alternate fuels and technologies will be extremely expensive."[78] In fact, the total cost of ownership for a battery electric bus is competitive with diesel and natural gas technologies today.[79]

SoCalGas' rate-based efforts to push local governments to procure natural gas buses over electric options are intended to lock in dependency to gas as a fuel source. In comments to the City of Pasadena, SoCalGas stated that "as Pasadena Transit has already invested in upgrading their fleets with CNG vehicles, a decision to electrify fleets could result in stranded investments. SoCaGas [sic] recommends that the City of Pasadena consider the costs and difficulty of transitioning fleets to electric technology."[80]

In justifying cost recovery for these activities, SoCalGas asserts that "[a]bsent SoCalGas' involvement in these planning activities, communities may fall short of attaining state emission reduction goals."[81] In my opinion, its involvement does the opposite by not only encouraging long-term investments in combustion technologies but also using those initial investments to justify continued dependency on fossil fuels. While SoCalGas' intervention in the procurement decisions of local governments may benefit its shareholders, it undermines the achievement of California's climate objectives and is not an activity that should be funded by SoCalGas ratepayers.

Q. Aside from buildings and transportation, in what other contexts has SoCalGas raised biomethane as a substitute for electrification? (O'Dea)

A. SoCalGas often offers the promise of biomethane as a reason why electrification of various sectors is unnecessary to meet state climate goals. In my review of SoCalGas' regulatory and policy comments, it suggests the following sectors can be powered by biomethane:

- Electricity generation[82]

[78] *See, e.g.*, Attach. 6(o), CEC Docket No. 17-IEPR-01, SoCalGas, *Comments on the Proposed Final 2017 Integrated Energy Policy Report*, p. 4 (Feb. 7, 2018).
[79] CARB, *5th Innovative Clean Transit Workgroup Meeting*, Slide 40 (June 26, 2017), https://arb.ca.gov/msprog/ict/meeting/mt170626/170626_wg_pres.pdf. Development of commercial electric vehicle rates such as that proposed by SCE offer even more favorable charging rates than today.
[80] Attach. 6(n), SoCalGas, *Letter to Anita Cerna, Senior Planner, City of Pasadena, Re: City of Pasadena Draft Climate Action Plan*, p. 2 (Jan. 23, 2018).
[81] Exh. SCG-21, Alexander Direct, p. LLA-21:15-16.
[82] *See, e.g.*, Attach. 6(q), SoCalGas, *Letter to Troy Clark, General Plan Administrator, City of Redlands, Re: City of Redlands Draft Sustainable Community Element*, p. 1 (undated) (stating the list of renewable electricity generation technologies "should include consideration of bioenergy

- City transit fleets[83]
- Heavy-duty vehicles and freight movement[84]
- Rail[85]

Similar to its advocacy against building and transportation electrification at the CEC, SoCalGas' promotion of investments in combustion technologies before local governments does not appear to clarify the limited supply of biomethane available. SoCalGas asserts that its participation in these proceedings is needed "to educate policymakers on gas utility operations and the use of natural gas and renewable gas by our customers and to support the agencies in achieving state environmental goals."[86] In my opinion, SoCalGas' failure to disclose the limited biomethane potential in arguing against electrification in agency proceedings both misinforms policymakers and undermines the aggressive action needed to achieve state environmental goals.

Q. What is the appropriate role of biomethane in meeting California's greenhouse gas reduction objectives? (O'Dea)

A. While there is some role for biomethane to play in replacing current uses of natural gas, the limited quantity available should be used in applications that are the most difficult to transition to electricity.[87] There is nowhere near enough potential biomethane to justify forestalling electrification of the building and transportation sectors. As CARB's 2017 Climate Change Scoping Plan recognizes, "[f]or end uses that *must* continue to rely on natural gas, renewable

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resources . . . such as biogas and biomethane"); Attach. 6(d), SoCalGas and SDG&E, *Written Comments to CARB on the Scoping Plan Update Workgroup on the Energy Sector*, p. 2 (Sept. 7, 2016) ("Distributed generation resources powered by RNG . . . can help manage load centers and our electricity demand.").

[83] *See, e.g.*, Attach. 6(n), SoCalGas, *Letter to Anita Cerna, Senior Planner, City of Pasadena, Re: City of Pasadena Draft Climate Action Plan*, p. 1 (Jan. 23, 2018); Attach. 6(h), SoCalGas, *Comments to CARB on the 2017 Climate Change Scoping Plan Update* (Apr. 10, 2017), pp. 5-6; Attach. 6(e), SoCalGas, *Written Comments to CARB on the 2030 Target Scoping Plan Update November 7, 2016 Workshop*, p. 4 (Nov. 21, 2016).

[84] *See, e.g.*, Attach. 6(c), SoCalGas, *Comments to South Coast Air Quality Management District and CARB on Proposed 2016 State Strategy for the State Implementation Plan*, p. 3 (July 18, 2016); Attach. 6(p), SoCalGas*, Letter to Leila Namvar, Assistant Planner, City of Indio, Re: Indio General Plan Update*, p. 2 (undated).

[85] *See, e.g.,* Attach. 6(p), SoCalGas, *Letter to Leila Namvar, Assistant Planner, City of Indio, Re: Indio General Plan Update*, p. 2 (undated); Attach. 6(a), SoCalGas, *Comments to Southern California Association of Governments on the Regional Transportation Plan/Sustainable Communities Strategy*, p. 2 (Feb. 1, 2016).

[86] Exh. SCG-21, Alexander Direct, pp. LLA-27:28 - 28:2.

[87] Attach. 3, UCS 2017, p. 3.

natural gas could play an important role."[88] End uses like transportation and building heating need not continue to rely on fossil fuels because electric options are, or will soon be, available.

IV. SoCalGas' Proposed Vehicle Fleet Investments Fail to Consider Electric Options (O'Dea)

Q. What is your understanding of the current vehicle and fuel type mix of SoCalGas' vehicle fleet?

In response to a Sierra Club/UCS Data Request, SoCalGas identified its fleet by vehicle type and fuel type as of year-end 2016 as follows:[89]

VEHICLE TYPES / No. of Units by Fuel Type	BI FUEL	CNG	DIESEL	ELECTRIC	HYBRID	LPG	NO FUEL	SOLAR	UNLEADED	Grand Total
AUTOMOBILES	102	180			85				14	381
COMPACT TRUCK & VANS									535	535
LIGHT TRUCK & VANS	193	536							2,153	2,882
MEDIUM DUTY TRUCK		10	489						66	565
HEAVY DUTY TRUCK		5	71							76
TRAILER			63				521	89	2	675
CONSTRUCTION EQUIPMENT			106	69		57	6		51	289
Grand Total	**295**	**731**	**729**	**69**	**85**	**57**	**527**	**89**	**2,821**	**5,403**

Q. What is your understanding of SoCalGas' proposed vehicle feet purchases?

A. SoCalGas states that it "continues to work toward its target of a majority NGV [natural gas vehicle] fleet and is targeting over 1,300 AFV's [alternative fuel vehicles] by 2020" and proposes to "grow its natural gas fleet by replacing traditional petroleum and diesel vehicles with natural gas vehicles."[90] Consistent with this objective, the replacement vehicles SoCalGas placed into service in 2017 were largely fueled by natural gas, as shown below in the table provided in response to a Sierra Club/UCS Data Request.[91]

VEHICLE TYPES	DED CNG	DIESEL	SOLAR	UNLEADED
COMPACT TRUCK VANS				1
LIGHT TRUCK VANS	80			8
MEDIUM DUTY TRUCK	13	24		17
HEAVY DUTY TRUCK		2		
NON MECHANIZED TRAILER			23	
Grand Total	93	26	23	26

[88] 2017 Climate Change Scoping Plan, p. 66 (emphasis added).
[89] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-01, Q.2(a).
[90] Exh. SCG-23-R, Revised Direct Testimony of Carmen L. Herrera, pp. CLH-53:15-16, CLH-21:2-3 (Dec. 2017) ("Herrera Rev. Direct").
[91] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-02, Q.13.

SoCalGas has stated it "does not have electric vehicles in the vehicle forecast."[92]

Q. Should SoCalGas be permitted to procure natural gas vehicles without first evaluating electric and hybrid electric options?

A. No. SoCalGas' fleet purchases are funded by ratepayers. Regardless of whether SoCalGas is a gas company, its fleet purchases should maximize ratepayer, economic, climate, and public health benefits.

Q. In proposing to "work toward its target of a majority NGV fleet," does SoCalGas' Application demonstrate the superior climate or public health benefits of CNG vehicles over electric and hybrid electric options?

A. No. SoCalGas avoids a comparison with electric (non-combustion) vehicles by stating that "[n]atural gas is the cleanest *burning* alternative transportation fuel that can economically power light-, medium-, and heavy-duty vehicle applications."[93] Indeed, its support for this statement is from a webpage of "Natural Gas Vehicles for America" that does not compare emissions reductions from electric or hybrid electric vehicles.[94] Similarly, its calculation of purported greenhouse gas emissions reductions achieved through CNG vehicle procurement does not address savings that would be achieved were procurement of electric and hybrid electric options maximized.[95]

Q. What are the greenhouse gas benefits of procuring NGVs to replace vehicles using diesel or gasoline?

A. Replacing diesel or gasoline with natural gas has little to no benefits for the climate, depending on the extent of natural gas leaks along the supply chain and the losses in fuel efficiency of a NGV compared to diesel or gasoline engines. In a recent life cycle analysis I conducted for the Union of Concerned Scientists, we found natural gas buses have nine percent lower global warming emissions than diesel buses. By comparison, battery electric buses on today's grid in California have more than 70 percent lower global warming emissions than natural gas buses. Fuel cell electric buses have 50 percent lower life cycle emissions.[96]

Our analysis is consistent with other scientific investigations of this question. The volume-weighted average carbon intensity of CNG in California's Low Carbon Fuel Standard was 10 percent lower than the carbon intensity required of diesel

[92] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-02, Q.14.
[93] Exh. SCG-23, Herrera Rev. Direct, p. CLH-21:6-7.
[94] *Id.* (citing Natural Gas Vehicles for America, Environmental Benefits).
[95] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-01, Q.6.
[96] Attach. 9, Delivering Opportunity Study.

fuel in 2017.[97] Depending on the assumptions regarding the methane leakage or the fuel economy of NGVs compared to diesel, other studies have found natural gas can be worse than diesel for climate change.[98] Notably, SoCalGas recorded 13 instances of methane leakage from its NGV refueling stations in 2016 alone.[99]

Results from the analyses above reflect a global warming potential of methane over a 100-year time frame; however, methane has an even greater warming effect over shorter periods. Using the global warming potential of methane over a 20-year period instead of 100 years, our analysis shows natural gas buses have 20 percent more global warming emissions than diesel buses.

