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Docket ID No. EPA-HQ-OAR-2022-0289
Office of Air and Radiation
Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, DC 20460

Re: Comments on EPA's White Paper: Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Combustion Turbine Electric Generating Units

Dear Administrator Regan,

Calpine Corporation (Calpine) submits the following comments on the U.S. Environmental Protection Agency's (EPA) draft White Paper: Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Combustion Turbine Electric Generating Units, Docket ID No. EPA-HQ-OAR-2022-0289 (White Paper).

Calpine operates the largest fleet of natural gas combined-cycle (NGCC) and combined heat and power (CHP) facilities in the United States. Calpine is also the nation's largest producer of electricity from renewable, base-load geothermal resources. Together, its generation resources are capable of delivering approximately 26,000 megawatts (MW) of clean, reliable electricity to customers and communities in 19 U.S. states and Canada, with over 75 power plants in operation or under construction. Calpine also operates and is developing battery storage projects, with 400 MW in operation and 1,500 MW in development.

Calpine supports imposing a price on carbon emissions as the most cost-effective means of achieving greenhouse gas (GHG) reductions across all sectors. Calpine has also long supported EPA's efforts to reduce emissions from the power sector and more broadly. It has been a leading supporter and defender of EPA's Clean Power Plan and Mercury Air Toxics Standards in litigation in the D.C. Circuit Court of Appeals and Supreme Court of the United States. It is also among several power companies defending EPA's authority to set GHG standards for light-duty vehicles that will drive electrification of the transportation sector and achieve significant reductions of both GHG and criteria pollutant emissions.

Given the rapid pace at which the electricity sector has reduced GHG emissions over the past decade and the projected acceleration of this pace in coming decades, the electricity sector will increasingly be called upon to support GHG reductions in transportation and other sectors. This will significantly increase demand for electricity, rendering the resilience and reliability of the electricity grid even more critical to achievement of net-zero emissions. Additionally, climate change and the extreme weather events precipitated by it are already stressing the electricity grid in ways unforeseen only a few years ago, necessitating the deployment of additional firm and flexible generation resources to avoid capacity shortfalls in the near term and efforts to maintain firm resources that would otherwise be retiring due to economic reasons.

GHG regulation alone may not remedy electricity market defects causing the retirement of resources needed to maintain reliability. However, the standards of performance and emission guidelines EPA establishes for new and existing fossil generation units under Section 111 may significantly influence policymakers' and electric utilities' selection and deployment of the optimal mix of technologies needed to decarbonize both the electricity grid and other sectors. Accordingly, Calpine welcomes this opportunity to provide these comments to inform the EPA's development of standards of performance for new gas-fired generation under Section 111.

I. Natural Gas-Fired Generation Will Continue to Be Needed for Decades to Maintain Reliability and Decarbonize the Power Sector and Other Sectors

Natural gas is now the primary fuel source for electricity generation in this country. Due to an abundant domestic supply of natural gas, economic considerations and other regulatory drivers, natural gas has overtaken coal as the primary fuel for power generation over the past decade, resulting in a significant reduction in GHG emissions.

As the electricity grid absorbs increasing volumes of electricity produced by intermittent renewable resources, the role of the U.S. gas-fired generation fleet is changing significantly, from substituting a firm power supply for less flexible and higher-emitting coal-fired generation, to serving as a firm and flexible backstop for renewable generation. According to a consensus of studies described below, the gas-fired generation fleet will remain needed and may even need to be expanded for decades to come to maintain reliability.

The gas-fired generation fleet can further support the Administration's decarbonization objectives, not only in providing critical backup for renewable generation resources, but also by utilizing innovative post-combustion and combustion technologies, including carbon capture, utilization and sequestration (CCUS) and low-carbon hydrogen. But the availability of these technologies and the appropriateness of their application to any particular generation unit may vary based on unit's size, duty cycle and geography. As discussed below, a one-size-fits-all approach to standards of performance could stand as an obstacle to meeting critical reliability needs.

A. Although Gas-Fired Generation Will Be Needed for Some Time, Its Role in the Electricity Grid Will Continue to Evolve

A decade ago, new gas-fired generation was built with the expectation that it would replace retiring coal units that operated primarily as baseload units. That has changed due to the rapid penetration of renewable generation. As the electricity grid incorporates increasing volumes of renewable generation, gas-fired units may run significantly less, but will nevertheless continue to be needed for decades to come to provide critical backstop capacity, particularly during sustained periods of low generation from renewable resources. Replacing gas-fired generation during these periods with renewable generation and battery storage would be resource- and cost-prohibitive, if not infeasible, due to limitations on available land and supply constraints for components of solar panels and batteries.

