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Ariel Fideldy, Manager
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Air Quality Planning and Science Division
California Air Resources Board
1001 I Street
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Subject: Comments on the Proposed 2022 State Strategy for the State Implementation Plan

Dear Ms. Fideldy and Mr. Hicks:

Southern California Gas Company (SoCalGas) appreciates the opportunity to provide comments on the California Air Resources Board (CARB) Draft 2022 State Strategy for the State Implementation Plan (Draft 2022 State SIP Strategy) released January 31, 2022. We recognize and appreciate the thoughtfulness put into the measures to control ozone precursor emissions, in particular oxides of nitrogen (NOx), to plan for attainment of the federal ozone standards. Unquestionably, we need to transition to clean fuels and zero-emission infrastructure to significantly reduce emissions from mobile sources statewide.

SoCalGas plays a vital role in providing infrastructure to transport clean molecules, such as renewable natural gas (RNG) and hydrogen. On February 17, 2022, SoCalGas filed an application at the California Public Utilities Commission (CPUC) requesting approval to track costs related to the development of the Angeles Link.[1] Angeles Link is our proposal to develop the largest green hydrogen Energy Infrastructure System in the U.S., which would drive deep decarbonization of dispatchable electric generation, hard-to-electrify industries, and heavy-duty transportation. The proposed Angeles Link would deliver green hydrogen in an amount equivalent to almost 25 percent of the natural gas SoCalGas delivers today and eliminate nearly 25,000 tons of smog forming NOx and 14.3 million metric tons of carbon dioxide (CO_2) from the air annually – the equivalent of taking 3.1 million cars off the road.[2]

[1] *See* A. 22-02-007 Angeles Link Project Memorandum Account Application, February 17, 2022, available at https://www.socalgas.com/sites/default/files/A22-02-SOCALGAS-Angeles_Link_Memorandum_Account_Application.pdf.
[2] "SoCalGas Angeles Link: Shaping the Future with Green Hydrogen," SoCalGas, February 2022, available at https://www.socalgas.com/sustainability/hydrogen/angeles-link.

We believe our proposal synergizes with and commend CARB for the inclusion of hydrogen vehicles and infrastructure in the Draft 2022 State SIP Strategy. Alternative clean forms of hydrogen offer longer-term opportunities for emissions reductions from California's transportation system. However, the State can better position itself to achieve its climate goals today through near-term air pollution reductions and supporting technologies.[3] Recognizing this Senator Bob Wieckowski, at the Senate Budget and Fiscal Review Subcommittee on the Zero-Emission Vehicle Package, asked CARB and California Energy Commission (CEC) representatives, "shouldn't [the State] consider short-term solutions for immediate emission reductions today?"[4] For example, replacing traditional diesel or gasoline with RNG can significantly reduce emissions of NOx, particulate matter, and greenhouse gases today.[5]

Thus, SoCalGas' comments focus on (1) Hydrogen fuel is an attractive long-term solution for medium- and heavy-duty trucks; (2) Forgoing RNG pathways eliminates an important and well-established emission reduction near-term pathway for heavy-duty trucks; and (3) Additional emissions analysis is needed for indirect stationary source emissions.

(1) Hydrogen fuel is an attractive long-term solution for medium- and heavy-duty trucks

Medium- and heavy-duty vehicles are responsible for 70 percent of smog pollution and 80 percent of diesel particulate matter (PM) emission.[6] Alone, "heavy-duty trucks emit over 22 percent of CO_2e from on-road transportation" in the State.[7] Hydrogen fuel is an attractive long-term solution for medium- and heavy-duty trucks. Currently, plug-in technologies cannot replace conventional fast-fuel technologies at a one-to-one ratio. In fact, a 2020 study found that 19 diesel drayage trucks would have to be replaced by 36 zero-emission drayage trucks.[8] This means that deploying one plug-in heavy-duty truck would not even get one full diesel truck off the road and the benefits of a plug-in heavy-duty truck would not be fully realized. Hydrogen fuel weighs much less than electric batteries, which could make trucks more efficient because they could carry more cargo, refuel faster, and drive longer distances.[9] In fact, Toyota and Hino collaborated to develop a 25-ton fuel cell electric truck for the Japanese market. The companies see hydrogen fuel cell technology as a superior zero emissions alternative to battery power for large commercial vehicles.[10] Likewise, the Department of Energy (DOE) is planning to invest $100 million over the