The U.S. DOE similarly found natural gas light-duty vehicles (390 g CO_2e/mi) have roughly nine percent lower global warming emissions compared to gasoline vehicles.[100] Our analysis using 2016 grid emissions rates in California shows the average light-duty electric vehicle has 74 percent lower global warming emissions than natural gas vehicles (101 g CO_2e/mi).[101]

I therefore disagree with SoCalGas' assertion that in replacing diesel and gasoline vehicles with natural gas vehicles, it "is supporting California's state initiatives to . . . achieve greenhouse gas (GHG) emission reduction targets of 40 percent below 1990 levels by 2030, with continued progress towards an 80 percent reduction by 2050."[102] The greenhouse gas reductions from converting petroleum and diesel vehicles to natural gas are far too nominal to meet the steep reductions needed to achieve California's greenhouse gas reduction objectives.

As discussed above in Section II of this testimony, electric vehicle options have superior benefits for the climate, air quality, and public health compared to both diesel and natural gas. Life cycle emissions of battery electric vehicles on today's

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[97] The volume-weighted average carbon intensity of CNG in the Low Carbon Fuel Standard was 89 g CO_2e/MJ in 2017. CARB, *Data Dashboard*, Tab 5 (last updated April 25, 2018) https://www.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm. *Compare with* CARB, *Low Carbon Fuel Standard Final Regulation Order*, p. 33 https://www.arb.ca.gov/regact/2015/lcfs2015/lcfsfinalregorder.pdf (2017 carbon intensity standard for diesel of 98 g CO_2e/MJ).

[98] Cohan and Sengupta, *supra* fn.59; Camuzeaux *et al.*, *supra* fn.659; Tong *et al.*, *supra* fn.59.

[99] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-01, Q.10(b)(ii).

[100] U.S. DOE, *Using Natural Gas for Vehicles: Comparing Three Technologies* (Dec. 2015), https://www.nrel.gov/docs/fy16osti/64267.pdf.

[101] David Reichmuth, *New Data Show Electric Vehicles Continue to Get Cleaner, United of Concerned Scientists* (Mar. 8, 2018), https://blog.ucsusa.org/dave-reichmuth/new-data-show-electric-vehicles-continue-to-get-cleaner. CA grid emissions of 297 g CO_2e/kWh and average efficiency of electric vehicles of 0.3385 kWh/mi.

[102] Exh. SCG-23-R, Herrera Rev. Direct, p. CLH-20:27 - 21:2.

grid are significantly lower than combustion technologies, including natural gas vehicles. Battery electric vehicles have no tailpipe emissions, eliminating hazardous exhausts where these vehicles operate; their emissions depend solely on how the electricity is produced, and California's sources of electricity are becoming cleaner every year.

Q. In proposing to "work toward its target of a majority NGV fleet," does SoCalGas' Application demonstrate the ratepayer benefits of NGVs over electric and hybrid electric options?

A. No. SoCalGas' cost demonstration is limited to the identification of purchase premiums for some vehicle classes and technologies.[103] SoCalGas does not identify a purchase premium for electric models, though it identifies a substantially lower premium for hybrid electric full size trucks and vans as compared to NGVs.[104]

Purchase premium is only one factor in assessing total vehicle costs: Fuel costs and maintenance over the vehicle's lifetime are a significant factor in determining overall ratepayer value. SoCalGas has stated it pools "maintenance expenses and [does] not distinguish between fuel types" in tracking O&M expenses.[105] Accordingly, SoCalGas does not appear to provide a basis upon which to compare operating costs of electric and hybrid electric vehicles with proposed NGV purchases.

SoCalGas also does not account for the increased refueling infrastructure costs to serve the proposed additional NGVs to its fleet. One of the justifications for the increased request for costs of refueling stations (from $5.66 million in 2016 to $18.8 million in 2019) is for an "[i]ncrease [in] fueling capacity due to the increase number of fleet vehicles served by our internal stations as well as the needed expansion of fueling capabilities to additional SoCalGas operating bases."[106] SoCalGas does not assess the comparative costs of providing or accessing electric vehicle refueling infrastructure to avoid these costs, diversify its fleet, and take advantage of the superior environmental benefits of electric vehicles. Instead, SoCalGas states that the reason it did not evaluate hybrid electric truck options, despite their lower purchase premium when compared to NGV models, is because it "does not have charging infrastructure for plug-in vehicles."[107]

[103] Exh. SCG-23-WP-S-C, Confidential Supplemental Workpapers to the Direct Testimony of Carmen Herrera.
[104] *Id.*
[105] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-03, Q.4(a).
[106] Exh. SCG-23-R, Herrera Rev. Direct, p. CLH-53:27-29 and Table CLH-25.
[107] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-03, Q.3(b).

Q. Do you agree that SoCalGas' current lack of charging infrastructure justifies the purchase of NGVs with higher premiums?

A. No. Investments in electric infrastructure to support electric and hybrid electric vehicles are much lower than proposed costs for new and expanded NGV refueling stations. While the specific costs of new natural gas refueling stations are designated as confidential in SoCalGas testimony, SDG&E states in its public testimony that the cost of a single new NGV refueling station is $2.617 million.[108] In contrast, utility estimates in the SB 350 Transportation Electrification proceeding for medium-heavy duty electric vehicle infrastructure were $150,000 to $400,000 per site.[109]

Q. Can electric vehicle options provide better value to ratepayers than gas vehicles?

A. Yes. Electric vehicles are significantly more fuel efficient than combustion technologies, reducing fuel costs. The higher efficiency of electric vehicles compared to combustion technologies is due to the laws of thermodynamics: natural gas and diesel engines generate heat during combustion, and heat represents wasted energy that is not converted into mechanical energy to propel the vehicle. On-road testing by the Federal Transit Administration of the same make of transit buses across diesel, natural gas, and battery electric models revealed the battery electric model is nearly four times more efficient than the diesel and natural gas models.[110] Recent on-road testing by NREL of battery electric transit buses operated by Foothill Transit in the San Gabriel Valley also found that the fuel economy of battery electric buses is four times better than CNG buses and up to eight times better on certain routes.[111]

Even after accounting for the efficiency of electricity generation and transmission, a battery electric bus will travel farther than a diesel or natural gas vehicle for the same amount of fuel. For example, a battery electric bus powered by electricity exclusively from a natural gas power plant will travel twice as far as a CNG bus using the same amount of natural gas, accounting for the efficiency of a natural gas power plant (51 percent), losses in the transmission and distribution of electricity (6.5 percent), and vehicle efficiencies (18.3 miles per diesel gallon equivalent for a battery electric bus and

[108] Exh. SDG&E-04-R, Revised Directed Testimony of Gina Orozco-Mejia, p. GOM-99:1-2 (Dec. 2017) ("Orozco-Mejia Rev. Direct").
[109] A.17-01-020 *et al.*, *Proposed Decision on the Transportation Electrification Standard Review Projects*, p. 74 (Mar. 30, 2018).
[110] Attach. 9, Delivering Opportunity Study, p. 2.
[111] Leslie Eudy and Matthew Jeffers, *Foothill Transit Battery Electric Bus Demonstration Results: Second Report*, NREL, pp. 13-14, 16-17 (June 2017), https://www.nrel.gov/docs/fy17osti/67698.pdf.

4.5 miles per diesel gallon equivalent for a CNG bus).[112] The U.S. DOE found similar results in a comparison of natural gas and battery electric light-duty vehicles.[113]

On today's electricity rates in Southern California, a fleet of heavy-duty battery electric vehicles can charge overnight at roughly the same cost as natural gas;[114] with revenue from the Low Carbon Fuel Standard, fuel costs can be even lower than natural gas. Notably, while SoCalGas states that the price spread between natural gas and diesel will "drive[] customers to adopt natural gas," its analysis again fails to account for electric vehicle options."[115]

A 2014 paper by the Electric Edison Institute ("EEI"), *Transportation Electrification: Utility Fleets Leading the Charge*, found that "fleet operators agree that electric-based vehicles have lower maintenance costs due to fewer parts and reduced engine usage. Regenerative braking reduces brake wear and electric driveline components tend to be more robust than conventional driveline components. Savings are achieved both in parts and labor as inspection and service intervals are less frequent."[116]

Q. What is your understanding of the electric vehicle options available in each vehicle type in SoCalGas' fleet?

A. The availability of electric vehicle options differs by vehicle class. For passenger vehicles, there is a wide range of available electric models while NGV models have been discontinued from production by original equipment manufacturers. For light-duty trucks and vans, which constitute the majority of SoCalGas' fleet, hybrid electric and electric models are available and are being procured by a number of fleet owners, including utilities. There are numerous electric options for medium-duty trucks and vans. For

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[112] Attach. 9, Delivering Opportunity Study, p. 16.
[113] U.S. DOE, *Using Natural Gas for Vehicles: Comparing Three Technologies*, p. 2 (Dec. 2015), https://www.nrel.gov/docs/fy16osti/64267.pdf.
[114] For example, a fleet of 50 heavy-duty vehicles with an efficiency of 2 kWh/mi and traveling 50 miles per day can charge overnight (off-peak) on SCE's EV-6 rate for $0.27/mile. This is the same cost as fueling CNG heavy-duty vehicles at a commercial natural gas cost of $8.77/thousand cubic feet in 2017 in California with a 4.5 mpdge efficiency (equivalent to 2 kWh/mi electric vehicle). For electricity costs, *see* CARB, *Battery Electric Bus Charging Calculator*, https://www.arb.ca.gov/msprog/bus/rate_calc.xlsm. For natural gas costs, *see* U.S. EIA, *Natural Gas Commercial Price*, https://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PCS_DMcf_a.htm.
[115] Exh. SCG-20, Direct Testimony of Andrew S. Cheung, p. ASC-38:31-32 (Oct. 6, 2017).
[116] Attach. 11, EEI, *Transportation Electrification: Utility Fleets Leading the Charge*, p. 24 (June 2014), http://www.eei.org/issuesandpolicy/electrictransportation/FleetVehicles/Documents/EEI_UtilityFleetsLeadingTheCharge.pdf.

heavy-duty trucks, which constitute less than two percent of SoCalGas' fleet, electric models are rapidly emerging.