According to a study from the Environmental Defense Fund, Clean Air Task Force and academic researchers from various institutions, including Princeton and Stanford, relying upon solar, wind and storage alone "would require building the system up to nearly 500 gigawatts of power-generating capacity" "just to serve California;" roughly half the entire installed capacity of the U.S. grid today.[1] Not only "may [it] simply not be possible to build renewable facilities at this scale" – "most of which [would] seldom [be] used" – but "[t]his excess capacity would be expensive," causing wholesale electricity rates in California to increase "by about 65% over today . . . to meet demand in 2045."[2] The study's authors conclude that the "better solution" is to rely upon "clean firm power," which includes gas-fired generation equipped with CCUS, geothermal, hydrogen and other low-carbon fuels.[3]

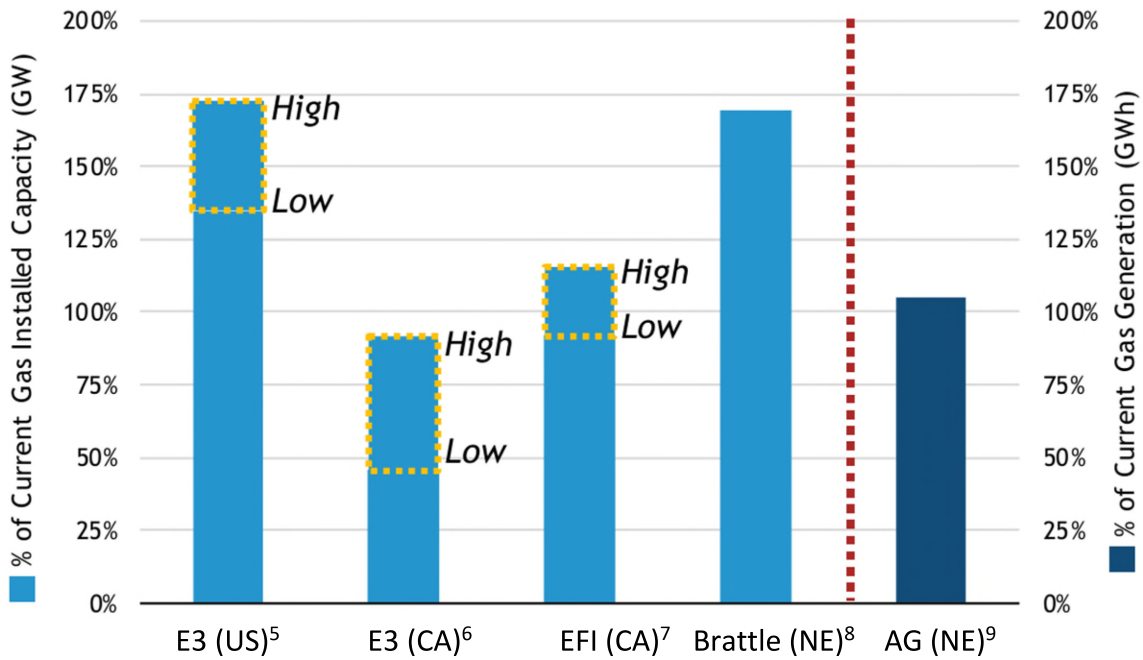
This study is not an outlier. Rather, a significant body of research supports the conclusion that maintaining and even expanding the existing gas-generation fleet is critical to achieving deep decarbonization, as summarized by Figure 1.

[1] Armond Cohen, Arne Olson, *et al*., CLEAN FIRM POWER IS THE KEY TO CALIFORNIA'S CARBON-FREE ENERGY FUTURE, ISSUES IN SCIENCE AND TECHNOLOGY at 2 (Mar. 24, 2021) *available at* https://issues.org/california-decarbonizing-power-wind-solar-nuclear-gas/ (emphasis added).

[2] *Id*.

[3] *Id*. at 3.

Figure 1: Summary of Various Studies' Projections of Percentage of Current Natural Gas-Fired Capacity/Generation (MWh) Required to Achieve Deep Decarbonization[4]



Other studies have affirmed that maintaining some amount of or expanding the existing gas-fired generation fleet would help achieve economywide decarbonization objectives at significantly less cost than if all fossil generation were eliminated. For example, a 2014 study[10] found that achieving an 80% reduction in emissions from 1990 levels by 2050 would require "electricity generation to

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[4] Calpine analysis. NORTH AMERICAN POWER MARKET OUTLOOK – NOVEMBER 2019; IHS MARKIT OUTLOOK (November 2019) (provides the total installed gas capacity (GW) per region); ISONE, KEY GRID AND MARKET STATS – RESOURCE MIX (Jan. 2020) (provides 2019 New England gas generation (GWh)).

[5] Energy and Environmental Economics (E3), PATHWAYS TO DEEP DECARBONIZATION IN THE UNITED STATES (Nov. 2015).

[6] E3, ENERGY AND CALIFORNIA ELECTRIC SYSTEM RESOURCE ADEQUACY UNDER LONG-TERM DEEP DECARBONIZATION PATHWAYS (Dec. 2018).

