Company: San Diego Gas & Electric Company (U 902 M)
Proceeding: 2024 General Rate Case
Application: A.22-05-015/-016 (cons.)
Exhibit: SDG&E-202

REBUTTAL TESTIMONY

OF ESTELA DE LLANOS

(SUSTAINABILITY POLICY)

BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF CALIFORNIA

May 2023

TABLE OF CONTENTS

I. INTRODUCTION 1
II. RESPONSE TO INTERVENOR TESTIMONY 6
A. SDG&E Seeks To Achieve State and Regional Goals for Decarbonization 6
B. Clean Hydrogen and Carbon Removal Have Potential to Advance California's Decarbonization 11
1. Clean Hydrogen 13
2. Carbon Removal 15
C. Customer-Owned Distributed Energy Resources Do Not Replace SDG&E's Investments Proposed in this Proceeding 16
D. UCAN Misunderstands the Purpose of SDG&E's Sustainability Strategy 22
III. CONCLUSION 22

APPENDICES

Appendix A – Glossary of Terms
Appendix B – Documents (Attachments A,B,C,D,E)
Attachment A. Sustainability Strategy 2020 ..... B-1
Attachment B. Sustainability Strategy Update 2021 ..... B-57
Attachment C. Sustainability Strategy Update 2022 ..... C-116
Attachment D-1. Path to Net Zero B-117
Attachment D-2. Path to Net Zero Technical Appendix B-143
Attachment E. CARB Press Release B-163

REBUTTAL TESTIMONY OF ESTELA DE LLANOS (SUSTAINABILITY POLICY)

I. INTRODUCTION

This rebuttal testimony regarding San Diego Gas & Electric Company's (SDG&E or Company) Sustainability Policy addresses the following testimony from other parties that relate to that policy:

- The Public Advocates Office of the California Public Utilities Commission (Cal Advocates), as submitted by Amin Younes (Ex. CA-09 (Younes)), dated March 27, 2023
- Environmental Defense Fund (EDF), as submitted by Michael Colvin, Dr. Richard McCann, and Joon Seong (Ex. EDF-01 (McCann/Seong)), dated March 27, 2023
- Protect Our Communities Foundation (PCF), as submitted by Bill Powers (Ex. PCF-01 (Powers)), dated March 27, 2023
- Utility Consumers Action Network (UCAN), as submitted by Dr. Eric Charles Woychik (Ex. UCAN (Woychik)), dated March 27, 2023
- California Environmental Justice Alliance (CEJA), as submitted by Matthew Vespa, Sara Gersen, Sasan Saadat, and Rebecca Barker (Ex. CEJA-01 (Gersen)), dated March 27, 2023

As a preliminary matter, the absence of a response in this rebuttal testimony to any particular issue raised in intervenor testimony does not imply or constitute agreement by SDG&E with the proposal or contention made by these or any other party. Moreover, my rebuttal testimony responds only to the above intervenor testimony about SDG&E's sustainability policy; other SDG&E witnesses will respond to such intervenor testimony with respect to specific projects, programs, and costs proposed by SDG&E in this proceeding.

In my direct testimony, Ex. SDG&E-02, I described SDG&E's commitment to deliver clean, safe, and reliable electric and natural gas service in a manner that supports California's climate and energy transition goals. As a utility based in California and serving the needs of business and residential customers in San Diego County and southern Orange County, SDG&E

is in a unique position to (a) actively support the State in reaching an important milestone of delivering 100% renewable/zero-carbon energy by 2045, and (b) deliver clean energy to customers also working to reduce their greenhouse gas emissions to meet local, state, and federal goals.

Sustainability is integral to SDG&E's business and my testimony helps connect how our work:

- Contributes to our region's and state's broader climate goals;
- Drives compliance with local, state, and federal policies and mandates; and
- Supports a safe and equitable transition to a clean energy economy.

In 2020, SDG&E first published its sustainability strategy in a report entitled "Building A Better Future: Our Commitment to Sustainability (Sustainability Strategy)."[1] SDG&E's Sustainability Strategy expresses the company's intention to advance sustainability for the benefit of its customers and stakeholders and identifies goals to guide the company's actions in seeking to advance sustainability. These goals are rooted in SDG&E's responsibility to provide safe and reliable energy to its customers. SDG&E's Sustainability Strategy also lays the foundation for the company to adapt its infrastructure, operations, and services in response to the growing clean energy needs of its stakeholders and on-going policy developments as communities across its service territory create and implement climate action plans and goals.

In April 2022, SDG&E published "The Path to Net Zero: A Decarbonization Roadmap for California" (Path to Net Zero).[2] The Path to Net Zero was the first publicly available analysis to use the utility industry reliability standard and industry-specific planning tools to model how to decarbonize California through 2045 while also prioritizing grid reliability, affordability, and equity. The Path to Net Zero used the "one day in ten year" loss of load expectation (LOLE) standard of electric reliability, which is both mandated by the California Public Utilities

---

[1] SDG&E, Building A Better Future: Our Commitment to Sustainability (2020) (Sustainability Strategy 2020), Appendix B at Attachment A, and available at https://www.sdge.com/sites/default/files/documents/SDG%26E%20Sustainability%20Report_0.pdf. SDG&E has published updates to its Sustainability Strategy in 2021 and 2022, *see* Appendix B at Attachments B and C.

[2] *See* SDG&E, The Path to Net Zero: A Decarbonization Roadmap For California (April 2022) (Path to Net Zero), Appendix B at Attachment D.

Commission (Commission or CPUC),[3] and critical to our customers, who expect reliable electric service. The Path to Net Zero also used a number of modeling tools leveraged by past reports and agencies to outline how California can meet economywide decarbonization and policy targets by 2045 with reliability in mind, including the Energy and Environmental Economics (E3) PATHWAYS model used by the California Air Resources Board (CARB) to develop the agency's 2022 Scoping Plan and also in E3's 2020 report "Achieving Carbon Neutrality in California."[4]

Among other important points, the Path to Net Zero predicts that electricity demand will increase dramatically by 2045 with electrification of the transportation and building sectors. The Path to Net Zero model projects a 96% increase in electric consumption in California with a nearly 100% increase in SDG&E's service territory and a 60% increase in net peak demand in the state with an approximately 85% increase in SDG&E's service territory. California will need to rapidly decarbonize (4.5 times the pace over the past decade)[5] and grow electric system capacity (approximately 4 times 2020 capacity benchmarks)[6] to support state goals for transportation and building electrification.

The anticipated demand for electricity to support the transportation sector is driven by California state mandates and regulations to reduce carbon emissions and improve air quality. For example, CARB's Advanced Clean Cars II Regulation requires 100% of new cars and light trucks sold in California to be zero emission by 2035.[7] Similarly, CARB's recently approved

---

[3] *See, e.g.*, CPUC, Reliable and Clean Power Procurement Program - CPUC Energy Division, Staff Paper (September 2022) at 10, available at https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M496/K684/496684997.PDF.

[4] *See* Path to Net Zero, Technical Appendix, Figure A1 at 3, available at https://www.sdge.com/sites/default/files/documents/TechnicalAppendixFinal_1.pdf?nid=22011.

[5] Path to Net Zero at 4.

[6] Path to Net Zero, Figure 1 at 5.

[7] *See generally* CARB Press Release 22-30, California moves to accelerate to 100% new zero-emission vehicle sales by 2035 (August 25, 2022), Appendix B at Attachment E and available at https://ww2.arb.ca.gov/news/california-moves-accelerate-100-new-zero-emission-vehicle-sales-2035. Specific regulations can be found at https://ww2.arb.ca.gov/rulemaking/2022/advanced-clean-cars-ii. *See, e.g.*, Sections 1961.4 & 1962.4, Title 13, California Code of Regulation (November 30, 2022). In approving the Advanced Clean Car II rules, CARB noted that "Transportation is responsible for approximately 50% of greenhouse gas emissions (when accounting for fuel production emissions) and 80% of air pollutants in California." *Id.* at CARB Press Release 22-30.

Advanced Clean Fleets regulation requires medium- and heavy-duty fleets to begin transitioning to zero-emissions technology beginning as early as next year, with requirements tightening as the state moves toward 2045.[8]

SDG&E must also support the decarbonization of buildings, which currently account for about 14% of California's greenhouse gas (GHG) emissions.[9] Following the California Energy Commission's (CEC) 2018 Integrated Energy Policy Report (IEPR) Update,[10] which found that greenhouse gas emissions from buildings are second only to transportation, two laws were passed to help reduce emissions from this sector. Assembly Bill (AB) 3232 directed the California Energy Commission to assess the feasibility of reducing emissions from the state's building sector 40% below 1990 levels by 2030. Senate Bill (SB) 1477 asks the CPUC to develop programs (BUILD and TECH) aimed at reducing greenhouse gas emissions from buildings. The CPUC has an active Order Instituting Rulemaking on Building Decarbonization (Rulemaking (R.) 19-01-011) focused on implementing SB 1477, developing new policies on building and appliance energy efficiency standards and establishing a building decarbonization policy framework.[11]

Critically, both SDG&E's Sustainability Strategy and Path to Net Zero recognize the possibility and even likelihood that new technology, regulatory decisions, and customer choices will require changes to SDG&E's approach to sustainability. As noted in SDG&E's Sustainability Strategy published in 2020, "customers' needs will evolve, new challenges will arise, technologies will emerge and [SDG&E] will adjust accordingly."[12] As stated in the Path to Net Zero:

---

[8] CARB, California approves groundbreaking regulation that accelerates the deployment of heavy-duty ZEVs to protect public health (April 28, 2023) available at https://content.govdelivery.com/accounts/CARB/bulletins/3579202.

[9] CARB Building Decarbonization Program, available at https://ww2.arb.ca.gov/our-work/programs/building-decarbonization/about.