[3] *See* Legislative Analyst Office comments on Zero-Emission Vehicle Package for the Senate Budget and Fiscal Review Subcommittee Number 2 Hearing held March 2, 2022, at page 10, available at https://sbud.senate.ca.gov/sites/sbud.senate.ca.gov/files/Sub%202%20Agenda%203.2%20Final.pdf.
[4] *Ibid.*
[5] *See* U.S. EPA Renewable Natural Gas: Benefits Webpage, last modified December 16, 2021, available at https://www.epa.gov/lmop/renewable-natural-gas.
[6] Austin L. Brown, Daniel Sperling, et al., Driving California's Transportation Emissions to Zero, UC Office of the President: University of California Institute of Transportation Studies, April 2021, at page 8, available at https://escholarship.org/uc/item/3np3p2t0.
[7] *Ibid.*
[8] Genevieve Giulliano, Maged Dessouky, et al., Developing Markets for ZEVs in Short Haul Goods Movement, UC Davis: National Center for Sustainable Transportation, 2020, available at https://escholarship.org/uc/item/0nw4q530.
[9] John Fialka, Hydrogen fuel weighs less than electric batteries, making it an attractive option for long-haul vehicles, Scientific American: E&E News, November 6, 2020, available at https://www.scientificamerican.com/article/energy-department-looks-to-boost-hydrogen-fuel-for-big-trucks/.
[10] Paul O'Donnell, Toyota expects to roll out a fuel cell electric big rig early next year in North America, The Dallas Morning News, October 5, 2020, available at https://www.dallasnews.com/business/localcompanies/2020/10/05/toyota-expects-to-roll-out-a-pilot-fuel-cell-electric-big-rig-early-next-year-in-north-america/.

next five years into research for hydrogen powered heavy-duty trucks.[11] The DOE intends for this investment to help jump-start the American hydrogen economy.

(2) Forgoing RNG pathways eliminates an important and well-established emission reduction near-term pathway for heavy-duty trucks.

The Draft 2022 State SIP Strategy outlines a zero combustion and zero emission approach for the proposed mobile source measures to reach near attainment. As recently stated by Matt Miyasato, Deputy Executive Officer of Science and Technology Advancement for the South Coast Air Quality Management District (SCAQMD), at the Senate Transportation Committee Informational Hearing on Sustainable Transportation, zero-emissions technologies for heavy duty trucks are "not available in large volumes."[12] Nor are there standardized charging equipment specifications and/or available public charging networks to support mass battery-electric trucking purchasers of Classes 7 and 8. Additionally, Classes 7 and 8 hydrogen fuel cell trucks, the most viable zero emission vehicle solution, are still in demonstration phases. Given these current circumstances, SoCalGas submits that the State should embrace available technologies, where feasible, to reduce near-term emissions to address the 70-ppb ozone standard and, as Mr. Miyasto remarked, "we should be saving lives today by putting out a cleaner technology that is commercially available in large numbers...we can clean the air while we plan for a zero emissions future."[13] SoCalGas believes that these approaches are not exclusive, but rather are complementary to each other.

Data and results to date demonstrate that RNG is vital to decarbonizing California's transportation and industrial sectors expeditiously. Since April 2019, SoCalGas has supported the RNG market by dispensing 100 percent RNG at all utility-owned refueling stations. The CARB Low Carbon Fuel Standard (LCFS) reporting shows that by the end of 2019, 98 percent of all the natural gas used in motor vehicles was RNG.[14] Appendix A contains comparative analyses of a Class 8 heavy, heavy-duty (HHD) truck powered by diesel, RNG, and battery electric (BE). The analyses shows that a Class 8 Optional Low NO_X HHD RNG truck can achieve nearly the same reductions in tailpipe NO_X emissions as a BE truck when replacing a Class 8 HHD truck. When considering a $1 Billion investment in BE trucks will result in avoided diesel emissions from approximately 1,500 diesel trucks; approximately 2,000 BE trucks would need to be purchased to replace 1,500 diesel trucks. This is because a BE truck cannot haul the same amount as a diesel truck due to weight and range limitations. Consequently, a single BE truck replaces only approximately 0.7 diesel trucks.