[7] Energy Futures Initiative, PATHWAYS FOR DEEP DECARBONIZATION IN CALIFORNIA (May 2019).

[8] Brattle, ACHIEVING 80% GHG REDUCTION IN NEW ENGLAND BY 2050: WHY THE REGION NEEDS TO KEEP ITS FOOT ON THE CLEAN ENERGY ACCELERATOR (Sept. 2019).

[9] New England Analysis Group, CONFIDENTIAL DRAFT: CARBON PRICING FOR NEW ENGLAND (Jan.2020) (shown as % of current generation (MWh), rather than capacity (MW)).

[10] Energy and Environmental Economics (E3), the Lawrence Berkeley National Laboratory, and the Pacific Northwest National Laboratory, US 2050 REPORT: PATHWAYS TO DEEP DECARBONIZATION IN THE UNITED STATES (Nov. 2014), *available at* https://biotech.law.lsu.edu/blog/US-Deep-Decarbonization-Report.pdf.

approximately double," and that this would require, not only deployment of wind and solar generation at about 30 times the capacity in 2014, but also 700 GW of fossil generation with CCS, nearly the installed capacity of fossil generation existing today.

More recent studies affirm these conclusions. In the Net-Zero America study,[11] a broad range of researchers found that, in all net-zero scenarios, the installed capacity of firm generation sources remains similar to current levels, with around 500-1000 GW (vs. 875 GW today), and that, in almost all scenarios, new natural gas capacity is added.[12]

While these studies all show that gas will be needed at certain times of the year for certain hours of the day, they also make clear that the gas fleet will be operated differently and much less frequently. According to one study, "the provision of reliable capacity (MW) in a decarbonized electricity system is fundamentally separate from the provision of energy (MWh),"[13] with the average capacity factor of the NGCC fleet peaking by the middle of this decade at greater than 50%, but then declining to an average of approximately 10% by 2050.[14]

Studies conducted for particular regions show directionally the same thing. For example, a 2019 study conducted by E3 on how California could reach 80% GHG reductions from the electric, building, transport, and industry sectors by 2050[15] found that, in its least-cost scenario, "while significant quantities of natural gas generation capacity are retained for reliability, the utilization of these remaining gas resources changes substantially over time."[16] The study's scenario for 2050 projects "many days in which no natural gas generation operates" and that the fleet-wide capacity factor "is reduced to 11% in the High Electrification scenario and 12% in the High Biogas scenario."[17]

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[11] Eric Larson, et al., NET-ZERO AMERICA: POTENTIAL PATHWAYS, INFRASTRUCTURE, AND IMPACTS (May 2022), *available at* https://netzeroamerica.princeton.edu/img/Princeton_NZA_Interim_Report_15_Dec_2020_FINAL.pdf.

[12] *Id.* at 177.

[13] James H. Williams, et al., CARBON-NEUTRAL PATHWAYS FOR THE UNITED STATES (2021), AGUADVANCES, *available at* https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2020AV000284.

[14] *Id.* at 11.

[15] Energy and Environmental Economics, LONG-RUN RESOURCE ADEQUACY UNDER DEEP DECARBONIZATION PATHWAYS FOR CALIFORNIA (2019), *available at*. https://www.ethree.com/wp-content/uploads/2019/06/E3_Long_Run_Resource_Adequacy_CA_Deep-Decarbonization_Final.pdf.

[16] *Id.* at 34.

[17] *Id.* A later E3 study on achieving California's 2045 carbon neutrality target similarly observed that "there is a general agreement that some form of firm, zero-carbon capacity is needed to complement large increases in renewable generation, as well as regional transmission where feasible," and mentions "gas with CCS" as a "promising option" to meet California's need for firm capacity (or dispatchable generation). *See* E3, ACHIEVING CARBON NEUTRALITY IN CALIFORNIA (Oct. 2020), *available at* https://ww2.arb.ca.gov/sites/default/files/2020-10/e3_cn_final_report_oct2020_0.pdf

These conclusions hold for other regions. For example, in PJM,[18] E3 found that, even in the most ambitious GHG reduction scenarios, "significant quantities of gas capacity" will need to remain in place through 2050 "to meet reliability needs while flexibly balancing renewable generation," although the gas-fired fleet would be "dispatched less and less over time as more zero-carbon generation sources are added to the system."[19] E3 concluded that eliminating these existing gas resources would significantly increase cost while doing little to reduce carbon emissions.[20]

For New England, a 2019 study by the Brattle Group found that achieving an 80% reduction in New England by 2050, in a highly electrified scenario, would require the gas fleet to play a key role in balancing system supply and demand.[21] Similarly, E3, along with the Energy Futures Initiative, found that up to 10 GW of *new* natural gas generation may be needed in New England in order to ensure reliability during extended periods of time in which wind and solar energy are not available,[22] and that replacing combustion technologies with renewables and storage would require overbuilding to ensure reliability, resulting in significant renewable curtailment under normal conditions and significant cost increases, as illustrated by Figure 2.[23]

[18] E3, LEAST COST CARBON REDUCTION POLICIES IN PJM (Oct. 28, 2020), *available at* https://www.ethree.com/wp-content/uploads/2020/10/E3-Least_Cost_Carbon_Reduction_Policies_in_PJM-1.pdf.