[10] CEC, 2018 Integrated Energy Policy Report Update, Volume II, Complete Report (February 20, 2019) at 17, available at https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2018-integrated-energy-policy-report-update.

[11] R.19-01-011, Order Instituting Rulemaking Regarding Building Decarbonization (February 8, 2019); *see* also, CPUC, Building Decarbonization, available at https://www.cpuc.ca.gov/about-cpuc/divisions/energy-division/building-decarbonization.

[12] Sustainability Strategy 2020 at 4.

> This Roadmap aims to provide what we believe is a reasonable and appropriate starting point for implementation and prioritization based on current knowledge, feasibility and market conditions. But the challenges, technologies and solutions associated with decarbonization are constantly evolving. The Roadmap will therefore need to be revisited as uncertainties are narrowed. For example, there are still unknowns about consumers' future adoption rate of electric vehicles (EV) and all-electric household appliances, as well as how the associated increase in electricity usage will impact the electric system. There are also uncertainties about the cost of decarbonization technologies. By pursuing multiple technological options for decarbonization, the Roadmap's diversified approach should provide California with the necessary flexibility to adapt its path to carbon neutrality.[13]

Flexibility is inherent in SDG&E's Sustainability Strategy and Path to Net Zero Roadmap. SDG&E also recognizes that the climate crisis is upon us, which requires the company take steps now to advance sustainability, even if new information in the future requires different or additional actions.

My direct testimony discussed how projects and expenditures included in SDG&E witnesses' testimony fell into three major categories that underpin SDG&E's Sustainability Strategy and provide a framework to advance environmental and social justice as well as climate equity pursuant to the CPUC's Environmental & Social Justice Action Plan:[14] climate change mitigation, climate change adaptation, and grid transformation.

Intervenor testimony in this proceeding recognizes the need to respond to climate change, and to do so in an equitable manner. However, some intervenors take a different view of SDG&E's role, propose different approaches to decarbonization, or disagree with SDG&E's proposals to explore and utilize new technologies for decarbonization. While the SDG&E witnesses for specific projects or investments will respond to the details of intervenor arguments, I respond below to climate policy issues raised by intervenors about SDG&E's sustainability policy (which is driven by the goals and principles set forth in the Sustainability Strategy, the roadmap set forth in the Path to Net Zero, and a prudent recognition that technologies and economics may require adjustments in the future).

---

[13] Path to Net Zero at 6.

[14] CPUC, Environmental & Social Justice Action Plan Version 2.0 (April 7, 2022) available at https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/news-and-outreach/documents/news-office/key-issues/esj/esj-action-plan-v2jw.pdf

II. RESPONSE TO INTERVENOR TESTIMONY

A. SDG&E Seeks To Achieve State and Regional Goals for Decarbonization

Cal Advocates asserts that SDG&E should not go beyond legal mandates in responding to climate change, stating: "Cal Advocates supports California's environmental policies and statutes but opposes ratepayer funding of projects which the utility engages in voluntarily. California's legislature and the Commission are responsible for establishing mandates for the utility in service of the state's environmental goals, and the utility has the duty to meet these mandates. The utility should not go beyond established needs at the expense of ratepayers."[15]

I strongly disagree with the suggestion that SDG&E's proposals are "voluntary." The California Legislature, California Governors, and this Commission have made plain that SDG&E and the other California investor-owned utilities (IOUs) are mandated to not only reduce their own GHG emissions and prepare their own infrastructure to withstand climate change impacts, but to advance the decarbonization of California's energy use by providing a resilient electrical grid that has the capacity and reliability to meet customers' electric demand, as well as addressing emissions from customers' energy use.

And with good reason. California is in a climate crisis. As noted in California's Fourth Climate Change Assessment, the state "is one of the most 'climate-challenged' regions of North America and must actively plan and implement strategies to prepare for and adapt to extreme events and shifts in previously 'normal' averages. Currently, temperatures are warming, heat waves are more frequent, and precipitation has become increasingly variable."[16] The California Climate Crisis Act (California AB 1279), passed in 2022 and established that it is state policy to "[a]chieve net zero greenhouse gas emissions as soon as possible, but no later than 2045 and to achieve and maintain net negative greenhouse gas emissions thereafter."[17]

---

[15] Ex. CA-09 (Younes) at 15.

[16] California Natural Resources Agency and California Energy Commission, California's Fourth Climate Change Assessment (August 2018) (Fourth Climate Change Assessment Report) at 13, available at https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf.

[17] AB 1279, codified at California Health & Safety Code Section 38562.2. This enacted into law Executive Order (EO) B-55-18 (2018), available at https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf.

SDG&E believes that achieving California's climate goals, as well as those of the communities it serves, requires taking a proactive and holistic approach. SDG&E further believes that such an approach benefits customers by avoiding the most devastating costs and consequences of the climate crisis. In short, California's climate policies and the climate crisis call for SDG&E to act with a sense of urgency, not to passively await further instructions from the CPUC.

As required by the Commission,[18] SDG&E's 2021 Risk Assessment and Mitigation Phase (RAMP) Report details threats posed by climate change.[19] This filing informed the company's current General Rate Case (GRC) request. While wildfire threat remains SDG&E's biggest risk, other hazards also exacerbated by climate change include the threat of rising sea levels, which poses safety risks to coastal regions, can damage infrastructure assets along these regions, and impact the safety of customers should the damaged assets result in extended outages. Similarly, the increasing frequency of extreme winter and summer weather in the Western United States due to climate change demonstrates the need for investment in a more resilient energy system. California's Fourth Climate Change Assessment notes the economic and health impacts of climate change, stating "Emerging findings for California show that costs associated with direct climate impacts by 2050 are dominated by human mortality, damages to coastal properties, and the potential for droughts and mega-floods. The costs are in the order of tens of billions of dollars. If global greenhouse gas emissions are reduced substantially from the current business-as-usual trajectory, the economic impacts could be greatly reduced."[20]

SDG&E's Sustainability Strategy is designed to support achieving California climate policies. For example, SDG&E's goal to reach net zero greenhouse gas emissions by 2045 is

---

[18] *E.g.,* R.18-04-019, Order Instituting Rulemaking to Consider Strategies and Guidance for Climate Change Adaptation (May 7, 2018) at 12, ("Beginning in 2014, the Commission required large electric and gas investor-owned utilities in the state to develop risk prioritization and mitigation plans that were informed by probabilistic risk models. These plans, which amongst other risk drivers also consider climate change impacts, are called the Risk Assessment and Mitigation Phase filings …").

[19] SDG&E RAMP Filing, available at https://www.sdge.com/proceedings/2021-sdge-ramp-report. *See* RAMP Cross-Functional Factor (SDG&E-CFF -2): Climate Change Adaptation, Energy System Resilience, and Greenhouse Gas Emission Reductions (May 17, 2021).

[20] Fourth Climate Change Assessment Report at 8.

aligned with California SB 32 (2016),[21] which ordered a reduction in economy-wide emissions of 40% below 1990 levels by 2030, as well as The California Climate Crisis Act (2022 AB 1279). In addition, SDG&E's renewable energy procurement and energy storage goals advance California's Renewable Portfolio Standard California, SB 100 (The 100% Clean Energy Act of 2018),[22] and SB 1020 (2022), which directed this Commission to "plan for 100 percent of total retail sales of electricity in California to come from eligible renewable energy resources and zero-carbon resources by December 31, 2045," with interim milestones of 90 percent by December 31, 2035 and 95 percent by December 31, 2040.[23]

Beyond the statewide goals, SDG&E seeks to support its customers and the communities it serves in achieving their climate policies and mandates. The City of San Diego, for example, has set a more aggressive climate goal to reach net zero GHG emissions by 2035.[24]

SDG&E's infrastructure, operations, and services play a critical role in enabling the customers and communities we serve to achieve their climate mitigation, climate equity, and climate resiliency goals. For example, SDG&E's clean transportation programs and collaborations have enabled cities to advance their climate equity initiatives.

Moreover, the Commission expects SDG&E and other California IOUs to take prudent steps to adapt to climate change. As noted in Decision (D.) 20-08-046:

> This decision takes steps to ensure the energy utilities we regulate are prepared to upgrade their infrastructure, operations and services to adapt to climate change, and to ensure safe and reliable energy service to all Californians – including those most vulnerable and disadvantaged.

---

[21] SB 32, available at https://legiscan.com/CA/text/SB32/id/1428776.

[22] SB 100, available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100.

[23] SB 100, Sections 1(b) & 5, codified at Cal. Pub. Util. Code Section 454.53(a), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB100; SB 1020, Section 4, codified at Pub. Util. Code Section 454.53. SB 1020, available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB1020.

[24] City of San Diego, San Diego's Landmark 2022 Climate Action Plan Unanimously Approved by City Council (August 2, 2022), available at https://www.sandiego.gov/sites/default/files/08-02-22_climate_action_plan_approved_by_city_council_news_release.pdf; *see also* City of San Diego, Climate Action Plan, Our Climate, Our Future (2022) at 16, 41, and 81, available at https://www.sandiego.gov/sustainability/climate-action-plan. SDG&E has agreed to collaborate with the City in achieving its goal. *Id.* at 30.

> At its essence, climate change adaptation for California's investor-owned energy utilities (IOUs or energy utilities) focuses on incorporating the best available climate science into utility infrastructure, operations and services for the long-term to help ensure provision of resilient and reliable service to all customers. The purpose of this Rulemaking and the guidance adopted herein is to provide a forum for addressing how energy utilities should plan and prepare for increased operational risks due to changing climate conditions and heightened risks from wildfires, extreme heat, extreme storms, drought, subsidence and sea level rise, among other climate change phenomena. Energy utilities need this guidance to plan to continue to fulfill their mission to provide safe, reliable, and affordable service in the future's more difficult operating environment.[25]

SDG&E agrees with the Commission that such planning of "infrastructure, operations and services" is necessary and pragmatic. The obvious next step following planning is to propose utility "infrastructure, operations and services" to implement climate change adaptation and mitigation, as SDG&E is doing through this GRC application.