In contrast, Optional Low NOx RNG trucks can replace diesel trucks on a one-to-one basis. Thus, an investment of a billion dollars in Optional Low NO_X RNG trucks in 2024 would deliver almost **three** times more tailpipe NO_X reductions (needed to meet the Federal Clean Air Act

[11] "DOE Announces $162 Million to Decarbonize Cars and Trucks," April 15, 2021, available at https://www.energy.gov/articles/doe-announces-162-million-decarbonize-cars-and-trucks.
[12] *See* Senate Transportation Committee Informational Hearing on Sustainable Transportation held February 15, 2022, available at https://www.senate.ca.gov/media/senate-transportation-committee-20220215/video.
[13] *Ibid.*
[14] "CARB Low Carbon Fuel Standard Data Dashboard, Figure 2," last modified April 2, 2021, available at https://www.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm.

Requirements) as compared to BE trucks. These values also do not account for the cost and implementation time of expanded electricity generation, transmission, and distribution infrastructure that would be necessary to serve BE trucks. Even greater reductions can thus be achieved if the investment is made for incremental vehicle costs only.

On March 2, 2022, Senator Wieckowski remarked that the State "can do things for near-term emissions – biofuels to be mixed with diesel in the short term – and improve air quality tomorrow."[15] A peer-reviewed 2021 study published by the University of California, Riverside in the journal "Transportation Research Part D" substantiates this point by stating heavy-duty trucks fueled with RNG should be rapidly deployed in the 2020-2040 timeframe to achieve NOx emission reduction targets, and "accelerating [the diesel trucks] fleet turnover is a more important NOx control strategy than dividing up vehicle replacements…between near-zero emissions and zero emissions vehicles."[16]

Lastly, at the February 24, 2022 CARB Board Meeting, several commenters expressed the need to incorporate vehicles fueled with RNG into the 2022 State SIP Strategy. Commenters stated that this carbon-negative fuel is successfully produced and utilized to power water treatment plants, dairy farms, and compressed natural gas (CNG) vehicles. David Rothbart with the Los Angeles County Sanitation Districts noted that the sanitation districts must manage the RNG that is produced during wastewater treatment and asked, "if this byproduct is banned from use in combustion equipment where will it go?"[17] Sarah Rees, Deputy Executive Officer at SCAQMD, expressed that while we need to transition to zero emission vehicles across all sectors we cannot sit and wait, we must implement commercially available technologies as they become available, including Low NOx RNG technologies.[18]

(3) Additional emissions analysis is needed for indirect stationary source emissions

Projected emissions reductions, as presented in the Draft 2022 State SIP Strategy, may not be indicative of whether, and the extent to which, certain proposed measures would reduce overall NOx emissions to provide meaningful or actual progress towards achieving the ozone standard. In particular, the proposed measures that would increase electricity consumption require a more granular analysis to consider the stationary source emissions resulting from meeting the additional demand.

On an episodic basis, recent and ongoing trendlines suggest that reductions in daily NOx emissions averaged across a year lack a necessary and appropriate correlation to peak day emissions that contribute to the daily maximum 8-hour average ozone concentrations, for such proposed measures. For instance, in August 2020, electricity capacity shortfalls caused load shedding and was the basis for Governor Newsom's July 30, 2021 Proclamation of a State of Emergency, "to