[19] *Id.* at 13.

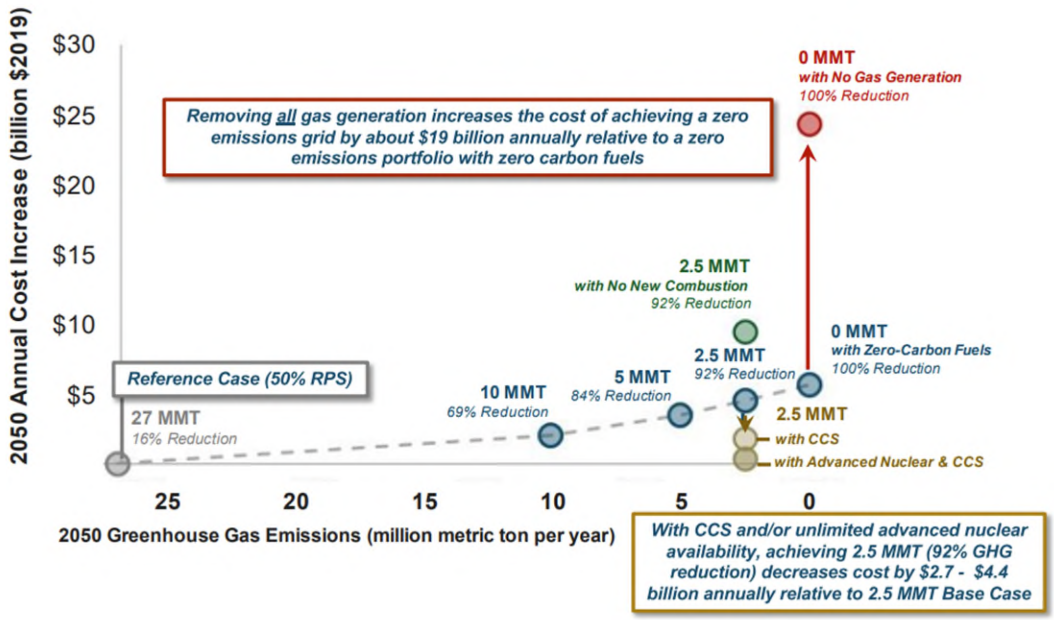
[20] *Id*. For another study of PJM that found directionally the same thing, *see* McKinsey & Company, A 2040 VISION FOR THE US POWER INDUSTRY: EVALUATING TWO DECARBONIZATION SCENARIOS (February 21, 2020), *available at* https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/a-2040-vision-for-the-us-power-industry-evaluating-two-decarbonization-scenarios (projecting that, in both the base case (current emissions trajectory) and deep decarbonization scenario, new gas capacity would be added, although it would be operated significantly less in the latter).

[21] Brattle, *supra* note 8.

[22] E3 and EFI, NET-ZERO NEW ENGLAND: ENSURING ELECTRIC RELIABILITY IN A LOW-CARBON FUTURE (Nov. 2020), *available at* https://www.ethree.com/wp-content/uploads/2020/11/E3-EFI_Report-New-England-Reliability-Under-Deep-Decarbonization_Full-Report_November_2020.pdf, at 54.

[23] *Id.* For another study of New England, *see, e.g*., Evolved Energy Research, ENERGY PATHWAYS TO DEEP DECARBONIZATION: A TECHNICAL REPORT OF THE MASSACHUSETTS 2050 DECARBONIZATION ROADMAP STUDY (Dec. 2020), *available at* https://www.mass.gov/doc/energy-pathways-for-deep-decarbonization-report/download, at 6 (finding no significant change in size of gas fleet because thermal generation would be needed for some hours on one third of the days in 2050, but during all hours on only 12 days corresponding with very low offshore wind production).

Figure 2: Increase in Electricity System Modeled Costs Relative to Reference Case, Including Limited/Expanded Firm Capacity Options Across Selected Set of Scenarios in 2050 (High Electrification).[24]



II. Carbon Capture and Sequestration Provides a Least-Cost Path to Economically Integrating Increasing Volumes of Renewable Generation, While Reducing Carbon Emissions

Given the role that the gas-fired generation fleet will continue to play for decades to come and its role as the largest gas-fired generator in the U.S., Calpine has assessed how best to decarbonize emissions from gas-fired power plants. For the reasons described below, Calpine has concluded that post-combustion carbon capture is clearly the most economic option to decarbonize natural gas-fired generation at this time and that equipping NGCCs with CCUS technology will be critical to ensuring a supply of "clean firm" power.