Suggesting these actions are "voluntary" ignores the goals and targets set by state and local governments to respond to the overwhelming scientific consensus that climate change poses an existential risk. It also ignores the scope and scale of the challenges presented by climate change, which call for SDG&E to work with and engage stakeholders proactively to find innovative, cost-effective, and equitable solutions. SDG&E's proactive approach is measured and prudent with respect to the technological and foundational investments it is proposing to support a sustainable energy system. By contrast, Cal Advocates states that the "best way for the utilities to support the state's environmental goals is by achieving the lowest possible rates while complying with safety, reliability, and environmental regulations."[26] SDG&E respectfully disagrees.

SDG&E does not take such a cramped view of its obligations. The California Climate Crisis Act (2022 AB 1279) states that it is California's policy to "[a]chieve net zero greenhouse gas emissions as soon as possible, but no later than 2045, and to achieve and maintain net negative greenhouse gas emissions thereafter."[27] California's mandate for climate action is well-established in law, policy, and regulation. SDG&E believes it is both necessary and prudent to

---

[25] D.20-08-046 at 2.

[26] Ex. CA-09 (Younes) at 16.

[27] AB 1279, Section 2, codified at California Health & Safety Code Section 38562.2, available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB1279.

propose programs and projects, in this GRC proceeding and elsewhere, that contribute to achieving the State's and this Commission's policies to respond to climate change and its impacts.

Cal Advocates seeks to block funding for various Clean Energy Innovation projects, asserting that SDG&E should not "voluntarily" propose programs to advance decarbonization because "[r]atepayer funding of projects which are neither caused by ratepayers nor provide a net benefit to ratepayers is regressive and inequitable."[28] While SDG&E shares Cal Advocates' concern about affordability, SDG&E does not believe this should prevent the company from proposing programs to advance California's energy transition. First, SDG&E's proposed investments serve and benefit its ratepayers. Among the many unique characteristics of SDG&E's service territory are its climate zone, building stock, and customer composition, all of which require tailored energy infrastructure, operations, and services solutions to enable the clean energy transition. As discussed in the rebuttal testimony of Fernando Valero, Ex. SDG&E-215, SDG&E's proposed Clean Energy Innovations energy storage projects (both battery and hydrogen) will capture excess energy so that it can be made available to SDG&E customers when needed, its Hydrogen Build-Ready Infrastructure project will connect customers' hydrogen generation equipment to the electrical grid to enable hydrogen-fueled vehicles, and its Innovation Technology Development Department's Clean Energy research will facilitate the decarbonization and electrification of customer end-uses.

Second, these sustainability programs provide net benefits to ratepayers because they assist in mitigating and adapting to climate change. Such mitigation and/or adaption helps Californians, including SDG&E ratepayers, avoid potential economic and health/wellbeing losses from catastrophic events like extended drought or flooding, extreme weather patterns, including lengthy heat or cold waves, and adverse health outcomes due to air pollution or extreme hot/cold. For example, the company's programs to decrease wildfire risk and make communities more resilient to climate change are foundational to community safety, which is a part of sustainability. SDG&E's wildfire mitigation efforts, which are aligned with state policy and subject to on-going review and direction of the Commission, not only help ratepayers and

[28] Ex. CA-09 (Younes) at 15 (footnote omitted).

the state avoid economic loss from any potential fire events, but also increase the resiliency and reliability of the grid.[29]

Third, SDG&E is acutely aware of the need for an affordable and equitable energy transition. As discussed in the rebuttal testimony of Bruce Folkmann, Ex. SDG&E 201, SDG&E is actively pursuing multiple pathways to reduce rates, including through the current GRC proposal. SDG&E recently filed a rate proposal to this Commission in response to California AB 205.[30] This proposal, which was filed in collaboration with all of the state's IOUs, seeks to reduce the energy burden on lower income households and provide predictable monthly budgeting that will encourage the transportation and building electrification needed to meet state and community climate objectives. SDG&E is also proactively pursuing additional affordability measures such as transferring the costs of some public purpose programs from ratepayers to funding through the State General Fund,[31] as well as applying for federal funds for climate mitigation and adaptation investments, including those available through Infrastructure Investment and Jobs Act, the landmark bipartisan bill of 2021.[32]

B. Clean Hydrogen and Carbon Removal Have Potential to Advance California's Decarbonization

Certain intervenors oppose SDG&E projects that explore and utilize the potential of clean hydrogen,[33] and study carbon removal,[34] to help decarbonize California. Some argue that such

---

[29] CEC Report, Assessing the Impact of Wildfires on California's Electricity Grid (August 2018), available at https://www.energy.ca.gov/sites/default/files/2019-12/Forests_CCCA4-CEC-2018-002_ada.pdf.

[30] *See* R.22-07-005 (Ex. SDG&E-01, Prepared Testimony of Gwendolyn R. Morien on behalf of SDG&E, dated April 7, 2023); AB 205 (2022), available at. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB205.

[31] Proposed AB 982 (introduced 2023), available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202320240AB982.

[32] Sdgenews.com, SDG&E Seeking $100M in Federal Funds to Advance Wildfire Safety Efforts in High Fire Threat District (April 7, 2023) available at https://www.sdgenews.com/article/sdge-seeking-100m-federal-funds-advance-wildfire-safety-efforts-high-fire-threat-district.

[33] *See* Ex. SDG&E-15-R (Valero) at FV-5 – FV-8 (Hydrogen Strategy and Implementation Department), FV-18 - FV-21 (Advanced Energy Storage and potentially Advanced Energy Storage 2.0), FV-28 (Hydrogen Build Ready Infrastructure), and FV-29 (Hydrogen Energy Storage System Expansion).

[34] *See* Ex. SDG&E-15-R at FV-11 – FV-13 (Innovation Technology Development O&M).

projects do not benefit SDG&E's ratepayers or, in a variation on the same point, that such projects are "new lines of business" for SDG&E that should not be charged to SDG&E's current customers.[35] Some intervenors also claim that clean hydrogen and/or carbon removal do not advance decarbonization.[36]

Based upon currently available information, SDG&E believes that both clean hydrogen and carbon removal have the potential to advance decarbonization. SDG&E's Sustainability Strategy Update for 2022 notes that cleaner fuels like hydrogen are "expected to play a vital role in helping decarbonize California's economy, including the potential to become a key source of clean, firm, dispatchable power."[37] The Path to Net Zero points out the need for clean fuels like hydrogen to support grid reliability given the intermittency of renewables. The Path to Net Zero "envisions 20 GW of 100% clean hydrogen generation as a critical technology needed for the state to maintain electric reliability while satisfying increased demand for clean electricity."[38] The Path to Net Zero study further predicts that in order to meet state renewable energy and reliability goals, "4 GW of electricity from natural gas with carbon capture and sequestration (CCS) will be needed to support reliability as the electric sector decarbonizes."[39]

As set forth below, federal, and state agencies, and this Commission, agree that clean hydrogen and carbon removal have potential to advance decarbonization. Moreover, SDG&E's projects for clean hydrogen and proposal to study carbon removal have the potential to benefit SDG&E's current customers, and such ratepayers thus are properly charged the costs to explore such technologies.

---

[35] Ex. CEJA-01 (Gersen) at 46-49, and 51-52; Ex. CA-09 (Younes) at 14, 19-20, and 49-52); and Ex. EDF-01 (McCann/Seong) at 49-50.

[36] Ex. CEJA-01 (Gersen) at 55 and 56-58; and Ex. EDF-01 (McCann/Seong) at 51-52.

[37] Sustainability Update 2022 at 11, available at https://www.sdge.com/sites/default/files/documents/SDGE%20Sustainability%20Strategy%202022_FINAL.pdf?pid=23531.

[38] The Path to Net Zero at 11 (citation omitted).

[39] The Path to Net Zero at 4.

1. Clean Hydrogen

In this GRC proceeding, SDG&E seeks funding of its operations and maintenance (O&M) Hydrogen Strategy and Implementation Department and several capital projects to utilize hydrogen for energy storage and facilitate hydrogen-based transportation.[40]

As noted above, SDG&E's Path to Net Zero concludes that clean hydrogen will be necessary to achieve the state's net zero goal. This conclusion is supported by external research and has been adopted by government agencies. The CARB 2022 Scoping Plan for Achieving Carbon Neutrality (2022 Scoping Plan)[41] notes the need for "scaling up new options such as renewable hydrogen for hard-to-electrify end uses and biomethane where needed."[42] CARB's Scoping Plan explains that "[t]he scale of transition includes adding four times the solar and wind capacity by 2045 and about 1,700 times the amount of current hydrogen supply."[43]

Passed in 2022, California SB 1075[44] further directs CARB to study and provide detailed policy recommendations regarding the use of hydrogen in California to help meet the State's GHG goals. Among other things, CARB, in consultation with this Commission,[45] is to describe "strategies, consistent with the state's climate, clean energy, and clean air requirements, supporting hydrogen infrastructure, including needed infrastructure for production, processing, delivery, storage, and end uses in difficult-to-decarbonize sectors of the economy for the purpose of preparing infrastructure and end uses for green hydrogen deployment."[46] SB 1075 also directs this Commission, CARB and the CEC to "consider green electrolytic hydrogen an eligible form

---

[40] *See* Ex. SDG&E-15-R at FV-5 – FV-8 (Hydrogen Strategy and Implementation Department), FV-18 – FV-21 (Advanced Energy Storage and potentially Advanced Energy Storage 2.0), FV-28 (Hydrogen Build Ready Infrastructure), FV-29 (Hydrogen Energy Storage System Expansion).