I address each vehicle class (excluding trailer and construction equipment) in turn.

Automobile (passenger) vehicles

Automobiles constitute nine percent of SoCalGas' vehicle fleet.[117] There are numerous electric vehicles on the market in this vehicle class: 42 models of electric passenger vehicles available in the United States (as of March 2018), of which 14 models operate entirely on batteries and the remainder are plug-in hybrids.[118] Full battery electric automobiles include the Nissan Leaf, Chevy Bolt, BMW i3, and others. As of March 2018, over 800,000 electric automobiles including full electric and plug-in hybrid models have been sold in the United States since December 2010.[119] Since becoming available in December 2016, 28,000 Chevy Bolts have been sold in the United States.[120]

In contrast to increased sales and models of electric passenger vehicles, there are no longer any models of CNG automobiles from original equipment manufacturers currently available for sale in the United States.[121]

Compact trucks and vans

Compact trucks and vans refer to vehicles smaller than light trucks and vans such as the Ford Ranger and Chevrolet Colorado.[122] Compact trucks and vans

[117] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-01, Q.2(a) (excluding trailers and construction equipment).
[118] InsideEVs, *Monthly Plug-In Sales Score Card*, https://insideevs.com/monthly-plug-in-sales-scorecard/ (last visited Apr. 12, 2018).
[119] Argonne National Laboratory, *Light Duty Electric Drive Vehicles Monthly Sales Update*, Figure 2, https://www.anl.gov/energy-systems/project/light-duty-electric-drive-vehicles-monthly-sales-updates (last visited May 8, 2018).
[120] By comparison, Honda sold a total of 16,000 CNG Civics in the United States over the 17-year period from 1998-2005 that this vehicle was available. *See* Neal E. Boudette, *Honda will drop CNG vehicles to focus on hybrids, EVS,* Automotive News (June 15, 2015), http://www.autonews.com/article/20150615/OEM05/150619915/honda-will-drop-cng-vehicles-to-focus-on-hybrids-evs.
[121] When asked to confirm that new passenger CNG vehicles are no longer available in U.S. markets, SoCalGas responded that "NGV America keeps a list of light-duty vehicles, including passenger vehicles, available for purchase in the United States," and provided a link to a document on the NGV America website. In the document, NGV America does not list any NGV passenger vehicles that are available for purchase, only conversion kits to convert gasoline passenger vehicles to run on natural gas. The link provided in the data request response no longer functions. Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-05, Q.5.
[122] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-03, Q.15(d).

constitute 12 percent of SoCalGas' vehicle fleet.[123] I am unaware of electric models of compact trucks. However, as SoCalGas' fleet also contains no NGVs in this category, NGV models may also be unavailable.[124]

Light-duty trucks and vans

The light-duty truck and van category refers to ½ ton vehicles such as the Ford 150, Chevrolet 1500, and Dodge 1500.[125] Light-duty trucks and vans constitute 65 percent of the SoCalGas vehicle fleet.[126] Hybrid electric and electric options are available and being procured by California fleet operators.

For example, the Workhorse W-15 is a battery electric plug-in hybrid truck similar to the Ford 150, Chevrolet 1500, and Dodge 1500 in terms of size, weight, payload capacity, towing capacity, and seating capacity.[127] The W-15 has an all-electric range of 80 miles and a hybrid range of 310 miles per tank of gasoline.[128] The W-15 also features a 7.2 kW power exporter that can power tools and equipment without the truck running. Over 5,000 orders have been placed for the W-15 by fleet owners, including utility companies.[129] Workhorse advertises the W-15 as having a total cost of ownership lower than the Ford 150 due to fuel and maintenance savings.[130] Workhorse is an original equipment manufacturer and is expected to deliver ordered vehicles at the end of 2018.[131]

Workhorse has also deployed the N-Gen electric light vans, currently being tested by a customer in San Francisco. The van has 100 miles of range on the battery and farther in an extended-range hybrid version of the vehicle. Workhorse says the N-Gen vans can earn back their cost premium in less than three years through

[123] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-01, Q.2(a) (excluding trailers and construction equipment).
[124] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-01, Q.2(a).
[125] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-03, Q.15(d).
[126] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-01, Q.2(a) (excluding trailers and construction equipment).
[127] *See* Workhorse, *W-15 Pickup*, http://workhorse.com/pickup/ (last visited May 10, 2018).
[128] *Id.*
[129] CleanTechnica, *Workhorse W-15 Orders Now Open To The Public* (Jan. 11, 2018), https://cleantechnica.com/2018/01/11/workhorse-w-15-orders-now-open-public/.
[130] Workhorse, *The Workhorse W-15: The Electric Truck With A Lower Total Cost Of Ownership Than A Ford F 150* (May 3, 2017), http://workhorse.com/newsroom/2017/05/workhorse-w-15-electric-truck-lower-total-cost-ownership-ford-f-150.
[131] Emme Hall, *Workhorse W-15 electric pickup truck comes to CES 2018*, CNET (Jan. 9, 2018), https://www.cnet.com/roadshow/news/workhorse-brings-its-w-15-electric-pick-up-truck-to-ces-2018/.

fuel and maintenance savings.[132] UPS is leasing 50 larger versions of the N-Gen, some of which will be deployed in Los Angeles. This initial deployment is the prelude to a larger rollout of these vehicles in 2019 and beyond, according to UPS.[133] UPS has said the purchase cost of these vehicles will be comparable – without incentives – to similarly equipped combustion vehicles.[134] UPS has said its goal is "to make the new electric vehicles a standard selection, where appropriate, in its fleet of the future."[135]

Additionally, the company XL Hybrids offers a battery electric plug-in hybrid version of the Ford 150, offering an advertised increase in fuel efficiency of 50 percent.[136] This vehicle is eligible for a $2,000 purchase incentive from CARB's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project ("HVIP").[137] The vehicle is a standard Ford 150 upfitted by XL Hybrids with plug-in hybrid components. The plug-in hybrid option is offered on a range of Ford 150 configurations.[138] The plug-in hybrid system consists of a 15 kWh battery,[139] which is similar to the 20 kWh effective capacity and range of the Workhorse W-15.[140]

Medium-duty trucks and vans

SoCalGas defines medium-duty trucks as those between 10,001 and 30,000 gross vehicle weight ("GVW").[141] This category constitutes 13 percent of its fleet.[142]

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[132] Eric Walz, *Workhorse Group to Deploy N-Gen Electric Delivery Vans in San Francisco*, FutureCar (Mar. 30, 2018), http://www.futurecar.com/article-2097-1.html; Workhorse, *Step Van*, http://workhorse.com/stepvans (last visited May 10, 2018).
[133] UPS, *UPS To Deploy First Electric Truck To Rival Cost Of Conventional Fuel Vehicles* (Feb. 22, 2018), https://pressroom.ups.com/pressroom/ContentDetailsViewer.page?ConceptType=PressReleases&id=1519225541368-230.
[134] *Id.*
[135] *Id.*
[136] XLFleet, *XLP Plug-in Hybrid Electric Upfit* (Feb. 26, 2018), http://www.xlfleet.com/content/assets/Uploads/XL-XLP-F150-Flyer-8.5x11-LR.pdf.
[137] California HVIP, *Eligible Technologies: Your Clean Vehicles*, https://www.californiahvip.org/eligible-technologies/#your-clean-vehicles (last visited May 10, 2018).
[138] XLFleet, *XLP Plug-in Hybrid Electric Upfit* (Feb. 26, 2018), http://www.xlfleet.com/content/assets/Uploads/XL-XLP-F150-Flyer-8.5x11-LR.pdf.
[139] *Id.*
[140] Fred Lambert, *Workhorse unveils its plug-in electric W-15 pickup truck: $52,000 and 60 kWh battery pack*, Electrek (May 3, 2017), https://electrek.co/2017/05/03/workhorse-plug-in-electric-pickup-truck/.
[141] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-04, Q.1.

Numerous electric vehicle options are currently available in the medium trucks and vans category.