[15] *See* Senate Budget and Fiscal Review Subcommittee Number 2 Hearing Recording held March 2, 2022, at 53:16.
[16] Arun S.K. Raju, Barry R. Wallerstein, Kent C. Johnson, "Achieving NOx and Greenhouse gas emissions goals in California's Heavy-Duty transportation sector", Transportation Research Part D: Transport and Environment, Volume 97, August 2021, https://www.sciencedirect.com/science/article/pii/S1361920921001826.
[17] CARB Board Meeting held February 24-25, 2022, available at https://cal-span.org/static/meetings-CARB.php.
[18] *Ibid.*

reduce the strain on the energy infrastructure and increase energy capacity."[19] During such state of emergencies, customers and some utilities resorted to using diesel-fired backup generation at unprecedented levels, with use often correlating to days of high daily 8-hour ozone concentrations. For example, the SCAQMD estimated that during a 2019 Public Safety Power Shutoff (PSPS) event in Los Angeles and San Bernardino Counties, less than 2,000 diesel back-up generators emitted 6 tons of NOx per day.[20] This is higher than average daily emissions from the largest refinery in its jurisdiction.[21] Accordingly, the required cost effectiveness analysis must assess the NOx emission reductions, which necessarily includes secondary or indirect emissions increases on an episodic basis, in order to assess the true efficacy of the proposed measures.

Whether or not CARB is legally empowered to impose NOx reduction strategies on stationary sources is irrelevant, however, to whether CARB's proposed measures would cause indirect NOx emissions increases from stationary sources, and consequently whether and the extent to which CARB's proposed measures would contribute to attainment. We respectfully suggest that bifurcating such analysis between CARB and the local air districts would address important unanswered questions regarding emissions impacts, which should be quantified prior to formal proposal or inclusion as SIP strategies.

Conclusion

In closing, CARB Staff has done an admirable job in developing a statewide implementation plan and we look forward to the actual measures when proposed. SoCalGas is committed to a collective, collaborative transition to cleaner energy, and believe that our strategy, discussed above, will help guide us on doing our part in reducing criteria pollutants.

Respectfully,

/s/ Kevin Barker

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[19] *See* State of California Executive Department Proclamation of a State of Emergency, July 30, 2021, at page 2, available at https://www.gov.ca.gov/wp-content/uploads/2021/07/Energy-Emergency-Proc-7-30-21.pdf.
[20] *See* SCAQMD Fact Sheet on Emergency Backup Generators, available at http://www.aqmd.gov/home/permits/emergency-generators#Fact2.
[21] *See* SCAQMD Legislative Update Presentation by Philip Crabbe to the Environmental Justice Community Partnership Advisory Council held September 2, 2020, available at http://www.aqmd.gov/home/news-events/webcast/live-webcast?ms=0U9KfvvcV3w.

Appendix A. Comparative Analyses of a Class 8 Heavy, Heavy-Duty Trucks Powered by Diesel, Renewable Natural Gas, and Battery Electric Trucks.

The following comparative analyses of a Class 8 heavy, heavy-duty (HHD) truck powered by Diesel, Renewable Natural Gas (RNG), and battery-electric (BE) shows that a Class 8 Optional Low NO_X HHD RNG truck can generate more significant reductions in the lifecycle (well-to-wheel) greenhouse gas (GHG) emissions than a BE truck when replacing a diesel truck. Further, the use of clean fuels like RNG eliminates carbon dioxide (CO_2) emissions since these fuels are plant/biogenically based.

Table 1 (below) shows that one Model Year (MY) 2024 Class 8 Optional Low NO_X RNG HHD truck can reduce lifecycle (well-to-wheel) GHG emissions by approximately 760 metric tons of carbon dioxide equivalent (MT CO_2e) over its ten-year lifetime as compared to its diesel counterpart, which is equivalent to taking almost 17 passenger vehicles off the road, annually.[22] These GHG reductions are more significant than those achieved by replacing the diesel truck with a BE truck.