[41] CARB, 2022 Scoping Plan for Achieving Carbon Neutrality (November 16, 2022) (2022 Scoping Plan), available at https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp_1.pdf.

[42] 2022 Scoping Plan at 2.

[43] 2022 Scoping Plan at 9.

[44] SB 1075, available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB1075.

[45] D.22-12-057 at 60, Finding of Law 45, ("SB 1075 (Skinner, 2022) requires CARB, in conjunction with the CPUC and the CEC, to provide policy recommendations regarding the use of hydrogen to help achieve California's climate, clean energy, and clean air objectives.").

[46] SB 1075, Section 2, codified at California Health & Safety Code Section 38561.8(b)(2).

of energy storage and shall consider other potential uses of green electrolytic hydrogen in their decarbonization strategies."[47]

Federal legislation such as the Inflation Reduction Act (IRA) of 2022[48] and the Infrastructure Investment and Jobs Act (IIJA)[49] recognize the potential of clean hydrogen and direct funding through tax credits and grants to support its development. California is also investing in hydrogen and has launched several programs aimed to help the state better understand how this clean energy source can play a key role in decarbonizing the economy, including a California Governor's Office of Business and Economic Development effort focused on making California a national Hydrogen Hub and a California Energy Commission-led effort to fund hydrogen pilots.

This Commission also has recognized the potential benefits of clean hydrogen. In D.22-12-055 at 2, the Commission stated: "Clean renewable hydrogen holds promise as a potential solution to decarbonize California's energy future and bring economic opportunities and new jobs to the region." In D.22-12-057, the Commission ordered the California IOUs to propose by application "pilot programs to test hydrogen blending in natural gas at concentrations above the existing trigger level,"[50] finding:

> As the UC Riverside Study finds, clean renewable hydrogen can be a beneficial fuel and energy storage medium that can help California meet its climate goals. The CPUC and other state agencies, including the California Air Resources Board, the California Energy Commission, and the Governor's Office of Business and Economic Development, are examining and advancing clean renewable hydrogen's role in California's energy future through various efforts including implementation of Senate Bill 1075 (Skinner, 2022), the development of the new clean renewable hydrogen demonstration program pursuant to Assembly Bill 209 (Committee on Budget, 2022) and Assembly Bill 179 (Ting, 2022), and the launch of the Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES) initiative.[51]

---

[47] SB 1075, Section 4, codified at California Public Utilities Code Section 400.3.

[48] IRA – Subtitle D, Part 2 – Clean Fuels, Section 13204, available at https://www.congress.gov/bill/117th-congress/house-bill/5376.

[49] IIJA – Title III, Subtitle B – Hydrogen Research and Development, available at https://www.congress.gov/bill/117th-congress/house-bill/3684/text.

[50] D.22-12-057 at 68, Ordering Paragraph 7.

[51] D.22-12-057 at 41.

Clean hydrogen can help to replace more GHG intensive fuels to help decarbonize California while maintaining energy reliability—particularly as the state increases its dependence on electricity to meet the needs of the transportation, building and other sectors. SDG&E's hydrogen-related proposals in this GRC proceeding advance decarbonization directly, leverage existing infrastructure, and provide SDG&E with information about its future potential in the effort to meet the State's climate change goals.

2. Carbon Removal

In this GRC proceeding, SDG&E is seeking O&M funding for its Innovation Technology Development, Clean Energy program, to "support the evaluation and study of new solutions for carbon sequestration and/or clean generation enhancements on a small scale to determine whether to adopt them commercially on a larger scale."[52] SDG&E's Path to Net Zero notes the need for carbon removal in order to meet net zero goals, and independent research from the Intergovernmental Panel on Climate Change (IPCC) found that carbon removal is necessary in order to meet international climate pledges to limit global warming to no more than 1.5ºC. According to the IPCC, CCS can help hard to decarbonize sectors like agriculture and industry reach net zero emission goals.[53]

California recognizes that carbon removal may be necessary. AB 1279 (2022) states that California's policy is to "[a]chieve net zero greenhouse gas emissions as soon as possible, but no later than 2045, and to achieve and maintain net negative greenhouse gas emissions thereafter."[54] To achieve "net negative" GHG emissions, carbon removal very likely will be needed. The CARB 2022 Scoping Plan also recognizes that "[c]arbon capture and sequestration (CCS) will be a necessary tool to reduce GHG emissions and mitigate climate change while minimizing leakage and minimizing emissions where no technological alternatives may exist."[55]

Further, passed in 2022, SB 905 requires CARB "to establish a Carbon Capture, Removal, Utilization, and Storage Program, as provided, to evaluate the efficacy, safety, and

---

[52] Ex. SDG&E-15-R at FV-11 – FV-13.

[53] IPCC Climate Change 2022: Impact, Adaptation and Vulnerability (2022) at 313, 829, 2658 and 2692, available at https://report.ipcc.ch/ar6/wg2/IPCC_AR6_WGII_FullReport.pdf.

[54] AB 1279, Section 2, codified at California Health & Safety Code Section 38562.2(c)(1), available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB1279.

[55] 2022 Scoping Plan at 84.

viability of carbon capture, utilization, or storage (CCUS) technologies and carbon dioxide removal (CDR) technologies and facilitate the capture and sequestration of carbon dioxide from those technologies, where appropriate."[56]

At the national level, both the Inflation Reduction Act of 2022 and the Infrastructure Investment and Jobs Act allocate funding to support carbon capture, management and storage projects for hard to decarbonize industries. Per the U.S. Department of Energy (DOE), "As a part of the Bipartisan Infrastructure Law, DOE will deploy approximately $6.5 billion in new carbon management funding over five years, largely for direct air capture and carbon dioxide storage. That includes the deployment of an additional $11.5 billion of related DOE activities on carbon capture pilots and demonstrations, along with hydrogen hubs."[57] The Inflation Reduction Act notes that "[t]he industrial sector is diverse, hard to decarbonize, and contributes nearly one-third of the nation's greenhouse gas emissions...Deploying technologies like carbon capture and storage (CCS) at scale will be critical for decarbonizing many industrial processes."[58]

SDG&E's Sustainability Strategy, and its proposal in this GRC proceeding to evaluate and study new solutions for carbon removal, are entirely consistent with California and federal climate change policy.

C. Customer-Owned Distributed Energy Resources Do Not Replace SDG&E's Investments Proposed in this Proceeding

UCAN's witness points to customer-owned distributed energy resources (DER) as helping to decarbonize California's electric supply through primarily solar panels. He suggests that customer-owned DER (which UCAN's witness refers to as customer side of the meter ("CSOM") DER) can contribute to reliability through grid-connected, customer-owned battery storage. Although not specific, he contends that customer-owned DER can displace the need for some utility investments.[59] As discussed in the rebuttal testimony of Bruce Folkmann Ex.

---

[56] SB 905, Section 2 (2022), codified at California Health & Safety Code Section 39741.1(a), available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB905.

[57] DOE IIJA Fact Sheet, available at https://www.energy.gov/sites/default/files/2021-12/FECM%20Infrastructure%20Factsheet.pdf.

[58] White House Guidebook on Inflation Reduction Act (January 2023) at 67, available at https://www.whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf.

[59] Ex. UCAN (Woychik) at 2 ("Both SDG&E's electric and gas distribution capital requests should be reduced by thirty percent (30%), in major part to enable customer side of the meter (CSOM)

SDG&E-201, SDG&E supports customer-owned DER, but these resources alone cannot support the grid and may exacerbate equity considerations. Other SDG&E witnesses will address technical and feasibility concerns about his claims.

I am responding to UCAN's claim that SDG&E's Sustainability Strategy does not adequately recognize the value of customer-owned DER.[60] SDG&E does, in fact, recognize the importance of customer-owned distributed energy resources in electric grid planning. However, the potential for such resources does not alter the investments SDG&E proposed in this proceeding. In SDG&E's Sustainability Strategy, the company notes its role "as a grid operator to be central to achieving California's climate agenda," stating:

> We recognize the need to adapt our systems to further facilitate zero-carbon energy productions, storage and use. These grid modernization efforts will require a holistic Distribution System Operator (DSO) strategy that advances the orchestration of Distribution Energy Resources (DERs), expands storage capabilities, integrates digital functionality when and where possible and provides customer communication and education. Playing an important role in our grid modernization plans are intelligent DERs, especially when they are unified as a group and provide customers the means to optimize their energy futures. Doing so will allow them to use their DERs to fully participate in the grid, whether through energy generation, load or storage.[61]

The Path to Net Zero also recognizes the need for a diverse mix of energy resources, including DERs like residential solar, in order to meet California's goal of net zero GHG emission by 2045. The Technical Appendix of the report explains many of the study's assumptions, which are based on industry tools and models such as the E3 Pathways model.[62] This same model was used to develop the 2017 CARB Scoping Plan, which notes that "[b]ehind-the-meter solar photovoltaic (BTM PV) is assumed to reach 18.2 GW statewide by 2030, based

---

Distributed Energy Resources (DERs) at large scale in preparation for the high DER future …"), *passim*; Ex. PCF-01 (Powers) at 1 ("The Commission should require local solar-plus-storage (SPS), interconnected to the distribution grid at or near the point-of-use, as an alternative to the Utilities' proposals to increase revenue requirements based on assumed need for capital additions and upgrades." (citations omitted), *passim*.

[60] Ex. UCAN (Woychik) at 209, 211, *passim*.

[61] Sustainability Strategy 2020 at 47.