A. Carbon Capture Utilization and Storage is Critical to Achieving Decarbonization Objectives

The International Energy Agency (IEA) has unequivocally stated that "[t]he next decade will be critical to the prospects for CCUS and for putting the global energy system on a path to net-zero emissions," concluding that "[w]ithout a sharp acceleration in CCUS innovation and deployment

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[24] Cost increases are reported relative to the hypothetical Reference Case (50% RPS), which has annual costs in 2050 of $20.7 billion. Emissions reductions relative to 2016 emissions of 32 MMT estimated based on EPA SIT database and import emissions for all New England States. The "No Gas Generation" Case removes all fossil and hydrogen/zero-carbon fuel generation (CC/CT/ST) from the portfolio.

over the next few years, meeting net-zero emissions targets will be all but impossible."[25] The IEA's own modeling projects that CCUS will be "increasingly called upon . . . to achieve the deep emissions cuts needed in the United States,"[26] envisioning a scenario where the initial focus is placed on retrofitting fossil-fuel-based plants and supporting low-carbon hydrogen production, followed by a shift to net removals of CO_2 through direct air capture (DAC) and as a source of climate-neutral CO_2 for synthetic aviation fuels.[27]

As EPA is aware, the President has proposed to "accelerate responsible carbon capture deployment and ensure permanent storage"—including through the establishment of "ten pioneer facilities that demonstrate carbon capture retrofits for large steel, cement, and chemical production facilities"—"all while ensuring that overburdened communities are protected from increases in cumulative pollution."[28] The President's proposal would also expand the Section 45Q tax credit for carbon oxide sequestration, "making it direct pay and easier to use for hard-to-decarbonize industrial applications, direct air capture, and retrofits of existing power plants."[29] The Clean Air Task Force estimates that the President's proposal "could grow U.S. carbon management capacity by more than 13 fold by 2035 while safeguarding and creating tens of thousands American jobs and establishing the U.S. as a global leader in innovation and decarbonization."[30]

The White House Council on Environmental Equality (CEQ) has reinforced these sentiments in its June 2021 Report to Congress on Carbon Capture, Utilization, and Sequestration. The report determines that "[t]o reach the President's ambitious domestic climate goal of net-zero emissions economy-wide by 2050, the United States will likely have to capture, transport, and permanently sequester significant quantities of carbon dioxide (CO_2)."[31] The report thereby outlines the

[25] IEA, SPECIAL REPORT ON CARBON CAPTURE UTILISATION AND STORAGE: CCUS IN CLEAN ENERGY TRANSITIONS, at 151 (Sept. 2020) *available at* https://iea.blob.core.windows.net/assets/181b48b4-323f-454d-96fb-0bb1889d96a9/CCUS_in_clean_energy_transitions.pdf.

[26] *Id.* at 130.

[27] *Id.* at 14, 129-30.

[28] FACT SHEET: THE AMERICAN JOBS PLAN, WHITE HOUSE (Mar. 31, 2021), *available at* https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/.

[29] *Id.*

[30] *The American Jobs Plan: What's in it for Carbon Capture?*, CLEAN AIR TASK FORCE (Apr. 22, 2021) (footnotes omitted), *available at* https://www.catf.us/2021/04/the-american-jobs-plan-whats-in-it-for-carbon-capture/.

[31] COUNCIL ON ENVIRONMENTAL QUALITY REPORT TO CONGRESS ON CARBON CAPTURE, UTILIZATION, AND SEQUESTRATION (June 30, 2021), *available at* https://www.whitehouse.gov/ceq/news-updates/2021/06/30/council-on-environmental-quality-delivers-report-to-congress-on-steps-to-advance-responsible-orderly-and-efficient-development-of-carbon-capture-utilization-and-sequestration/.

incentives, policies, and infrastructure in place, or still needed, to accelerate widespread deployment of CCUS across the country, with a view to benefiting "all communities."[32]

Similarly, lawmakers in Congress—Democrats and Republicans alike—have introduced multiple bills to encourage the wide-scale deployment of CCUS, acknowledging the promise that CCUS holds to substantially contribute to our nation's emission reduction goals.[33] Carbon capture, moreover, is a key element of the United States' new Nationally Determined Contribution under the Paris Agreement, which identifies carbon capture as a pathway to decarbonize both electricity and industry in the United States.[34]

In sum, at both the national and international level, CCUS has been recognized as an integral component of the United States' plan to reduce GHG emissions.

B. Equipping Natural Gas-Fired Generation with Post-Combustion Carbon Capture Is the Most Economical Solution to Ensure Firm, Reliable Power Generation

While EPA did not provide cost projections or comparisons of such costs in its White Paper, Calpine believes that such projections and comparisons are critical to sending the right signals to the market about the resources that should be designed and built to achieve the Administration's decarbonization objectives.