Table 1. Class 8 HHD Trucks Well-to-Wheel GHG Emission Estimates for MY 2024

Greenhouse Gas	Units	Diesel Truck	Optional Low NO_x RNG Truck	BE Truck
Tailpipe Emissions[23,24]				
CO_2 Emissions	MT/truck	614	0	0
CH_4 Emissions	MT/truck	0.00108	0.704	0
N_2O Emissions	MT/truck	0.0967	0.112	0
BC Emissions	MT/truck	0.00211	0.00026	0
Tailpipe CO_2e Emissions	MT/truck	645	51	0
Upstream Emissions				
Upstream CO_2e Emissions	MT/truck	225	54	175
Total CO_2e Emissions	**MT/truck**	**869**	**105**	**175**
Reduction of CO_2e Emissions Compared to Diesel	MT/truck	--	764	694
Percent Reduction of CO_2e Emissions Compared to Diesel	-	--	**87%**	**80%**

Please view footnotes to determine the basis for Table 1 Calculations.[25]

[22] *See* Greenhouse Gas Equivalencies Calculator, US EPA, March 2021, available at https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.
[23] *See* Direct Global Warming Potentials: CO_2, CH_4, and N_2O GWP values, IPCC, 2007, available at https://archive.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html.
[24] *See* California's Black Carbon Emission Inventory, CARB, 2015 Edition, available at https://ww3.arb.ca.gov/cc/inventory/slcp/doc/bc_inventory_tsd_20160411.pdf.
[25] The tailpipe emissions of CO_2, methane, and black carbon were obtained from EMFAC2021 for a T7 Tractor Class 8 in California for Calendar Years 2024-2033. Lifetime emissions were integrated over an assumed vehicle lifespan of 10 years and activity level of 43,500 miles per year, based on the US EPA's definition of HHDT useful life[25] and CARB's Low-NOx Omnibus Regulation.[25] Upstream emission factors were calculated using the CA-GREET3.0 model for diesel and electricity generation. The electricity grid mix inputs to the model were adjusted based on California Energy Commission data for the current year and

Further, Table 2 (below) shows that the total cost of ownership for an Optional Low NO_X RNG truck is approximately 50 percent lower ($480,000 versus $1,019,000) than a BE truck[26] needed to replace an MY 2024 diesel Class 8 HHD truck. Transitioning diesel Class 8 HHD trucks to Optional Low NO_X RNG trucks is more cost-effective in reducing GHG emissions than a transition to an equivalent number of BE trucks. An RNG pathway for HHD trucks is estimated to cost -$107/MT CO_2e compared to a BE pathway estimated to cost $658/MT CO_2e. These cost numbers do not account for the additional dollars necessary to upgrade the electric grid to support a zero-emission vehicle transition in the transportation sector.

Table 2. Lifetime Ownership Costs and Incremental Cost-Effectiveness

Description	**Units**	**Diesel Truck**	**Optional Low NO_x RNG Truck**	**BE Truck**
Total Cost of Ownership for Single Truck[27]	$	$562,149	$480,576	$823,411
Additional Capital Cost for Battery Electric Truck[28]	$	--	--	$195,779
Total Cost of Ownership	$	$562,149	$480,576	$1,019,190
Incremental Cost of Ownership	$	--	-$81,573	$457,041
	%	--	-15%	81%
Reduction in Lifecycle GHG Emissions Compared to Diesel	MT CO_2e	--	764	694
Reduction in Tailpipe NO_x Emissions Compared to Diesel	tons	--	0.97	1.18
Cost Effectiveness for GHG Reductions	**$/MT CO_2e**	**--**	**-$107**	**$658**
Cost Effectiveness for Tailpipe NO_x Reductions	**$/ton**	**--**	**-$83,935**	**$387,983**

Table 3 (below) shows that Optional Low NO_X RNG trucks can achieve nearly the same reductions in tailpipe NO_X emissions as a BE truck when replacing a Class 8 HHD truck.

projections, with renewables comprising 47 percent in 2023 and growing to 81 percent in 2037. RNG upstream carbon intensities were obtained from the LCFS program pathway lookup tables for the following RNG feedstocks: landfill gas, food wastes, and animal waste/dairy digester gas. A weighted average of the carbon intensities is calculated based on the LCFS sales volumes in 2019-2020 before being used in these calculations.

[26] *See* Developing Markets for Zero Emission Vehicles in Short Haul Goods Movement: A Research Report from the National Center for Sustainable Transportation, 2020, available at https://escholarship.org/uc/item/0nw4q530. Note 1.4 BE trucks are needed to replace a diesel truck in calendar year 2024.