[62] E3 Pathways Model, Summary of the California State Agencies' PATHWAYS Project: Long-Term GHG Reduction Scenarios, available at https://www.ethree.com/public_proceedings/summary-california-state-agencies-pathways-project-long-term-greenhouse-gas-reduction-scenarios/.

on an extrapolation of the California Energy Demand 2016 – 2026 Adopted Forecast mid-case."[63] The Path to Net Zero Technical Appendix notes that the assumptions used in the study are "consistent with those used in the RESOLVE model developed for the California Public Utilities Commission (CPUC) 2019 Integrated Resource Plan (IRP) proceeding."[64]

SDG&E expects and wants to connect distributed energy resources to the grid in support of state goals. As a utility, SDG&E has an obligation to serve and the company has been instrumental to helping San Diego become a leader in rooftop solar.[65] In addition to connecting customer-owned distributed energy resources to the grid, SDG&E also understands the importance of clean energy equity and affordability, and is supporting the direct installation of rooftop solar for families who may not otherwise be able to afford the systems. The San Diego Solar Equity Program is sponsored by SDG&E and designed to enable income-qualified San Diego homeowners, who historically been unable to access solar technology, to install grid-connected solar systems.

As a demonstration of our commitment to understand and work with customer-owned DERs, in 2022, SDG&E launched a Virtual Power Plant (VPP) project in Shelter Valley, a rural community in eastern San Diego County. This pilot was one of the goals identified in our 2020 Sustainability Strategy and is an example of prudent, small-scale investment in emerging clean energy technologies that can help SDG&E better plan future infrastructure, operations, and services. The pilot is testing how to best coordinate the dispatch of customer resources enrolled in the VPP to help balance the supply and demand for energy to meet the needs of both a smaller microgrid and the larger power grid. Lessons learned from this project will be applied to future projects to safely and cost-effectively integrate customer-owned resources to enhance grid reliability.

SDG&E also recognizes that the incorporation of customer-owned DER into the utilities' grid and resource planning raises technical and policy questions that are the subject of ongoing Commission proceedings.

---

[63] CARB, 2017 Scoping Plan (November 2017) at 12, available at https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/2030sp_appd_pathways_final.pdf.

[64] Path to Net Zero, Technical Appendix at 6.

[65] Frontier Group, Shining Cities 2022, The top U.S. cities for solar energy (April 18, 2022), available at https://frontiergroup.org/resources/shining-cities-2022/.

For example, the CPUC DER Action Plan 2.0 states in Track Two that "[t]he Grid Infrastructure Track is focused on CPUC actions to guide utility infrastructure planning and operations to make the most of existing and future infrastructure and maximize the value to ratepayers of DERs interconnected to the electric grid." Further, the "CPUC will guide the utilities to modernize the electric grid for a high DER future and will consider a range of distribution system operator roles and responsibilities to determine a distribution system operator (DSO) model that best enables swift evolution of grid capabilities and operations to integrate higher levels of DER to meet the State's 100 percent clean energy goals." The DER Action Plan 2.0 also compels utilities to "incorporate findings of the CPUC electrification impact studies and evolve distribution planning in ways that effectively anticipate the impacts of electrification to maximize public benefits, minimize cost, and optimize deployment of complimentary and supporting infrastructure and DER" in 2025.[66]

In July 2021, the Commission adopted an Order Instituting Rulemaking to Modernize the Electric Grid for a High Distributed Energy Resources Future, R.21-06-017, which establishes three goals: "(1) modernize the electric distribution system to accommodate two-way flows of energy and energy services throughout the IOUs' networks; (2) enable customer choice of new technologies and services that reduce emissions and improve reliability in a cost-efficient manner; and (3) animate opportunities for DERs to realize benefits through the provision of grid services."[67]

In July 2022, following issuance of an Energy Division Whitepaper and Proposal: Advanced Strategies for Demand Flexibility Management and Customer DER Compensation ("CalFUSE Proposal"),[68] the Commission adopted an Order Instituting Rulemaking to Advance Demand Flexibility Through Electric Rates (R.22-07-005). In that proceeding, the Commission

---

[66] CPUC, DER Action Plan 2.0 (April 21, 2022) at 12-15, available at https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M467/K470/467470758.PDF.

[67] R.21-06-017, Order Instituting Rulemaking to Modernize the Electric Grid for a High Distributed Energy Resources Future (July 2, 2021) at 4.

[68] CPUC, Advanced Strategies for Demand Flexibility Management and Customer DER Compensation Energy Division Whitepaper and Proposal (June 22, 2022) (CalFUSE Report), available at https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/demand-response/demand-response-workshops/advanced-der---demand-flexibility-management/ed-white-paper---advanced-strategies-for-demand-flexibility-management.pdf.

is considering, among other things: "How should the Commission ensure universal access to dynamic electricity prices by customers, devices, distributed energy resources, and third-party service providers?"[69] The Commission adopted D.23-04-040 in that proceeding, which adopted rate design principles, including: "Demand flexibility tariffs should provide a dynamic price signal in a standardized format that can be integrated into third-party distributed energy resource and demand management solutions. … Demand flexibility tariffs should provide marginal cost-based compensation for exports to enable economically efficient grid integration of customer-sited electrification technologies and distributed energy resources."[70] Importantly, the Commission has not yet determined the "demand flexibility tariffs" that would enable "economically efficient grid integration of customer-sited … distributed energy resources."[71]

In November 2022, the Commission issued an Order Instituting Rulemaking to Consider Distributed Energy Resource Program Cost-Effectiveness Issues, Data Use And Access, And Equipment Performance Standards, R.22-11-013. The Commission noted:

> In 2016, the Commission established an Integrated Resource Planning (IRP) process in R.16-02-007. The IRP process is designed to guide electric utility planning, using capacity expansion and production cost modeling, to determine the least-cost path to achieving electric sector GHG reduction goals, while ensuring reliability. As of yet, DERs are not completely incorporated into IRP modeling as candidate resources. Accomplishing this will require increasing coordination amongst the various DER resource proceedings and programs and the IRP proceeding.[72]

In short, while recognizing the importance of customer-owned DERs to the functioning of the electric grid, the Commission has identified numerous questions about incorporating DER

---

[69] R.22-07-005, Order Instituting Rulemaking to Advance Demand Flexibility Through Electric Rates (July 14, 2022) at 8.

[70] D.23-04-040, Decision Adopting Electric Rate Design Principles and Demand Flexibility Design Principles (May 3, 2023) at 3.

[71] *Id.* Notwithstanding the Commission's ongoing consideration of dynamic pricing, Ex. UCAN (Woychik) at 95-96, asserts: "Neither SDG&E's Chief two witnesses Mr. Folkmann or Ms. De Llanos, nor any of SDG&Es other supporting witnesses seem able to grasp that dynamic capabilities are essential for innovation, capabilities that enable access to a host of DER providers, especially at this time of new technology and the challenges from climate change." (Citation omitted).

[72] R. 22-11-013, Order Instituting Rulemaking to Consider Distributed Energy Resource Program Cost-Effectiveness Issues, Data Use and Access, and Equipment Performance Standards (November 23, 2022) at 4-5 (citation omitted).

into grid planning and operations to be answered in these DER-specific proceedings.[73] UCAN's witness, Dr. Woychik, contends that SDG&E's investments in this GRC proceeding should implement the proposals in the CalFUSE Report.[74] With due respect, Dr. Woychik's contentions are premature. The Commission initiated R.22-07-005 precisely to consider the CalFUSE report.[75] The CPUC website for this Rulemaking states:

> If the State is to fully capture the significant demand-side potential enabled by electrification and customer DERs, a key 'chicken-and-egg' problem related to demand response and retail rates must be resolved. For large numbers of customers (both residential and commercial) to adopt flexible demand management solutions at the scale necessary to support the future electricity grid, automation technologies for controlling various end-uses and DERs must be inexpensive and ubiquitous. For this to be true, there must exist a robust and stable policy pathway that is standardized, easy to implement, and allows the industry to develop low-cost, flexible demand management capabilities and integrate them into smart end-use devices and DERs by default for use by all customer classes.[76]

These active proceedings are the appropriate place for UCAN to offer its proposals for how customer-owned DERs may fit in with grid modernization and management. Attempting to resolve them in SDG&E's GRC proceeding, where such issues are not directly at issue (and not within its scope) and all interested parties are not present, would not be appropriate. When

---

[73] *See* R.21-06-017, Order Instituting Rulemaking to Modernize the Electric Grid for a High Distributed Energy Resources Future (July 2, 2021) at 15-24; and R.22-11-013, Order Instituting Rulemaking to Consider Distributed Energy Resource Program Cost-Effectiveness Issues, Data Use and Access, And Equipment Performance Standards (November 23, 2022) at 18-25.

[74] Ex. UCAN (Woychik) at 206-207 (SDG&E's choices fail to implement the "Commission's Cal-FUSE approach"); *id.* at 218-220 (contending SDG&E grid investments should advance ten element he claims are "consistent with the Commission's Cal-FUSE proposal"); *id.* at 236 (claiming that the Commission has "explained how DER integration must proceed" in the DER Action Plan 2.0, R.21-06-007, and "(R.22-07-005 known as Cal-FUSE)"); *id.* at 264-265 (pointing to the Staff CalFUSE report, Woychik asserts SDG&E should focus its investments on technologies to facilitate DERS); *id.* at 267-269 (stating "six Cal-FUSE steps that need to be put in place"); *id.* at 269-270) (stating that SDG&E's capital investments should implement CalFUSE objectives).

[75] R.22-07-005, Order Instituting Rulemaking to Advance Demand Flexibility Through Electric Rates (July 22, 2022) at 6-7 ("The Commission anticipates that this proceeding will also consider: … (iii) establishing policies and programs to advance demand flexibility pursuant to strategies identified in the Demand Flexibility Whitepaper or by a working group").