As indicated by Figure 3, Calpine believes equipping the new or existing gas-fired generation fleet with post-combustion CCUS is the most efficient way to reduce emissions from the residual gas-fired generation needed to maintain reliability. As noted, the cost comparisons shown by Figure 3 do not include current or existing subsidies for CCUS (45Q) or a hydrogen production tax credit.

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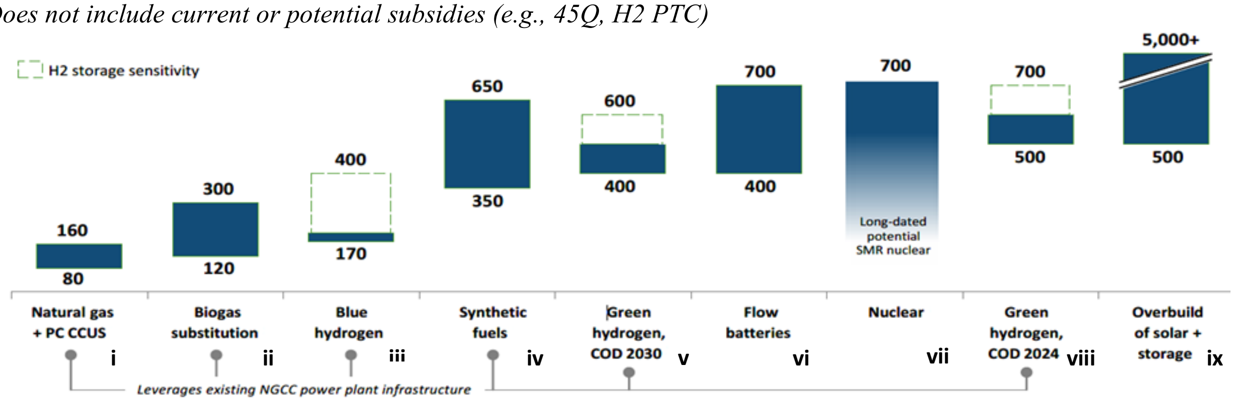
[32] *Id*. (quoting CEQ Chair Brenda Mallory).

[33] This legislation includes the Carbon Capture, Utilization, and Storage Tax Credit Amendments Act of 2021 (S. 986), the Coordinated Action To Capture Harmful (CATCH) Emissions Act (H.R. 3538), the Storing CO_2 And Lowering Emissions (SCALE) Act (S. 799), as well as the Energy Act of 2020, the latter of which Congress enacted into law in December 2020.

[34] THE UNITED STATES' NATIONALLY DETERMINED CONTRIBUTION - REDUCING GREENHOUSE GASES IN THE UNITED STATES: A 2030 EMISSIONS TARGET, UNFCCC, at 3-4 (Apr. 2021), *available at* https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/United%20States%20of%20America%20First/United%20States%20NDC%20April%2021%202021%20Final.pdf.

Figure 3: Relative Cost of Carbon Abatement (\$/tCO_2e)[35]
Does not include current or potential subsidies (e.g., 45Q, H2 PTC)



As the most right-hand bar indicates in Figure 3, eliminating all combustion technology by replacing it with renewable and storage resources sufficient to meet demand during all hours of the year is drastically more expensive and, as suggested above, may be practically infeasible.

While Calpine has concluded that gas-fired generation with post-combustion CCUS is the most economic way of decarbonizing the residual generation needed to ensure reliability, it is not to the exclusion of other technologies. Indeed, in certain circumstances – where no sequestration capacity is available nearby or where space constraints preclude construction of carbon capture equipment – hydrogen, biogas or synthetic fuels may be the best means of abating GHG emissions. Additionally, Calpine is itself pursuing renewable generation and energy storage projects and has already installed 40 MW of battery storage capacity, with 1,500 MW more in development.

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[35] Cost of carbon abatement assuming an existing NGCC alternative, 50% LHV efficiency; \$3.5/MMBTU NG fuel costs; 8% WACC and 20-yr lifetime; unless otherwise noted, lower limit corresponds to 85% CF and upper 30% Capacity factor.

i. Assumes 95% capture of effluent and 16% additional power losses to drive CCUS; cost drops further for lower efficiency plants where abatement opportunity is larger.
ii. Ranged based on biogas costs from \$12-24/MMBTU; capacity constrained by viable feedstocks.
iii. Boston Consulting Group (BCG) hydrogen for power production model output.
iv. Range based on e-methane costs from \$30-50/MMBTU; nascent technology
v. BCG hydrogen for power production model output.
vi. Ranged based on cycles per year, 200-300; assumes \$500/kWh storage costs.
vii. Low end of range reflects SMR nuclear emerging technology estimate from Breakthrough Institute NuScale analysis (low technology readiness today); high end reflects Lazard LCOE analysis for existing nuclear, ~\$130-200/MWh.
viii. BCG hydrogen for power production model output.
ix. Lazard LCOS analysis, wholesale PV+storage use case; "Long run resource adequacy under deep decarbonization pathways for CA," E3, 2019

C. Calpine's CCUS Development Program Demonstrates the Availability of This Technology Today

Consistent with its view on the efficiency of post-combustion carbon capture, Calpine has two pilot projects underway and is advancing full-scale CCUS retrofits at a number of our sites.