Workhorse offers the E-Gen plug-in hybrid electric step van with 60 miles of range on the battery and 120 miles of total range. Companies that use step vans with the Workhorse chassis (electric motor, batteries, etc.) include the United States Postal Service, DHL, Frito-Lay, Cintas, Aramark, and others.[143]

Chanje offers the battery electric V8100 Panel Van with a 150-mile range, 6,000 lbs payload capacity, and 675 cubic feet of storage space.[144] Truck leasing and rental company Ryder has ordered 125 panel vans from Chanje.[145] Chanje panel vans are eligible for $80,000 incentive funding from HVIP.[146]

Zenith Motors also offers a battery electric cargo van with 530 cubic feet of cargo space, a 3,800 lbs payload capacity, and up to 135 miles in range.[147] This cargo van is eligible for $50,000 incentive funding from HVIP.[148] Zenith also offers a larger battery electric step van with a 6,000 lbs payload capacity and up to 95 miles per charge.[149] Zenith's customers include major hotel chains, local governments, and delivery companies.[150] Zenith advertises over $100,000 in operations savings over the life of their vans.[151]

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[142] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-01, Q.2(a) (excluding trailers and construction equipment).
[143] Workhorse, *Step Van*, http://workhorse.com/stepvans (last visited May 10, 2018).
[144] Chanje, *Vehicles*, https://chanje.com/vehicles/ (last visited May 10, 2018).
[145] Nick Carey, *U.S. rental truck firm Ryder makes first big electric van order*, Reuters (Nov. 2, 2017), https://www.reuters.com/article/us-ryder-chanje-vans/u-s-rental-truck-firm-ryder-makes-first-big-electric-van-order-idUSKBN1D222D.
[146] California HVIP, *Eligible Technologies: Your Clean Vehicles*, https://www.californiahvip.org/eligible-technologies/#your-clean-vehicles (last visited May 10, 2018).
[147] Zenith Motors, *100% Electric Vans & Buses* (Dec. 2017), http://www.zenith-motors.com/wp-content/uploads/2013/05/Brochure122017.pdf.
[148] California HVIP, *Eligible Technologies: Your Clean Vehicles*, https://www.californiahvip.org/eligible-technologies/#your-clean-vehicles (last visited May 10, 2018).
[149] Zenith Motors, *100% Electric Vans & Buses* (Dec. 2017), http://www.zenith-motors.com/wp-content/uploads/2013/05/Brochure122017.pdf.
[150] Zenith Motors, *Our Customers*, http://www.zenith-motors.com/our-customers/ (last visited May 10, 2018).
[151] Zenith Motors, *Home*, http://www.zenith-motors.com/ (last visited May 10, 2018).

Motiv Power Systems offers a battery electric powertrain for the Ford E450, which is eligible for $80,000 incentive funding from HVIP.[152] Motiv's electric Ford E450 is offered as a walk-in van, box truck, work truck, shuttle bus, and school bus with ranges up to 75 miles.[153] Motiv also offers an all-electric powertrain for the Ford F59 and F53 platforms with up to 90 miles in range.[154] Motiv's vehicles are eligible for HVIP incentives of $80,000 to $95,000.[155]

Phoenix Motor Cars also offers a battery electric powertrain for the Ford E450. Phoenix Motor Cars has provided 16 battery electric shuttle buses built on the Ford E450 chassis to Wally Park, an airport parking company serving LAX.[156] The electric Ford E450 has a range of 100 miles and is also sold as a flatbed truck and a utility truck.[157] These trucks are eligible for $50,000 to $80,000 in incentives from HVIP.[158]

Lightning Systems also offers a battery electric version of the Ford Transit 350HD cargo van with a range up to 100 miles and a payload capacity of 2,000-4,000 lbs.[159] Deliveries of these vans were made in March of 2018, and CARB vehicle testing showed the Lightning Systems cargo van has 61 mpg-equivalent on city routes compared to 13 mpg for the gasoline version of the van.[160] Lightning Systems is adding a hydrogen fuel cell range extender to the van that

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[152] California HVIP, *Eligible Technologies: Your Clean Vehicles*, https://www.californiahvip.org/eligible-technologies/#your-clean-vehicles (last visited May 10, 2018).
[153] Motiv Power Systems, *Epic 4 Dearborn*, http://www.motivps.com/motivps/portfolio-items/epic4series/ (last visited May 10, 2018).
[154] Motiv Power Systems, *Epic 6 Dearborn*, http://www.motivps.com/motivps/portfolio-items/epic6dearborn/ (last visited May 10, 2018).
[155] California HVIP, *Eligible Technologies: Your Clean Vehicles*, https://www.californiahvip.org/eligible-technologies/#your-clean-vehicles (last visited May 10, 2018).
[156] Larry E. Hall, *WallyPark Deploys Electric Shuttle Buses at LAX Airport*, HybridCars (Apr. 12, 2017), http://www.hybridcars.com/wallypark-deploys-electric-shuttle-buses-at-lax-airport/.
[157] Phoenix Motor Cars, *Products*, http://www.phoenixmotorcars.com/products/#1505308785414-38579dc5-df17 (last visited May 10, 2018).
[158] California HVIP, *Eligible Technologies: Your Clean Vehicles*, https://www.californiahvip.org/eligible-technologies/#your-clean-vehicles (last visited May 10, 2018).
[159] Lightning Systems, *Products: LightningElectric*, https://lightningsystems.com/lightningelectric (last visited May 10, 2018).
[160] Lightning Systems, *Lightning Systems Showcases All-Electric Ford Transit on Road Show and Announces Industry-Leading Efficiency Results* (Apr. 3, 2018), https://lightningsystems.com/news-posts/lightning-systems-showcases-all-electric-ford-transit-on-road-show-and-announces-industry-leading-efficiency-results.

will provide over 200 miles in range. The battery/fuel cell version will be available in California in September of 2018.[161]

BYD, the largest electric car maker in the world,[162] offers the 5F box truck, a Class 5 (19,500 lbs GVW rating) battery electric truck with a 155-mile range. This truck is eligible for $80,000 incentive funding from HVIP. BYD also offers the 6F box truck, a Class 6 (26,000 lbs GVW rating) battery electric truck with a 124-mile range. The 6F is eligible for $90,000 in HVIP funding.[163] BYD also offers the 6D, a Class 6 (23,000 lbs GVW rating) step van with 100 miles in range.

Mitsubishi FUSO, under the parent company Daimler Group, offers the eCanter, a Class 4 (15,995 lbs GVW rating) battery electric box truck with a range of up to 80 miles. Fleets with eCanters include Habitat for Humanity, UPS, and University of California, Irvine.[164] The eCanter has been deployed since 2017, and a full product launch is scheduled for 2019.[165]

Heavy-duty trucks

Heavy-duty trucks, defined as those above 30,001 GVW, constitute less than two percent of SoCalGas' fleet.[166] Electric options are emerging for this class of vehicles. BYD offers the 8TT, a Class 8 battery electric truck with 100 miles in range.[167] Over 30 of these trucks have been ordered already.[168] This truck is

[161] *Id.*
[162] John Voelcker, *China's BYD tops global electric-car production for third year in a row*, Green Car Reports (Feb. 21, 2018), https://www.greencarreports.com/news/1115398_chinas-byd-tops-global-electric-car-production-for-third-year-in-a-row.
[163] California HVIP, *Eligible Technologies: Your Clean Vehicles*, https://www.californiahvip.org/eligible-technologies/#your-clean-vehicles (last visited May 10, 2018).
[164] John O'Dell, *Daimler Launches eCanter Electric Truck, UPS Among First Customers*, Trucks.com (Sept. 14, 2017), https://www.trucks.com/2017/09/14/daimler-ecanter-electric-truck-launches/.
[165] Mitsubishi Fuso, *eCanter* (2017), http://www.mitfuso.com/files/FUSO-eCANTER-Datasheet-EN-US.pdf.
[166] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-01, Q.2(a) (excluding trailers and construction equipment); Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-04, Q.1.
[167] BYD Product Brochure, Spring 2018.
[168] Personal communication with Zach Kahn, Director of Government Relations & Director of Business Development, BYD (Apr. 30, 2018).

eligible for $150,000 in HVIP incentives.[169] I expect the market for zero-emission heavy-duty trucks to further develop in the coming years, including during the next three years of the current GRC cycle. Because the availability of electric vehicles in this class is growing, in my opinion, it is not prudent to invest ratepayer funds in NGVs and charging infrastructure that will soon be surpassed by cleaner and potentially cheaper electric options.

V. REFUELING STATIONS (O'DEA)

Q. What is your understanding of SoCalGas' proposed investment in NGV refueling stations?

A. SoCalGas is proposing to upgrade existing NGV stations and has plans for 19 new NGV refueling stations: eight that would only serve SoCalGas' fleet and 11 that would be open to the public.[170] SoCalGas seeks $7.175 million in 2017, $15.937 million in 2018, and $18.799 million in 2019. This marks a significant ramping up from the current expenditure level of $5.6 million in 2016.[171]

Q. Has SoCalGas supported the need for new and expanded NGV refueling stations?

A. No. With regard to "Fleet-Public" NGV stations, SoCalGas states that "[a]nalysis was performed to support the need for new proposed public NGV refueling stations" yet then states that the "actual analysis cannot be provided since customer vehicle data used in the analysis was purchased, is proprietary and under the terms of the purchase agreement cannot be provided to 3rd parties."[172]

SoCalGas also stated that its "Fleet-Public NGV stations are planned based on surveys conducted by the SoCalGas NGV team."[173] When asked for the surveys, SoCalGas then "clarifie[d] that the surveys referenced in the original response were conducted by a third party that develops and sells proprietary fleet vehicle data. SoCalGas has no knowledge of the methodology used for the survey and SoCalGas is not in possession of the surveys or responses."[174] When then asked to provide all non-proprietary information supporting

[169] California HVIP, *Eligible Technologies: Your Clean Vehicles*, https://www.californiahvip.org/eligible-technologies/#your-clean-vehicles (last visited May 10, 2018).
[170] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-02, Q.10.
[171] Exh. SCG-23-R, Herrera Rev. Direct, p. CLH-53.
[172] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-02, Q.11.
[173] *Id.*
[174] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-03, Q.1.

the need for the proposed Fleet-Public NGV stations, SoCalGas was unable to provide any.[175]

Q. What is your understanding of SDG&E's proposed investment in NGV refueling stations?

A. SDG&E is requesting to build one NGV refueling station per year in 2018 and 2019 at a cost of $2.617 million per station.[176]

Q. Has SDG&E supported the need for new NGV refueling stations?

A. No. SDG&E states that that "[c]ompany owned public access CNG stations serve the increasing use of CNG vehicles throughout Southern California" but provides no data or projections supporting the need for additional facilities.[177] In response to a data request on this issue from TURN, SDG&E provided a customer survey conducted at its NGV fueling stations in January 2012.[178] A survey conducted in 2012 cannot logically be used to support the need for the new charging stations in 2018 and 2019, given the proliferation of electric vehicle options since 2012 and the decline in availability of natural gas passenger vehicles.