[76] CPUC, Demand Flexibility Rulemaking (R.22-07-005), Background, available at https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/demand-response-dr/demand-flexibility-rulemaking (emphasis added).

technical and feasibility concerns have been resolved, with stakeholder involvement, in the Commission's DER-specific proceedings, SDG&E's Sustainability Strategy and Path to Net Zero will adapt as needed to collaborate with customer-owned DER.

D. UCAN Misunderstands the Purpose of SDG&E's Sustainability Strategy

UCAN criticizes SDG&E's Sustainability Strategy for not providing a detailed timeline and tasks on how the company will achieve state climate goals.[77] SDG&E's Sustainability Strategy was never intended to be a project plan to reaching net zero but rather an overview of how the company incorporates sustainability into its work and an overview of high-level goals and milestones to reach key company and state objectives. The document expresses the company's intention to reduce its operational greenhouse gas emissions, support community and other stakeholder objectives, ensure compliance with all local, state, and federal regulations, and deliver innovative solutions that will help California achieve its climate goals. It is SDG&E's call to action on sustainability and request to collaborate with stakeholders. It was developed to be a living strategy that helps the company plan, prepare, act, and evaluate initiatives and programs with a goal to continually improve and create positive impactful change for our customers, region, and state. SDG&E's sustainability strategy outlines a number of technology solutions that the company is currently developing or may explore in the future to help California reach net zero emissions by 2045. It is not an exhaustive list of discrete projects but rather an open portfolio of current and potential solutions that can evolve with technology and customers' needs and is inclusive of technologies like DERs and hydrogen.

Built into the strategy is an active feedback loop that engages more than 3,500 stakeholders that the company listens to and learns from to solve challenges together. Just as with these public proceedings, SDG&E's Sustainability Strategy provides transparency through regularly reporting progress to stakeholders.

III. CONCLUSION

SDG&E is committed to its employees, customers, and the communities it serves. SDG&E is also committed to helping California achieve its climate goals. To document SDG&E's intention and solicit stakeholder input, the company published a sustainability strategy (SDG&E Sustainability Strategy) and a model (Path to Net Zero) to guide the state and utility's

[77] Ex. UCAN (Woychik) at 196 and 202.

transition to an equitable, carbon-neutral future. SDG&E has set milestones to achieving these goals and ensuring on-going compliance with all state and federal laws. We recognize that a diverse portfolio of clean energy solutions that include hydrogen, DERs and more will be necessary to reach net zero emissions by 2045. Our GRC outlines how our company investments support these efforts with safety, reliability and affordability in mind.

This concludes my prepared rebuttal testimony.

APPENDIX A

GLOSSARY OF TERMS

ACRONYM	DEFINITION
AB	Assembly Bill
BTM PV	Behind-the-meter solar photovoltaic
CCS	Carbon Capture and Sequestration
CCUS	Carbon, capture, utilization or storage
CDR	Carbon dioxide removal
Commission	California Public Utilities Commission
CSOM	Customer side of the meter
D.	Decision
DER	Distributed Energy Resources
DSO	Distribution System Operator
DOE	U.S. Department of Energy
E3	Energy and Environmental Economics
GHG	Green House Gas
GRC	General Rate Case
IEPR	Integrated Energy Policy Report
IIJA	Infrastructure Investment and Jobs Act
IOU	Investor-Owned Utility
IRA	Inflation Reduction Act
IPPC	Intergovernmental Panel on Climate Change
LOLE	Loss of load expectation
SDG&E	San Diego Gas & Electric Company
CARB	California Air Resources Board
SB	Senate Bill
SoCalGas	Southern California Gas Company
TY	Test Year
VPP	Virtual Power Plan

APPENDIX B

SUPPORTING DOCUMENTS

Attachment A: SDG&E, Building A Better Future: Our Commitment to Sustainability (2020) (Sustainability Strategy 2020)

Attachment B: 2021 Sustainability Strategy Update

Attachment C: 2022 Sustainability Strategy Update

Attachment D: SDG&E, The Path to Net Zero: A Decarbonization Roadmap For California (April 2022) (Path to Net Zero),

Attachment E: CARB Press Release 22-30, California moves to accelerate to 100% new zero-emission vehicle sales by 2035 (August 25, 2022),

SDGE

A Sempra Energy utility®

BUILDING A BETTER FUTURE

OUR COMMITMENT TO SUSTAINABILITY

TABLE OF CONTENTS

06
OUR COMMITMENT

12
DOING THE RIGHT THING

29
CHAMPIONING PEOPLE

40
SHAPING THE FUTURE

LETTER FROM OUR CHIEF EXECUTIVE OFFICER

2020 will go down as a seminal moment in time. Clearly, COVID-19 has dramatically upended the lives and livelihoods of our customers, our employees and the world at large. But the pandemic has not changed our mission to improve lives and communities by building the cleanest, safest and most reliable energy infrastructure company in America.

It has, in fact, only strengthened our resolve to anticipate, plan for and meet the needs of those we serve and bring sustainability to all our endeavors.

In short, we work every day to safeguard our operations, our resources and our environment – and shape the nature and role we play in delivering better energy outcomes for the communities we serve.

Doing so will not be easy, but it is the right thing to do. By championing people, investing wisely in our infrastructure and working collaboratively with local organizations, energy partners and our customers, we can help forge the path to carbon neutrality in California. In doing so, we will need to embrace the environmental, social and governance sustainability criteria that every successful organization is measured by.

The pages that follow will reveal the people of SDG&E, our commitment to sustainability and the actions we have taken and plan to take to shrink our carbon footprint. By doing so, we believe we can help expand opportunity for everyone – no matter who they are, where they live or work or what their future energy needs may be.

Partnering with you for a sustainable future,

Caroline Winn
Chief Executive Officer, SDG&E

LETTER FROM OUR CHIEF ENVIRONMENTAL OFFICER

At SDG&E, we spend a lot of time thinking about our mission and values. We ask ourselves: what will it take to be the cleanest, safest, most reliable energy infrastructure company in America? What does it mean to do the right thing, champion people and shape the future? Not just in 2020, but in 2030, 2040 and 2050.

We feel a sense of urgency about climate change and what it means for our future. The clock is ticking on achieving California's climate goals, and year after year, we see record-setting weather and devastating fires. It is clear we need bold action and extensive collaboration to reverse these patterns. We cannot wait for the pandemic to subside to tackle climate change.

At the same time, bold climate action must be equitable and affordable. The events of 2020 have highlighted deep divisions, inequalities and inequities throughout society. As we look to accelerate the transition to more renewable and zero-carbon resources, integrate technology and innovate, we must aspire to do so in a way that maximizes value and leaves no one behind.

And, that's not all. The transition to cleaner energy must also be reliable. For the first time in nearly 20 years, state authorities called for rotating outages. There was not enough energy on the electric grid to supply high demand throughout the West during a record-setting heat event. Unfortunately, we expect to see more heat events like these in the future.

These are daunting challenges, and we do not have all the answers. But we are willing to make commitments, be transparent, hold ourselves accountable and adapt to new circumstances. This region is not just where we do business. It's where we live, raise our families and contribute to our communities. We care deeply and personally about the future of this region and are ready to partner with stakeholders to find solutions.

This strategy takes a fresh look at SDG&E's commitment and efforts on sustainability in light of the need to accelerate decarbonization. We've identified long-term goals that are rooted in California's landmark climate policies, our mission and our values to do the right thing, champion people and shape the future. It includes a set of aspirational goals that we will hold ourselves accountable to over the next decade. We're already working out plans for how to deliver on these goals.

We know that circumstances will change. Our employees' and customers' needs will evolve, new challenges will arise, technologies will emerge and we will adjust accordingly. We look forward to your input and collaborating with you to achieve bold and equitable climate action safely, reliably and affordably.

This living strategy will guide us on our mission to build the cleanest, safest and most reliable energy infrastructure company in America.

The future is what we make it. We have an opportunity and an obligation to make it a promising one for everyone.

Estela de Llanos
VP of Clean Transportation,
Sustainability and Chief Environmental Officer, SDG&E

ED-B-4

OUR MISSION

To improve lives and communities by building the cleanest, safest and most reliable energy infrastructure company in America.

OUR VALUES:

- Do the Right Thing
- Champion People
- Shape the Future

To progress towards our goals, we must modernize our infrastructure and improve the customer experience through innovation and technology while we manage costs. Together, we are working to create a sustainable energy future for generations to come.

At SDG&E, we're committed to the success of our customers and employees. Our goal is to help build a community that is innovative and forward thinking by continuing to inform individuals on the importance of clean energy initiatives. Our dedication to protecting and improving lives is driven by a deep desire to better our environment with changes that help us adopt cleaner energy, enhance safety measures and redefine how we operate our reliable energy grid. Together, we can help ensure a better future for generations to come.

- **WE DO THE RIGHT THING BY HOLDING OURSELVES TO HIGH STANDARDS IN ETHICS, SAFETY, QUALITY AND SUSTAINABILITY.**
- **WE CHAMPION PEOPLE AND INVEST IN AND VALUE THE DIVERSE PERSPECTIVES THAT EACH OF US CONTRIBUTES TO THE COMPANY.**
- **WE SHAPE THE FUTURE BY COMBINING THE POWER OF TECHNOLOGY WITH THE BEST OF NATURE TO HELP MAKE A POSITIVE DIFFERENCE.**

SECTION 1

OUR COMMITMENT

OUR COMMITMENT

Our commitment to sustainability is built into everything we do. And as a forward-looking company in the pioneering state of California, we are closely aligned with our state's bold climate and environmental agenda. We believe California's progressive environmental policy leadership, its early adoption of clean energy solutions and the urgency to address climate change will continue to grow both inside and outside our state.

We are ready to do our part to help the state meet its ambitious goals.