At our Los Medanos Energy Center facility, in Pittsburg, California, we host two pilot CCUS projects: With DOE Funding, ION Clean Energy has developed a proprietary solvent and process that captures more than 90% of CO_2 from power plant emissions at less than USD 50/ton.[36] This project will demonstrate the declining costs of post-combustion carbon capture and further advance the deployment of CCUS technology for low-CO_2 combustion emissions as are prevalent at gas-fired power plants.

Additionally, Calpine has partnered with Blue Planet to utilize its innovative technology, which mineralizes captured CO_2 to create light-weight building materials and other products.[37] For example, lightweight concrete was already successfully tested as part of constructing a parking facility in San Francisco. The pilot project to produce around 5 tons/day will start in 2022. The use of Blue Planet's technology can be scaled up after the pilot phase to capture and convert more CO_2, with the intent of eventually reaching commercial scale.

Nearby, at our Delta Energy Center facility in Pittsburgh, CA, where Calpine has a net interest of 835 MW, the company is currently conducting an engineering design study to capture 95% of site emissions. Additionally, at Calpine's Deer Park Energy Center in Texas, which has an estimated volume of CO_2 emissions of up to 5 million tons of CO_2e annually, we are also conducting an engineering study to assess the possibility to capture 95% of site CO_2 emissions with the help of two CCS trains. In October 2021, DOE awarded grants to fund these two engineering studies in the respective amounts of $5,811,210 and $4,791,966.[38]

These two engineering studies are among twelve projects funded by DOE pursuant to Funding Opportunity Announcement 2515, and the funding provided for them amounts to nearly one quarter of the $45MM awarded by DOE pursuant to Funding Opportunity Announcement 2515, which addresses natural gas power and industrial sources.[39] Upon announcing these awards, DOE Secretary Jennifer M. Granholm observed that, "to dramatically reduce carbon pollution in our

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[36] THE ION SYSTEM SOLUTION, *available at* https://ioncleanenergy.com/our-technology/.

[37] BLUE PLANET SYSTEMS, The Science, *available at* https://www.blueplanetsystems.com/technology.

[38] FUNDING OPPORTUNITY ANNOUNCEMENT 2515, CARBON CAPTURE R&D FOR NATURAL GAS AND INDUSTRIAL POINT SOURCES, AND FRONT-END ENGINEERING DESIGN STUDIES FOR CARBON CAPTURE SYSTEMS AT INDUSTRIAL FACILITIES AND NATURAL GAS PLANTS, DOE Office of Fossil Energy and Carbon Management (Oct. 6, 2021), *available at* https://www.energy.gov/fecm/articles/funding-opportunity-announcement-2515-carbon-capture-rd-natural-gas-and-industrial.

[39] DOE INVESTS $45 MILLION TO DECARBONIZE THE NATURAL GAS POWER AND INDUSTRIAL SECTORS USING CARBON CAPTURE AND STORAGE (Oct. 6, 2021), *available at* https://www.energy.gov/articles/doe-invests-45-million-decarbonize-natural-gas-power-and-industrial-sectors-using-carbon.

fight against climate change, we must deploy all of the tools at our disposal, including the innovative technologies that capture CO_2 emission before they reach the atmosphere."[40]

Calpine is also working with other partners to develop a hub concept to enable efficient decarbonization of clustered emissions, located near ideal geologic storage locations. Indeed, our projects for retrofitting gas-fired generation and CHP facilities with CCS could help de-risk investments in CCS technology for harder-to-abate sources and help realize the emission reduction opportunities among those sectors.

One key advantage for Calpine is that it has a number of CCS-ready facilities located near high-quality sequestration basins, including in the Central Valley of California and the Gulf of Mexico. As one report by the Energy Futures Initiative and Stanford University found, California has the potential to store 60 million tons of CO_2 each year—the equivalent of total electricity sector emissions in 2017—for 1,000 years.[41] That report specifically noted that pairing CCS with NGCCs provides the opportunity "to create a 'clean firm' resource," which other studies (as described above) identified "as critical for maintaining grid reliability and managing energy system costs."[42] It also described how deploying CCS on existing industrial and power generation sources through the development of regional hubs with shared pipelines could unlock potential for carbon removal technologies such as DAC.[43]

In sum, Calpine is advancing full-scale CCUS projects to achieve the decarbonization potential identified by the IEA, this Administration and many academic and research institutions.