Q. Do additional investments in NGV refueling stations pose risks to ratepayers?

A. Yes. SoCalGas has acknowledged that its existing natural gas refueling infrastructure is at risk of becoming a stranded asset due to vehicle electrification. In the *Application of Southern California Edison Company for Approval of its 2017 Transportation Electrification Proposals*, SoCalGas submitted testimony asserting that "the displacement of natural gas vehicles by the SCE standard review programs would result in long-term stranded costs of utility assets serving natural gas vehicles."[179] As SoCalGas testified, displacement of natural gas vehicles with electric vehicles would:

> [P]lace existing CNG refueling infrastructure at risk, including pipeline extensions, pipeline services and meter set assemblies (MSA's) used to transport and deliver natural gas and renewable gas to natural gas vehicle refueling stations.

[175] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-05, Q.9. SoCalGas provided a list of third party NGV fueling stations closest to its proposed new locations, noting that these third party facilities are not suitable for heavy-duty vehicles. However, this fact does not explain why heavy-duty charging is needed at the proposed locations or include information on distance to the nearest charging station that would be suitable for heavy-duty vehicles.
[176] Exh. SDG&E-04-R, Orozco-Mejia Rev. Direct, pp. GOM-98 - 99.
[177] Exh. SDG&E-04-R, Orozco-Mejia Rev. Direct, p. GOM-98.
[178] SDG&E Response to Data Request TURN-SDG&E-055, Q.1. The results of the survey were designated as confidential.
[179] Attach.10, A.17-01-021, Direct Testimony of Edwin T. Harte on Behalf of SoCalGas, pp. 1-2 (Aug. 1, 2017).

> SoCalGas currently owns and operates twelve (12) CNG stations at utility-owned facilities which serve utility fleet vehicles and the general public. Ratepayer assets supporting these stations, including equipment related distribution service upgrades, have a current book value of $14.5 million. Furthermore, the net book value of natural gas system upgrades, funded by ratepayers, supporting CNG stations owned by 3rd parties is $18.7 million. Accordingly, total SoCalGas ratepayer assets at risk from the possibility of transportation fuel-switching, is potentially $33.2 million."[180]

Rather than decline to approve investments to facilitate electrification of medium- and heavy-duty vehicles as urged by SoCalGas, the Proposed Decision on the Transportation Electrification Standard Review Projects "agree[d] with the 'utilities, transit agencies, and technology providers…that the time is now to invest in the success of transportation electrification.'"[181] The Proposed Decision found "that the utility medium- and heavy-duty programs propose to provide make-ready infrastructure to an appropriate number of sites, striving to 'maximize the benefits of transportation electrification by targeting medium- and heavy-duty vehicles and equipment. These vehicles and equipment create significant levels of pollution, disproportionately impact disadvantaged communities, are ripe for electrification, are the targets of other public investment for electrification, provide platforms for technology development that will promote transfer to other categories, and are primed for acceleration from utility infrastructure investment.'"[182]

Accordingly, SoCalGas is seeking substantial increases in investment in NGV refueling as the market for medium- and heavy-duty electric vehicle options is "primed for acceleration." By SoCalGas' own admission, further expansion of NGV refueling infrastructure will result in substantial stranded asset risk for SoCalGas ratepayers.

Indeed, both state policy and the market are moving toward widespread electrification of vehicles. For example, CARB is currently updating the Low Carbon Fuel Standard, with the new standard expected to be voted on in Fall 2018. CARB has proposed increasing the stringency of the fuel standard by requiring fuels substituting for diesel to have a carbon intensity of 20 percent below diesel by 2030.[183] Because natural gas has a carbon intensity 10 percent

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[180] *Id.* at pp. 22-23.
[181] A.17-10-020, *Proposed Decision on the Transportation Electrification Standard Review Projects*, p. 73 (Mar. 30, 2018), http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M212/K643/212643024.PDF.
[182] *Id.*
[183] CARB, *Staff Report: Initial Statement of Reasons*, Attachment A, Low Carbon Fuel Standard Proposed Regulation Order, p. 61, Table 2 (Mar. 6, 2018), https://www.arb.ca.gov/regact/2018/lcfs18/appa.pdf.

below the 2017 LCFS standard diesel, natural gas may soon no longer be considered a "low carbon" fuel, reducing the incentive to purchase a NGV.[184] Similarly, the California State Transportation Agency allocated all transit funding from Senate Bill 1—the gas tax—to assist transit agencies in electric bus purchases; no transit agency was granted money for CNG-powered transit.[185] I have also observed increased orders of and commitment to electric vehicles by fleet operators, a trend I expect will increase as the technology continues to improve and prices continue to decline. For example, LA Metro approved contracts for 95 electric buses and adopted a motion endorsing a plan to transition to a 100 percent zero emission bus fleet by 2030.[186] LA Metro has the second largest transit bus fleet in the United States. The largest, Metropolitan Transportation Authority in the New York City metro area, recently indicated its intention to transitioning to an all zero-emission fleet.[187] Other examples of fleets switching from natural gas to electric in Southern California include Foothill Transit and Santa Monica's Big Blue Bus, who have both committed to all-electric fleets by 2030.[188]

CARB standards for electric trucks and buses are driving the transition to zero-emission vehicles. Such standards include: the Innovative Clean Transit standard (all zero-emission transit bus *purchases* by 2029);[189] the Zero-Emission Airport Shuttle Bus standard (all zero-emission *fleet* by 2035);[190] the Advanced Clean Local Truck standard (zero-emission trucks comprise 15 percent of manufacturer sales by 2030);[191] and

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[184] *See* CARB, *Data Dashboard*, *supra* fn.97. *See also* CARB, *Low Carbon Fuel Standard Final Regulation Order*, *supra* fn.97.
[185] California State Transportation Agency, *Transit and Intercity Rail Capital Program 2018 Awards*, https://calsta.ca.gov/wp-content/uploads/sites/12/2018/04/Transit-and-Intercity-Rail-Capital-Program-2018-Awards.pdf.
[186] LA Metro, *Metro Leads the Nation in Setting Ambitious 2030 Zero Emission Bus Goal; Takes Frist Step with Purchase of 100 Electric Buses* (Aug. 2, 2017), https://www.metro.net/news/simple_pr/metro-leads-setting-2030-zero-emission-bus-goal/.
[187] Metropolitan Transit Authority, *Bus Plan*, p. 17 (Apr. 2018), http://web.mta.info/nyct/service/bus_plan/bus_plan.pdf.
[188] Foothill Transit, *Electric Program*, http://foothilltransit.org/news/sustainability/electric-program/ (last visited May 11, 2018); Big Blue Bus, *Ride Blue. Go Green*, https://www.bigbluebus.com/About-BBB/Ride-Blue--Go-Green-.aspx (last visited May 11, 2018).
[189] CARB, *Public Workshop on the Proposed Innovative Clean Transit Regulation Discussion Document*, p. 10 (Dec. 15, 2017), https://arb.ca.gov/msprog/ict/meeting/mt171215/171215ictconcept.pdf.
[190] CARB, *Zero-Emission Airport Shuttle Bus Regulatory Language Outline*, p. 4 (Mar. 6, 2018) https://www.arb.ca.gov/msprog/asb/workshop/asbdraftreglanguage.pdf.
[191] CARB, *Advanced Clean Local Trucks, Second Workgroup Meeting*, Slide 3 (Aug. 30, 2017), https://www.arb.ca.gov/msprog/actruck/mtg/170830arbpresentation.pdf.

recently-proposed action for a zero-emission drayage truck standard, for implementation 2026-2028.[192] CARB's development of standards for zero-emission forklifts, cargo handling equipment, and airport ground support equipment also point to the transition to zero-emission off-road vehicles and equipment.[193] The California Sustainable Freight Action Plan, calling for the deployment of over 100,000 zero-emission heavy-duty vehicles and equipment by 2030, represents a multi-agency commitment to zero-emission vehicles.[194]

The constant stream of announcements and commitments from private sector fleets and manufacturers around zero-emission trucks point to the transition to battery and fuel cell electric vehicles. Such announcements include Anheuser-Busch announcing its plans to replace its entire long-haul truck fleet in the U.S. (800 trucks) with zero-emissions vehicles by 2025;[195] more than 400 orders placed by 20 companies for the Telsa electric semi-truck;[196] major truck maker Mack Trucks advertising "[t]he future is electric" when it recently rolled out an electric refuse truck;[197] the electric school bus maker Lion Electric Co., which has 40 electric school buses operating in California, recently announcing it will sell Class 5-8 electric trucks;[198] and major truck maker Peterbilt announcing it is developing Class 8 electric drayage and refuse trucks.[199] Major engine