[27] *See* Ramboll Multi-Technology Pathways Study, WSPA, July 2, 2021, available at https://www.wspa.org/resource/ramboll-multi-technology-pathways-study/. Note total costs of ownership for a single truck are taken from the study.

[28] Additional capital costs for Battery Electric Truck occur due to anticipated growth in the fleet when BEVs are used to replace conventional diesel trucks, per Giuliano et al. (2020). A factor 1.4 is applied to the BEV capital costs to reflect added costs due to fleet growth.

Table 3. Class 8 HHD Trucks NOx Emission Estimates for MY2024

	Units	Diesel Truck	Optional Low NO_x RNG Truck	BE Truck
Tailpipe NOx Emissions[29]	tons	1.18	0.21	0
Incremental Reduction of NO_x Emissions Compared to Diesel	tons	--	0.97	1.18
Percent Reduction of NO_x Emissions Compared to Diesel	-	--	83%	100%

Table 4 (below) considers investing a billion dollars in either Optional Low NO_X RNG trucks or BE trucks and then calculates the emissions reductions compared to an equivalent number of diesel trucks, respectively. Because a BE truck cannot haul the same amount as a diesel truck (weight and range limitations), the calculations in Table 4 (below) assume that a single BE truck replaces only approximately 0.7 diesel trucks. In addition, as previously noted, the capital costs of BE trucks are greater than diesel trucks. Thus, a $1B investment in BE trucks will result in avoided diesel emissions from approximately 1,500 diesel trucks; approximately 2,000 BEVs would need to be purchased to replace 1,500 diesel trucks, in contrast to Optional Low NOx RNG trucks that can replace diesel trucks on a one-to-one basis. An investment of a billion dollars in Optional Low NO_X RNG trucks in 2024 would deliver about **three** times more black carbon reductions (a health harmful carcinogen), almost **three** times more lifecycle GHG reductions, and almost **three** times more tailpipe NO_X reductions (needed to meet the Federal Clean Air Act Requirements) as compared to BE trucks. This still does not account for the cost and implementation time of expanded electricity generation, transmission, and distribution infrastructure. Even greater reductions can be achieved if the investment is made for incremental vehicle costs only.

[29] Tailpipe emissions are obtained from EMFAC2021 for a T7 Tractor Class 8 in California for Calendar Years 2024 2033. Lifetime emissions are integrated over an assumed vehicle lifespan of 10 years and activity level of 43,500 miles per year, based on the US EPA's definition of HHDT useful life, and CARB Low-NOx Omnibus Regulation, available at: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-86/subpart-A/section-86.004-2, and at: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2020/hdomnibuslownox/res20-23.pdf.

Table 4. Potential Emission Reductions in Investing $1 Billion in MY2024 Class 8 HHD Trucks

Truck Technology		**Optional Low NO_x RNG Truck**	**BE Truck**
Capital Cost for Single Truck[30]	**$/truck**	**$192,719**	**$489,448**
Number of Trucks Purchased	--	5,188 (replaces 5,188 diesel trucks)	2,043 (replaces about 1,500 diesel trucks)
Reduction of BC Tailpipe Emissions Compared to Diesel[31,32]	MT	9.61	3.08
Reduction of Lifecycle GHG Emissions Compared to Diesel	MT CO_2e	3,963,507	1,419,337
Reduction of NO_x Emissions Compared to Diesel	tons	5,042	1,719

[30] *See* Ramboll Multi-Technology Pathways Study, WSPA, July 2, 2021, available at https://www.wspa.org/resource/ramboll-multi-technology-pathways-study/. Note the total capital cost for a single truck is taken from this study.
[31] GHG emissions here include those contributed by black carbon. Values for black carbon and GHG reductions per truck are referenced from Table 1.
[32] *See* California's Black Carbon Emission Inventory, CARB, 2015 Edition, available at https://ww3.arb.ca.gov/cc/inventory/slcp/doc/bc_inventory_tsd_20160411.pdf.