III. Standards for the Gas-Fired Generation Fleet Should Allow for the Most Cost-Effective Path to Firm, Decarbonized Electricity System

To address climate change, the U.S. electricity sector has been transformed over the past decade and continues to evolve. As described above, gas-fired generation capacity now plays a critical role in supporting the integration of renewable resources and will continue to do so for decades to come, although it will operate at significantly reduced capacity factors. Deploying and maintaining the resources needed to meet increasing demand for electricity will necessarily involve decisions of policymakers on how best to achieve policy objectives, at least cost to consumers.

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[40] *Id*.

[41] ENERGY FUTURES INITIATIVE, STANFORD PRECOURT INSTITUTE FOR ENERGY & STANFORD CENTER FOR CARBON STORAGE, AN ACTION PLAN FOR CARBON CAPTURE AND STORAGE IN CALIFORNIA: OPPORTUNITIES, CHALLENGES, AND SOLUTIONS, at S-6 (Oct. 2020), *available at* https://static1.squarespace.com/static/58ec123cb3db2bd94e057628/t/5f91b40c83851c7382efd1f0/1603384344275/EFI-Stanford-CA-CCS-FULL-10.22.20.pdf (citing OPTIONALITY, FLEXIBILITY & INNOVATION, ENERGY FUTURES INITIATIVE (May 2019)).

[42] *Id.* at S-1; *see also* S-6.

[43] *Id*. at S-7.

Calpine would submit that the choice of which firm capacity resources are best suited to support this transition should be locally determined and that such decisions will necessarily be based on local conditions. Regions should use the resources that are available to them. Factors like geography, climate, and existing installed capacity will lead to different cost-effective solutions. A one-size-fits-all approach, where standards presume the availability of certain technologies, such as CCS, could stymie innovation and stand as an obstacle to deploying the best resources to fulfill the need.

As an example, facing a projected shortfall of electricity supply during extreme weather events, last summer, California Governor Gavin Newsom issued an emergency proclamation in response to extreme weather conditions, to reduce the strain on California's energy infrastructure and increase energy capacity.[44] The proclamation found that, due to extreme heat conditions that increased demand for electricity throughout the west, drought, which reduced supply from hydroelectric resources, and wildfires that threatened critical transmission infrastructure, the California Independent System Operator (CAISO) was forecasting an energy supply shortage of up to 3,500 MW during the afternoon-evening "net-peak" period of high demand on days with extreme weather conditions. It also found that there was insufficient time or supply to install new energy storage or zero-carbon energy projects to meet the 2021 shortfall and that it was already too late, under normal procedures, to bring additional sources online in time to address a previously unforseen shortfall of up to 5,000 MW projected for the summer of 2022. The proclamation therefore ordered California's energy agencies to "act immediately to achieve energy stability."[45]

Pursuant to that order, the California Department of Water Resources (DWR) purchased three simple-cycle gas turbines to provide critical electricity supply on a temporary basis, projected through 2023, when sufficient new zero-carbon generation and storage resources may be available to avoid a shortfall. These simple-cycle units – two of which were installed on the site of an existing NGCC facility owned by Calpine – only operate at times of peak demand, when no other resources are available, and with an emissions profile that is significantly better than diesel-fired generators.

If standards of performance for gas-fired combustion turbines generally required some form of GHG abatement, such as CCUS, green hydrogen or biogas, those standards could have stood as an obstacle to DWR's and Calpine's rapid deployment of the resources needed to avoid shortfalls. Additionally, if DWR and Calpine were required to conduct a best available control technology (BACT) analysis that looked more broadly at other alternatives to gas generation, such as renewable energy or storage (despite the Governor's determination that no time existed to deploy such generation or storage resources to avert the shortfall), such a "redefinition of the source" could have precluded DWR from procuring the turbines and Calpine from installing them, in time for them to be operational in 2021.

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[44] PROCLAMATION OF A STATE OF EMERGENCY (July 30, 2021), https://www.gov.ca.gov/wp-content/uploads/2021/07/Energy-Emergency-Proc-7-30-21.pdf.

[45] *Id*. at § 2.

As the example presented by California's procurement of new gas generation to fulfill a near-term critical reliability need demonstrates, even jurisdictions that are leaders in the deployment of clean energy generation and storage resources may find, due to increasing stress on the electricity grid, that they need to add gas-fired generation capacity. In the California example, it would have made no sense to consider post-combustion CCS as an available technology for units that would seldom be operated and only for a limited number of years to meet a critical reliability need. Calpine would therefore submit that EPA should ensure that, whatever form its standards of performance take under Section 111 or whatever additional guidance it provides to permitting authorities on how to conduct BACT analyses for proposed gas-fired generation, those standards and guidance do not prevent resource planners and utilities from rapidly deploying the resources they determine are needed to cost-effectively meet demand.

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Please contact me at 713-830-2000 or Steven.Schleimer@calpine.com with any questions regarding these comments.

Sincerely,

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