[192] CARB, *Concepts to Reduce the Community Health Impacts from Large Freight Facilities*, Slide 21, https://www.arb.ca.gov/board/books/2018/032218/18-2-6pres.pdf.
[193] CARB, *2016 State Strategy for the State Implementation Plan*, Slides 44, 47 (Sept. 1, 2016), https://www.arb.ca.gov/planning/sip/2016sip/090116wkshp_slides.pdf; CARB, *Concepts to Reduce the Community Health Impacts from Large Freight Facilities*, Slide 21, https://www.arb.ca.gov/board/books/2018/032218/18-2-6pres.pdf.
[194] California Department of Transportation *et al.*, *California Sustainable Freight Action Plan*, Attachment B, p. B-3 (July 2016), http://www.dot.ca.gov/casustainablefreight/documents/CSFAP_AppendixB_FINAL_07272016.pdf.
[195] John O'Dell, *Anheuser-Busch Makes Record Order of 800 Nikola Fuel Cell Trucks*, Trucks.com (May 3, 2018), https://www.trucks.com/2018/05/03/anheuser-busch-nikola-truck-order/.
[196] FedEx (@FedEx), Twitter (Mar. 26, 2018), https://twitter.com/FedEx/status/978295037808259072.
[197] Mack Trucks (@MackTrucks), Twitter (Apr. 25, 2018), https://twitter.com/MackTrucks/status/989239753403977733.
[198] Carly Schaffner, *Lion Plans Electric Truck Line, Deploys School Buses*, Trucks.com (May 2, 2018), https://www.trucks.com/2018/05/02/lion-electric-truck-line-school-buses/.
[199] *Peterbilt is at work on an all-electric Class 8 trucks*, CDL Life (May 2, 2018), https://cdllife.com/2018/peterbilt-is-at-work-on-an-all-electric-class-8-truck/.

maker Cummins expects delivery of an electric drivetrain in 2019.[200] Major truck maker Kenworth has developed a Class 8 fuel cell electric truck:[201]

> "Kenworth's hydrogen fuel-cell T680 is a reality," said Stephan Olsen, Kenworth director of product planning. "The T680 has been running trials in the Seattle area and performing very well. The next step is real-world testing with Total Transportation Services Inc. (TTSI) at the ports of Los Angeles and Long Beach in Southern California."

Finally, the rapid progress made on electric vehicles outside of the United States points to the readiness of electric vehicle technology today. Such progress includes over 300,000 electric buses on the road in China,[202] including the entire 16,000 bus fleet in Shenzhen;[203] for reference, there are 11,000 transit buses in all of California.[204] One manufacturer alone in China—Dongfeng Motor Corporation—has more than 64,000 electric trucks in operation today.[205] Battery and fuel cell electric vehicle technology is ready today and will become increasingly available in the coming months and years.

VI. RESEARCH, DEVELOPMENT, AND DEMONSTRATION FUNDING (GOLDEN)

Q. SoCalGas' 2019 test year request for Research, Development, and Demonstration ("R&D") is $14.329 million, a 35 percent increase from 2016 levels.[206] Do you have concerns with SoCalGas implementing an R&D program?

A. Yes. While the CPUC has authorized SoCalGas R&D funding in the past, there is an increasing misalignment between SoCalGas business interests and achievement of the aggressive reductions in fossil fuel use needed to avoid

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[200] Mark Kane, *Cummins Outlines Plans for Electric Powertrains By 2019*, Inside EVs (July 4, 2017), https://insideevs.com/cummins-outlines-plans-for-electric-powertrains-by-2019/.
[201] Kenworth, *Zero-Emission Kenworth T680 Equipped with Hydrogen Fuel Cell on Display at Consumer Electronics Show* (Jan. 9, 2018), https://www.kenworth.com/news/news-releases/2018/january/t680-zect/.
[202] Tim Dixon, *China 100% Electric Bus Sales Drop to ~89,546 in 2017*, EV Obsession (Jan. 25, 2018), https://evobsession.com/china-100-electric-bus-sales-drop-to-89546-in-2017/.
[203] Linda Poon, *How China Took Charge of the Electric Bus Revolution*, City Lab (May 8, 2018), https://www.citylab.com/transportation/2018/05/how-china-charged-into-the-electric-bus-revolution/559571/.
[204] Federal Transit Administration, *2016 Vehicles*, https://www.transit.dot.gov/ntd/data-product/2016-vehicles (last visited May 11, 2018).
[205] John O'Dell, *U.S. Hybrid Powers World's First Fuel Cell Street Sweeper*, Trucks.com (May 2, 2018), https://www.trucks.com/2018/05/02/us-hybrid-first-fuel-cell-street-sweeper/.
[206] Exh. SCG-21, Alexander Direct, p. LLA-9.

catastrophic climate impacts. Transparency, accountability, and use of ratepayer funds in a manner that best advances California's decarbonization objectives is improved when funding is administered through a state agency through a transparent stakeholder process. The CEC has a program for allocating ratepayer-funded natural gas research and development through a surcharge on natural gas consumption. I agree with the testimony of ORA that, given the existence of the CEC-administered, ratepayer-funded natural gas R&D program, SoCalGas' request for funding for an additional, large natural gas R&D program is not appropriate.[207] Indeed, SoCalGas has requested the CEC's R&D budget for natural gas research be increased, while also requesting substantial increases in its own ratepayer-funded R&D program.[208] To the extent the CPUC believes overall levels of ratepayer-funded natural gas R&D should be maintained, the CEC allocation could increase with a corresponding decrease to the SoCalGas program.

Q. Please describe the CEC Natural Gas R&D program.

A. The CEC's program originated with Assembly Bill ("AB") 1002 (2000), which provided a funding vehicle for public interest natural gas R&D through a natural gas consumption surcharge. In D.04-08-010, the CPUC implemented AB 1002 by "initiat[ing] a public interest R&D program, and appoint[ing] an administrator, the California Energy Commission (CEC), to improve gas energy efficiency and environmental quality, develop renewable technologies, and otherwise provide benefits to the public."[209] The CPUC approved the CEC's proposed $24 million budget for implementation of the Natural Gas Research and Development Program in 2016 and 2017 in Resolution G-3519.[210]

The CEC's implementation of R&D funding involves a public workshop where CEC R&D staff "present the proposed natural gas research initiatives" and consider stakeholder recommendations to refine that year's Natural Gas R&D

[207] Exh. ORA-17 (C. Yeh), SoCalGas Customer Services – Field & Meter Reading; Office Operations; Information; and Technologies, Policies & Solutions, p. 42:10-16 (Apr. 13, 2018).
[208] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-06, Q.1 (*Letter from Lisa Alexander Re: SoCalGas Response to the California Energy Commission's FY 2017-2018 Natural Gas Research, Development and Demonstration Program* (Jan. 31, 2017)); Exh. ORA-17 (C. Yeh), p. 42, Table 17-33 (showing the increase in SoCalGas' 2019 R&D funding request relative to expenditures over the past five years).
[209] D.04-08-010, *Order Regarding Implementation of Assembly Bill 1002, Establishing a Natural Gas Surcharge*, p. 2 (Aug. 19, 2004).
[210] CPUC, *Resolution G-3519* (Sept. 29, 2016), http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M167/K772/167772745.PDF.

Plan.[211] SoCalGas is a stakeholder participant in this process.[212] The CEC issues solicitations for funding of projects in the research areas identified in the Natural Gas R&D Plan and releases an annual report describing the projects funded in the previous fiscal year.[213]

Q. Do you have specific concerns about how SoCalGas is implementing its R&D program?

A. Yes. I have several concerns.

SoCalGas has been misleading in its public representations of ratepayer-funded R&D.

For example, SoCalGas recently issued a press release titled "SoCalGas Donates $100,000 to Support Cal State LA Combustion Engineering Research" wherein the funding was described as "a gift" from SoCalGas.[214] SoCalGas has confirmed the money was 70 percent ratepayer-funded.[215] Use of "donation" and "gift" in its press release announcing an allocation of R&D funding creates an inaccurate impression of the extent of SoCalGas' corporate philanthropy. Administration of

[211] CEC, *Staff Report: Natural Gas Research and Development Program, Proposed Program Plan and Funding Request for Fiscal Year 2016-17*, p. 2 (Nov. 2016), http://www.energy.ca.gov/2016publications/CEC-500-2016-063/CEC-500-2016-063.pdf; *see also* CEC, *Notice of Staff Workshop to Discuss Proposed Natural Gas Research Initiatives for FY 2018-19 and Proposed Natural Gas Research Program Expansion Request*, http://www.energy.ca.gov/research/notices/2018-01-25_workshop/2018-01-25_NG_Stakeholders_Workshop.pdf.

[212] CEC, *Notice of Staff Workshop to Discuss Proposed Natural Gas Research Initiatives for FY 2018-19 and Proposed Natural Gas Research Program Expansion Request*, http://www.energy.ca.gov/research/notices/2018-01-25_workshop/2018-01-25_NG_Stakeholders_Workshop.pdf; Appendix B: Questions and Answers from January 25, 2018 Staff Workshop to Discuss Proposed FY 2018-19 Natural Gas Research Initiatives, http://www.energy.ca.gov/research/notices/2018-01-25_workshop/Appendix_B_Workshop_Questions_and_Answers.pdf.

[213] CEC, *Current Solicitations for the Energy Research and Development Division*, http://www.energy.ca.gov/contracts/pier.html#anticipated (last visited Apr. 11, 2018); CEC, *Staff Report: Natural Gas Research and Development Program, 2017 Annual Report* (Nov. 2017), http://www.energy.ca.gov/2017publications/CEC-500-2017-036/CEC-500-2017-036.pdf. Prior annual reports are available at the CEC, *Prior Annual Reports of the Energy Research & Development Program*, http://www.energy.ca.gov/research/annual_reports_prior.html (last visited May 10, 2018).

[214] Attach. 12, SoCalGas Press Release, *SoCalGas Donates $100,000 to Support Cal State LA Combustion Engineering Research that Advances Clean Air and Energy Efficiency Technologies*, (Mar. 28, 2018) (emphasis added), https://sempra.mediaroom.com/index.php?s=19080&item=137437.

[215] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-03, Q.12.

R&D funding through the CEC avoids the potential for SoCalGas to misrepresent the sources of R&D funding it administers to third parties.

Leaving ratepayer-funded R&D investments to the discretion of SoCalGas can result in funding of projects that may not align with state policy or priorities.