FOCUSED ON SETTING THE STANDARD FOR SUSTAINABILITY IN SEVERAL CRITICAL AREAS:

STEADILY EVOLVING OUR ROBUST WILDFIRE MITIGATION OPERATIONS

IMPLEMENTING AN AGGRESSIVE VEHICLE ELECTRIFICATION PLAN

MANAGING OUR NATURAL GAS SYSTEM TO REDUCE LEAKS

INNOVATING OUR GRID TO REDUCE EMISSIONS

EXPANDING OUR CLEAN TECHNOLOGY PORTFOLIO WITH ENERGY STORAGE AND MICROGRIDS

DEDICATING OURSELVES TO ENVIRONMENTAL STEWARDSHIP

CALIFORNIA LIVING

We have called the San Diego and Southern Orange County regions home for nearly 140 years – and proudly so. As such, we support California's aggressive sustainability goals, America's most ambitious, that call for 40% fewer greenhouse gas (GHG) emissions by 2030 and net zero emissions by 2045.

To meet these ambitious goals and build a zero-carbon grid affordably and reliably by 2045, our actions are guided by **the commitment to:**

- **SEEK SUSTAINABLE LOW-COST RESOURCES THAT ARE SAFE AND RELIABLE**
- **EVALUATE FLEXIBLE DEMAND-SIDE AND SUPPLY-SIDE RESOURCES AND PARAMETERS**
- **INTEGRATE RENEWABLES AND LOW-CARBON RESOURCES**
- **INNOVATE AND DEPLOY BREAKTHROUGH CLIMATE MITIGATION AND ADAPTATION SOLUTIONS**
- **EMBRACE LONG-TERM SOLUTIONS, PARTICULARLY LONG-DURATION STORAGE OPPORTUNITIES INCLUDING GREEN HYDROGEN**
- **EXPLORE OPPORTUNITIES FOR REDUCING THE CARBON INTENSITY OF OUR GAS PLATFORM THROUGH SUSTAINABLE BIOMASS, RENEWABLE NATURAL GAS (RNG), POWER TO GAS (P2G), HYDROGEN AND OTHER EMERGING TECHNOLOGIES**

We believe this multi-pronged approach is necessary to any successful decarbonization strategy for two fundamental reasons: 1) we are facing great uncertainty and 2) safety, reliability and affordability remain paramount.

CURRENT CALIFORNIA CLIMATE GOALS

2050

GHGs 80% below 1990 levels (AB 32)

2045

Renewable energy resources and zero-carbon sources supply 100% retail sales of electricity (SB 100)

Net Carbon Neutral across all sectors of the economy (Executive Order)

100% of trucks sold and operated are zero-emission (Executive Order)

2035

100% of cars sold are zero-emission (Executive Order)

2030

GHGs 40% below 1990 (SB 32)

60% renewable electricity (SB 100)

5 million EVs (Executive Order)

2020

GHGs at 1990 levels (AB 32)

JUST ENOUGH IS NEVER ENOUGH

Our goal to deliver clean, safe and reliable energy is merely a starting point. The same can be said for our environmental compliance efforts. So, as we execute our mission, we must consider the disproportionate societal impacts related to energy transition and climate action. We are designing innovative solutions to accelerate decarbonization and encouraging our employees and the communities we serve to take daily action to help ensure a sustainable energy future. The current pandemic, record-high temperatures, raging wildfires and rolling blackouts provide a sobering reminder that we need to be more adaptable in the face of adversity. These events also alert us to the need to collaborate and define a coordinated response to solve the complex challenges that affect us all.

We're looking at a transformation of the electric and transportation systems in the next 10 to 25 years in our service territory and beyond. There is a real sense of urgency to deliver solutions that build on our strengths in transportation, grid resilience, clean technologies, supply chain management and environmental stewardship. When it comes to sustainability, doing more than enough must be our mantra.

Making it so demands that we continue to do the right thing, champion people and shape a future where everyone and this planet we inhabit can thrive. Our sustainability strategy builds on our strengths, but doesn't stop there. Our commitment includes specific, actionable goals with the potential for high positive impact.

OUR SUSTAINABILITY STRATEGY BUILDS ON OUR STRENGTHS, BUT DOESN'T STOP THERE.

ATTACHMENT A

SEMPRA SUSTAINABILITY GOALS

DO THE RIGHT THING

Achieving World Class Safety

For our customers, employees, contractors and the communities we serve

Each year, we aim to:

Achieve zero employee and contractor fatalities

Improve employee and contractor OSHA recordable injury rates and lost work-time incident rates

Participate in emergency planning processes in 100% of the communities we serve

Train 100% of critical employees in emergency management and response

Driving Resilient Operations

To achieve consistent excellence in all we do

Each year, we aim to:

Achieve electric reliability in top quartile

By 2030, we aim to:

Reduce fugitive emissions from our natural gas transmission and distribution systems by 40% from our 2015 baseline

Eliminate 100% of natural gas vented during planned pipeline work (excludes emergency repairs)

CHAMPION PEOPLE

Championing People

To create an inspired workforce

Each year, we aim to:

Achieve a voluntary employee turnover rate of 5% or less

Achieve a companywide employee engagement survey score in the top quartile

Provide 30+ training hours per employee

Achieve or maintain workforce diversity consistent with that of the communities where we operate

SHAPE THE FUTURE

Enabling the Energy Transition

To provide affordable, lower-carbon energy in every market we serve

Each year, we aim to:

Enroll 90% of eligible customers in alternative rates for energy programs

By 2045, we aim to:

Deliver 100% renewable or zero-carbon energy to electric utility customers

This chart shows goals released by Sempra in the May Corporate Sustainability Report (CSR) and adopted by SDG&E.

ATTACHMENT A
SDG&E SUSTAINABILITY GOALS

DO THE RIGHT THING

Environmental Stewardship

Each year, we aim to:

Plant at least 10,000 trees (starting in 2021), support local biodiversity with the "Right Tree, Right Place" program and intelligent water use

By 2030, we aim to:

- Divert 100% of our organic green waste, especially green waste related to vegetation management, from entering landfills
- Increase recycled water use to at least 90% at all our facilities

Sustainable Operations – Fleet Decarbonization; SF6 Alternatives

By 2030, we aim to:

- Electrify 100% of our Light Duty Fleet
- Transition 30% of our overall fleet to Zero Emission Vehicles (ZEV)[1]

By 2040, we aim to:

- Operate a 100% ZEV fleet
- Deploy 100% non-SF6 equipment, everywhere feasible

CHAMPION PEOPLE

"Outside In" Community Outreach

Each year, we aim to:

Actively engage a growing network of external, community-based, nonprofit stakeholders that provides continuous constructive feedback and partners with us on meeting the needs of diverse, underserved and disadvantaged communities through sustainability initiatives

Creating Opportunities through Diversity, Equity & Inclusion Actions

Starting in 2020:

We are advancing our commitment to engage, act, measure and report our performance related to Diversity and Inclusion (D&I) with greater transparency and urgency. Emphasizing five key pillars to track progress:

1. Leading from the top
2. Accelerating employee engagement
3. Creating opportunity
4. Driving conscious inclusion
5. Partnering with the communities we serve

Sustainable Supply Chain

By 2025, we aim to:

Develop an energy-industry leading supply chain sustainability program

SHAPE THE FUTURE

Reimagine Transportation

Starting in 2020, we aim to:

Support California's goal to transition to zero-emission vehicles by accelerating our strategic collaboration of key stakeholders[2] to deliver an ambitious region-wide clean transportation infrastructure goal, address air pollution and solidify the region's leadership on the global transportation map; we will continue to shape constructive policies and legislation to ensure customer adoption and facilitate an equitable transition

Grid Modernization & Breakthrough Solutions

By 2022, we aim to:

Place two green hydrogen projects into service to offer long duration energy storage, increase system resiliency and reduce carbon intensity

By 2025, we aim to:

Plan and pilot a Virtual Power Plant (VPP) to further expand and leverage distribution-level demand response (DR) as a means to reduce GHG emissions, advance resource adequacy and enhance grid resiliency

By 2030, we aim to:

Collaborate with industry leaders and implement at least one breakthrough solution that mitigates direct emissions from gas-fired generation

1. CPUC and CARB Zero-Emission Vehicle (ZEV) technologies definition includes full battery electric vehicles (BEV), plug-in hybrid electric vehicles (PHEV) and hydrogen fuel cell vehicles. Fleet goals contingent on original equipment manufacturer (OEM) vehicle availability and funding approval through the California Public Utilities Commission (CPUC).