For example, in the CEC's Electric Program Investment Charge ("EPIC") Triennial Investment Plan, SoCalGas submitted comments urging the inclusion of power-to-gas in the EPIC portfolio.[216] The CEC declined to include power-to-gas in the 2018-2020 EPIC Investment Plan.[217] The CPUC has also rejected requests to classify power-to-gas as eligible to count toward energy storage targets.[218] SoCalGas now seeks $1.7 million for power-to-gas R&D through this Application.[219]

Power-to-gas projects raise environmental concerns. In my understanding, power-to-gas is a process by which energy is used to hydrolyze water to create hydrogen, which can then be used directly or then undergo a second process that combines the hydrogen with carbon dioxide to create methane.[220] Methane created through this process is also referred to as synthetic natural gas. In its Application, SoCalGas seeks R&D funding for the latter process, to "convert excess renewable energy directly to methane."[221]

The production of synthetic methane is an inefficient process that could result in net increases in greenhouse gas emissions. A ratepayer-funded report commissioned by SoCalGas, *Decarbonizing Pipeline Gas to Help Meet California's 2050 Greenhouse Gas Reduction Goal*, estimates a current roundtrip efficiency of approximately 52 percent with the theoretical maximum roundtrip efficiency of power-to-gas technology of 63 percent.[222] Thus, 100 MWh of electricity could create the equivalent of 52 to 63 MWh of synthetic gas to deliver

[216] Attach. 6(g), CEC Docket No. 17-EPIC-01, SoCalGas, *Comments on the 2018-2020 EPIC Investment Plan Funding Initiatives* (Mar. 20, 2017).
[217] CEC Docket No. 17-EPIC-01, CEC, *EPIC Proposed 2018-2020 Triennial Investment Plan* (Apr. 2017) (adopted on Apr. 27, 2017), http://docketpublic.energy.ca.gov/PublicDocuments/17-EPIC-01/TN217347_20170428T145448_The_Electric_Program_Investment_Charge_Proposed_20182020_Trienn.pdf.
[218] D.17-04-039, *Decision on Track 2 Energy Storage Issues*, pp. 11-13 (May 8, 2017).
[219] Exh. SCG-21, Alexander Direct, p. LLA-15.
[220] *See* Attach. 13, Excerpts of Hearing Transcript in A.15-09-013, p. 363:7-20 (SDG&E/SoCalGas, Smith).
[221] Exh. SCG-21, Alexander Direct, p. LLA-B-8.
[222] Decarbonized Gas Report, *supra* fn.10, p. 57.

to gas appliances.[223] By contrast, using electricity directly in appliances avoids this energy loss in conversion. Were natural gas used as an electricity source to generate synthetic gas, the inefficiencies of the process would result in an increase in greenhouse gas emissions. When asked how it would ensure the project would only utilize excess renewables and therefore not increase greenhouse emissions, SoCalGas stated this question was "outside the scope of the subject matter involved in the pending proceeding," despite its request for $1.7 million in this proceeding to fund a power-to-gas project. [224]

Even assuming a power-to-gas facility is optimized to use surplus renewable energy, the power-to-gas process would take zero emissions energy and convert it to a high global warming pollutant that poses leakage risks in pipeline infrastructure. If methane leaks from a pipeline, it has the same global warming impact—28 to 86 times that of carbon dioxide—regardless of whether it is fossil natural gas, biomethane, or synthetic natural gas.[225] Furthermore, SoCalGas has admitted that upon combustion, all types of methane, regardless of origin, emit essentially the same criteria air pollutants.[226] Directing excess renewable energy to electric vehicles or electric appliances avoids the air pollution generated by methane leakage and combustion.

Because of these serious drawbacks, it is my opinion that SoCalGas should not independently decide to allocate ratepayer funding to power-to-gas research. Neither the CEC's electric nor its natural gas research programs have selected power-to-gas as a research priority. To the extent public funds are used to research this technology, the debate over the extent and direction of this funding should occur through the CEC's stakeholder process, which is better able to solicit and weigh stakeholder concerns.

R&D funding is used to commission studies that support continued use of natural gas and discourage electrification.

As discussed in Section II of this testimony, there is a conflict between SoCalGas' business interest in maintaining reliance on natural gas as a fuel source and the aggressive reductions in fossil fuel use needed to meet state greenhouse gas reduction requirements. Given this conflict, there is the potential for bias in

[223] *Id.*; Attach. 13, Excerpts of Hearing Transcript in A.15-09-013, p. 368:16-25.
[224] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-06, Q.2(c).
[225] *See, e.g.*, CARB, *Short-Lived Climate Pollutant Reduction Strategy*, p. 40 (Mar. 2017), https://www.arb.ca.gov/cc/shortlived/meetings/03142017/final_slcp_report.pdf (using 20-year GWP).
[226] *See* Attach. 13, Excerpts of Hearing Transcript in A.15-09-013, p. 365:13-14.

SoCalGas evaluation of the merits of electrification over continued reliance on gas.

For example, SoCalGas spent $384,000 of R&D funding on a study by Navigant to examine the costs of gas-fueled Zero Net Energy ("ZNE") homes.[227] As an initial matter, it was not clear from the previous GRC cycle authorizing SoCalGas' funding that SoCalGas would conduct this study: when asked to identify the section of its previous application that authorized the study, SoCalGas referred to testimony stating funding would be directed to the "[d]evelopment of efficient natural gas technologies to support" ZNE buildings.[228] The funding was then used instead to commission a study to analyze the "technical, economic and market outlook" of mixed-fuel (gas and electric) ZNE homes over electric-only homes.[229] CEC administration of R&D funding would improve transparency over how funding is allocated.

SoCalGas used the Navigant Study as the basis for its arguments at the CEC that renewable natural gas should be used in residential buildings instead of electrification.[230] I have some concerns with the assumptions used in this study. For example, in the comparison of construction cost between natural gas ZNE homes and all-electric ZNE homes, the analysis does not appear to include the cost of gas pipeline infrastructure, either to construct the gas distribution network or to connect the home to the distribution system. The cost of connecting a home to the natural gas system is substantial, and I have seen estimates for this cost between $2,000 and $14,000.[231]

The omission of this cost illustrates for me the importance of ratepayer-funded research being conducted by a public agency, where stakeholders can provide input on study assumptions and objectives. In my opinion, when SoCalGas uses R&D funding to commission research, company objectives can affect the impartiality of study framing or inputs. I do not believe this is an appropriate use

[227] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-05, Q.1, Attachment 2017 RD&D Report, p. 52 (excerpt).
[228] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-04, Q.4(b)(ii) (citing Attach. 14, Excerpts of Exh. SCG-13-R, Revised Direct Testimony of Jeffrey Reed in A.14-11-004, pp. JGR-12 - 13 (Mar. 2015)).
[229] Attach. 4, SoCalGas Response to Data Request Sierra Club/UCS-SCG-05, Q.2 (Navigant Study, p. 5).
[230] Attach. 6(m), CEC Docket No. 17-IEPR-01, SoCalGas, *Comments on the Draft 2017 Integrated Energy Policy Report*, p. 5 (Nov. 13, 2017).
[231] Attach. 15, CEC Docket No. 16-BSTD-06, *Letter from Nehemiah Stone, Stone Energy Associates, to CEC Re: 2019 Building Energy Efficiency Standards Development*, p. 2 (June 21, 2016).

of ratepayer funding and do not believe SoCalGas should continue to administer an R&D program.

ATTACHMENTS

1. Statement of Qualifications of James O'Dea
2. Resume of Rachel Golden
3. Union of Concerned Scientists, *The Promises and Limits of Biomethane as a Transportation Fuel* (May 2017)
4. Selected Responses to Sierra Club/UCS Data Requests to SoCalGas
5. Sempra Energy, SoCalGas and SDG&E Form 10-K Annual Report (Feb. 27, 2018) (Excerpt)
6. Selected Comment Letters from SoCalGas to State and Local Agencies
    a. SoCalGas, *Comments to Southern California Association of Governments on the Regional Transportation Plan/Sustainable Communities Strategy* (Feb. 1, 2016)
    b. SoCalGas and SDG&E, *Written Comments to CARB on the 2030 Target Scoping Plan Update Concept Paper* (July 8, 2016)
    c. SoCalGas, *Comments to South Coast Air Quality Management District and CARB on Proposed 2016 State Strategy for the State Implementation Plan* (July 18, 2016)
    d. SoCalGas and SDG&E, *Written Comments to CARB on the Scoping Plan Update Workgroup on the Energy Sector* (Sept. 7, 2016)
    e. SoCalGas, *Written Comments to CARB on the 2030 Target Scoping Plan Update November 7, 2016 Workshop* (Nov. 21, 2016)
    f. CEC Docket No. 17-IEPR-06, SoCalGas, *Comments on the Joint Agency IEPR Workshop on 2030 Energy Efficiency Target*s (Feb. 15, 2017)
    g. CEC Docket No. 17-EPIC-01, SoCalGas, *Comments on the 2018-2020 EPIC Investment Plan Funding Initiatives* (Mar. 20, 2017)
    h. SoCalGas, *Comments to CARB on the 2017 Climate Change Scoping Plan Update* (Apr. 10, 2017)
    i. CEC Docket No. 17-IEPR-06*, SoCalGas, Comments on the IEPR Staff Workshop on 2030 Energy Efficiency Targets* (June 30, 2017)
    j. CEC Docket No. 17-IEPR-06, SoCalGas, *Comments on CEC Staff's Two Draft Papers on SB 350 Energy Efficiency Savings Doubling Targets* (Aug. 3, 2017)
    k. CEC Docket No. 17-BSTD-01, SoCalGas, *August 22, 2017 Proposed 2019 Building Energy Efficiency Standards ZNE Strategy Presentation Comment Letter* (Sept. 6, 2017)

l. CEC Docket No. 17-IEPR-06, SoCalGas, *Comments on CEC Draft Commission Report on SB 350: Doubling Energy Efficiency Savings by 2030* (Sept. 21, 2017)

m. CEC Docket No. 17-IEPR-01, SoCalGas, *Comments on the Draft 2017 Integrated Energy Policy Report* (Nov. 13, 2017)

n. SoCalGas, *Letter to Anita Cerna, Senior Planner, City of Pasadena, Re: City of Pasadena Draft Climate Action Plan* (Jan. 23, 2018)

o. CEC Docket No. 17-IEPR-01, SoCalGas, *Comments on the Proposed Final 2017 Integrated Energy Policy Report* (Feb. 7, 2018)

p. *Letter to Leila Namvar, Assistant Planner, City of Indio, Re: Indio General Plan Update* (undated)

q. *Letter to Troy Clark, General Plan Administrator, City of Redlands, Re: City of Redlands Draft Sustainable Community Element* (undated)

7. California Independent System Operator, *CEC IEPR Workshop Presentation* (May 12, 2017) (Excerpts)

8. Imran A. Sheikh, *Lowest cost reduction of space and water heating emissions in California* (Nov. 2017)

9. Sara Chandler, Joel Espino, and Jimmy O'Dea, *Delivering Opportunity: How Electric Buses and Trucks Can Create Jobs and Improve Public Health in California*, Union of Concerned Scientists and The Greenlining Institute (May 2017)

10. A.17-01-021, Direct Testimony of Edwin T. Harte on Behalf of SoCalGas (Aug. 1, 2017)

11. Edison Electric Institute, *Transportation Electrification: Utility Fleets Leading the Charge* (June 2014)

12. SoCalGas Press Release, *SoCalGas Donates $100,000 to Support Cal State LA Combustion Engineering Research that Advances Clean Air and Energy Efficiency Technologies* (Mar. 28, 2018)

13. Excerpts of Hearing Transcript in A.15-09-013 (SDG&E/SoCalGas, Smith)

14. Excerpts of Exh. SCG-13-R, Revised Direct Testimony of Jeffrey Reed in A.14-11-004 (Mar. 2015)

15. CEC Docket No. 16-BSTD-06, *Letter from Nehemiah Stone, Stone Energy Associates, to CEC Re: 2019 Building Energy Efficiency Standards Development*, (June 21, 2016)

Attachments Omitted

Exhibit 2

LOW INCOME WEATHERIZATION PROGRAM

TENANT ELECTRIFICATION RESULTS
Solinas Village and Almond Court

Low-Income Weatherization Program (LIWP) at Solinas Village

- Annual greenhouse gas reduction (energy efficiency + solar PV): **174 metric tons** of CO2
- Total installed cost of $1,133,518
- Total leveraged incentives of $798,570 (70% of project costs)

Low-Income Weatherization Program (LIWP) at Almond Court

- Annual greenhouse gas reduction (energy efficiency + solar PV): **111 metric tons** of CO2
- Total installed cost of $1,022,240
- Total leveraged incentives of $533,700 (52% of project costs)

Scope of Work

Electrification:

- Replace all Gas Water Heaters with Heat Pump Water Heaters
- Replace Gas Furnace/AC with Inverter Drive Heat Pump
- Solar PV (110 kW system at Almond Court; 171 kW at Solinas Village)

Efficiency:

- Seal Ductwork with Aeroseal
- Air Seal and Insulate Attic
- Replace Tenant Washing Machines and Refrigerators with High Efficiency Models
- Install Dual Pane Windows
- Upgrade Tenant and Common Area Lighting to LED
- Install Low-Flow Aerators and Showerheads

SOLINAS VILLAGE

711 5th St.
McFarland, CA 93250
52 Units
60,000 Square Feet
Built in 1995

ALMOND COURT

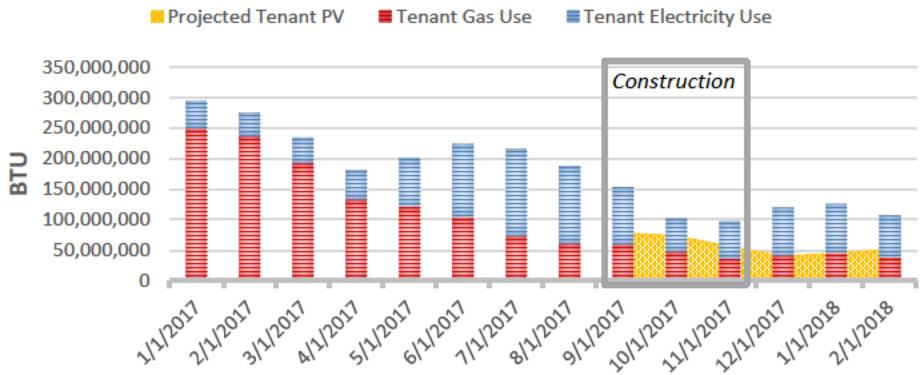
801 Almond Ct.
Wasco, CA 93280
36 Units
46,000 Square Feet
Built in 1996

PROPERTY OWNER
Self Help Enterprises

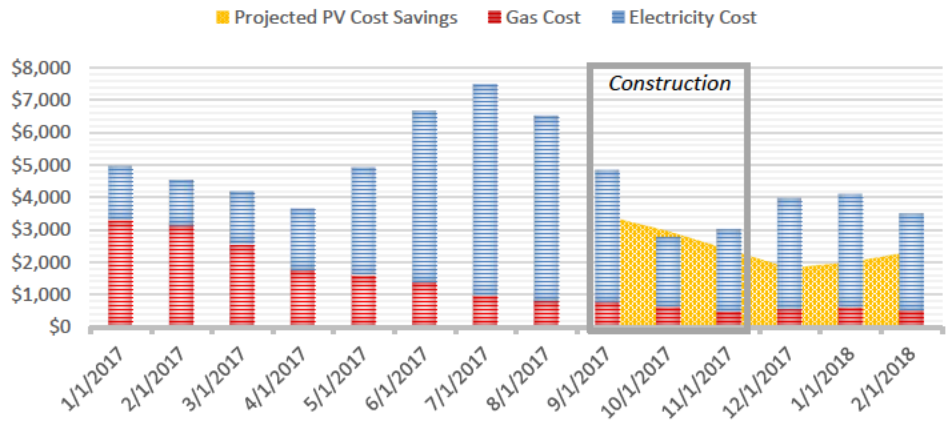
GENERAL CONTRACTOR
Wallace and Smith Construction

SOLAR PV CONTRACTOR
Sunrise Energy LLC

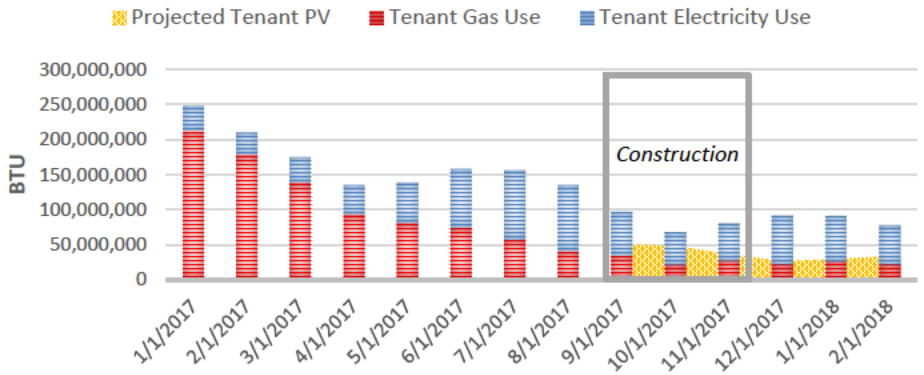
SOLINAS VILLAGE
TENANT ENERGY USE* AND SOLAR PV PROJECTIONS



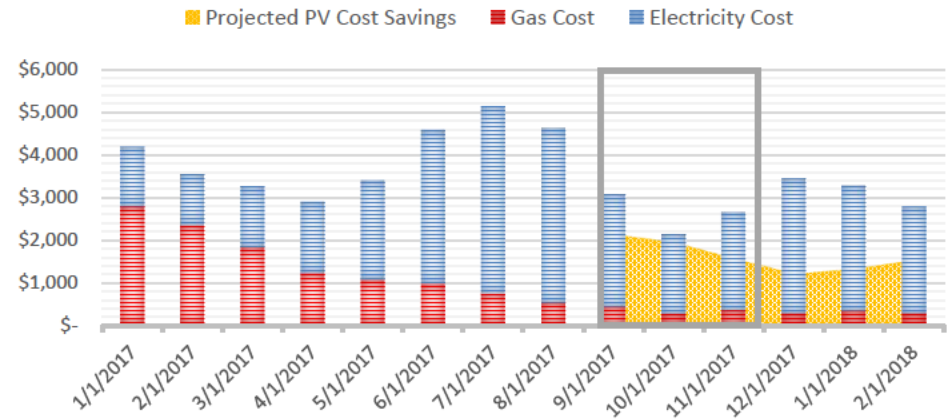
SOLINAS VILLAGE
TENANT UTILITY COSTS



ALMOND COURT
TENANT ENERGY USE* AND SOLAR PV PROJECTIONS



ALMOND COURT
TENANT UTILITY COSTS



Analysis based on aggregated data provided by PG&E via their whole building benchmarking portal

DESCRIPTION OF ELECTRIFICATION SCOPE

Heat Pump Water Heaters

Existing: Low efficiency gas water heaters

Installed: Heat pump water heaters (>3.2 Energy Factor) in all residential units

Existing Gas Water Heaters (left), New Heat Pump Water Heater (right)

High Efficiency Heat Pumps

Existing: Low efficiency gas furnaces and split DX cooling

Installed: High efficiency inverter drive ducted heat pumps (19+ SEER, 10+ HSPF). All duct systems were sealed with aeroseal reducing duct leakage by 50% to 80%.

Existing Gas Furnace (left), New Heat Pump HVAC (right)