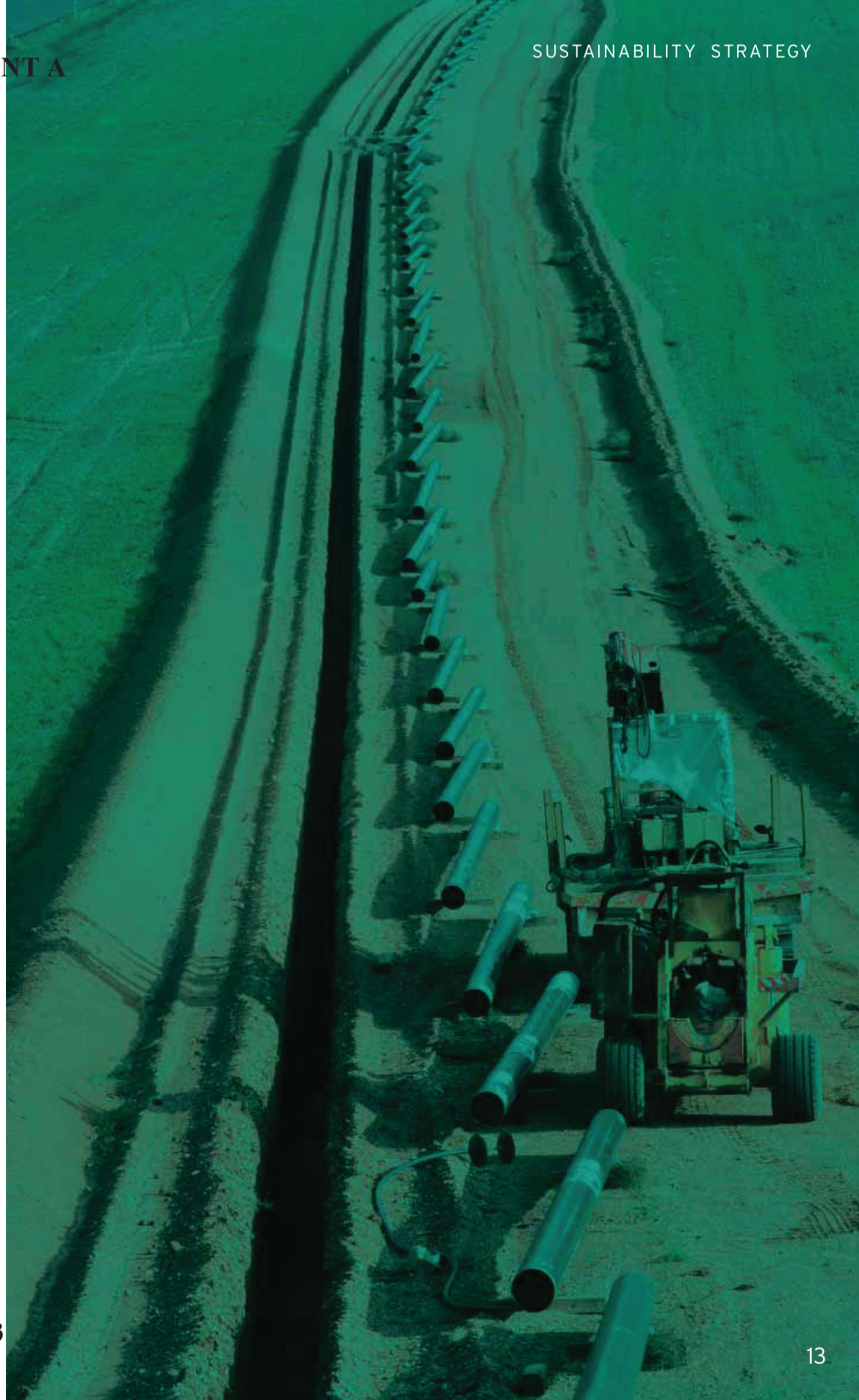
2. These stakeholders include local jurisdictions, regional agencies, utilities and other key stakeholders.

SECTION 2

DOING THE RIGHT THING

DOING THE RIGHT THING

At SDG&E, doing the right thing means striving to build sustainability into our operations, lead the nation in safety and deliver energy reliably to all our customers – residential, commercial and industrial. We all play a role in making progress toward a sustainable world and in this section, you will find examples of the sustainable endeavors SDG&E is undertaking in these three critical areas.



BUILDING SUSTAINABILITY INTO OUR OPERATIONS

Our operations encompass everything from physical facilities including power plants, transmission lines, company vehicles and office buildings to the basics of purchasing, complying with regulation, sharing and reporting environmental data that goes into safe and reliable energy delivery. Doing so takes commitment, collaboration and innovation to make our operations more sustainable and help enable the communities we serve to thrive.

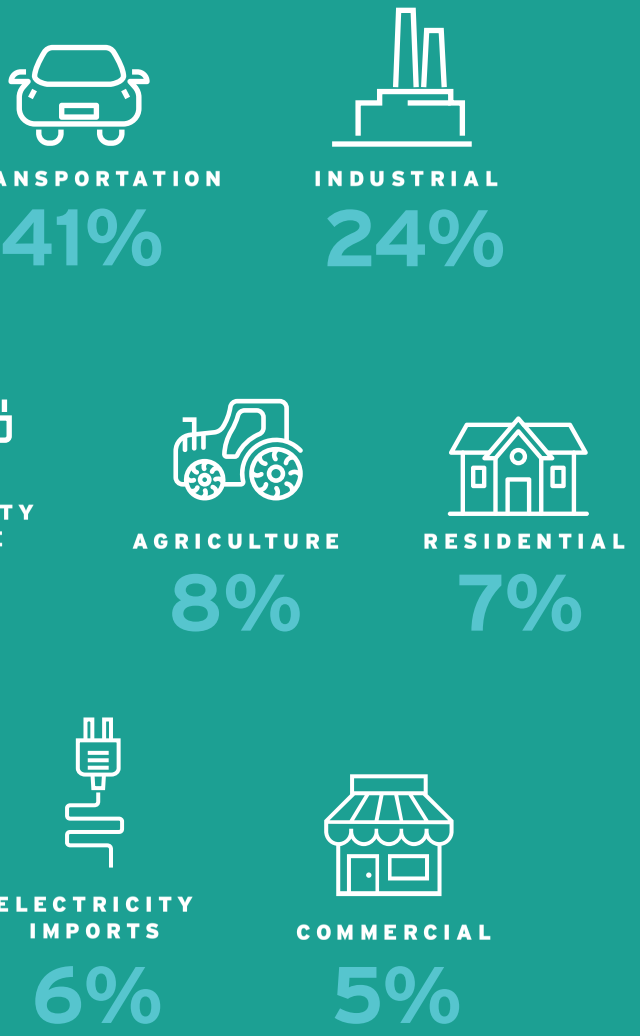
WORKING COLLABORATIVELY

Given the diversity of economic sectors that contribute to GHG emissions, we cannot achieve our goals alone. We need to define and develop creative solutions, embrace interconnected energy sectors (producers and consumers), take collective action and outline policies that deliver the desired environmental and socioeconomic outcomes.

By undertaking and establishing collaborative, sector-wide efforts, we can help accelerate the speed and scale needed to achieve California's 2045 sector-wide carbon neutrality goal.

Focusing more narrowly on our service territory, a clear example of collective action stands out: transportation. Due to this sector's disproportionately high contribution of GHG emissions, SDG&E has partnered with several local agencies including, the regional planning authority (SANDAG), the San Diego Air Pollution Control District (SDAPCD) and the County of San Diego since early 2019 on efforts to accelerate the adoption of electric vehicles throughout San Diego.

CALIFORNIA GHG EMISSIONS INVENTORY BY SECTOR



Source: 2017, CARB, https://ww2.arb.ca.gov/ghg-inventory-data

ATTACHMENT A

LEADING THE EFFORT TO CAPTURE, REPORT AND SHARE EMISSIONS DATA

Accurate GHG emissions data is critical to establishing baselines and charting success in reducing CO2 output. As a leader in GHG emissions reporting efforts, we joined the California Climate Action Registry (CCAR) in 2003 and The Climate Registry (TCR) in 2008. We supported the development of GHG reporting guidelines early on and began voluntary reporting long before it became mandatory. We also began third-party verification of our first 2004 emissions inventory in 2005. An accurate account of our emissions includes not only our own carbon footprint, but the footprint of the end consumers of the energy we deliver, which falls into three categories or scopes.

2018 SDG&E GREENHOUSE GAS EMISSIONS MTCO2e

1.64M MTCO2e

POWER GENERATION
16.1%

FUGITIVE EMISSIONS
1.2%

FLEET VEHICLES
0.2%

SCOPE 1
Emissions from **sources we control**

184K MTCO2e

POWER LOST DURING TRANSMISSION AND DISTRIBUTIONS
1.7%

FACILITY ENERGY USE
0.3%

SCOPE 2
Emissions from **other companies' generation** of power we use in our operations

7.54M MTCO2e

CUSTOMERS' COMBUSTION OF NATURAL GAS
41.9%

PURCHASED ELECTRICITY DELIVERED TO CUSTOMERS
38.6%

SCOPE 3[1]
Emissions from others that were a **result of our business activity**

ED-B-16

[1] Scope 3 emissions data based on internal estimate, not 3rd party verified

SETTING THE BAR FOR LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN

Currently, 14 SDG&E facilities are LEED (Leadership in Energy and Environmental Design) certified. LEED is the most widely used green building rating system in the world. And we are pursuing LEED certifications as part of our SDG&E Headquarters (Century Park) Renew Project. All new construction or tenant improvements at SDG&E facilities larger than 10,000 sq. ft. are required to pursue LEED Silver or higher certification. We have also set targets around reducing energy and water usage and waste production at all our facilities.

We are reducing energy usage at existing office facilities through HVAC system efficiencies, renewable energy sourcing and Energy Star certifications. For new facilities and leases, SDG&E aims to incorporate green building principles from LEED and other building-industry sustainable best practices.

FINDING WAYS TO MAKE WASTE WANTED

We are committed to a circular economy – one that is regenerative by design and aims to gradually decouple growth from the consumption of finite resources and reducing waste. **By 2030, we aim to:**

- **DIVERT 100% OF OUR ORGANIC GREEN WASTE, ESPECIALLY GREEN WASTE RELATED TO VEGETATION MANAGEMENT, FROM ENTERING LANDFILLS**
- **INCREASE RECYCLED WATER USE TO AT LEAST 90% AT ALL OUR FACILITIES**

Our most recent data shows we have diverted or reclaimed more than 13.5 tons of waste since 2017. Efforts include reducing our food waste through composting the pre-consumer food waste from our on-site dining facilities and donating unused food to Feeding San Diego.

SDG&E WASTE INITIATIVES

9,860 TONS
VEGETATION WASTE DIVERTED FROM LANDFILLS[1]

3,842 TONS
SOLID WASTE RECYCLED[1]

1,108 TONS
FACILITY GREEN WASTE RECYCLED[2]

159 TONS
CAFÉ FOOD WASTE RECYCLED[2]

238 POUNDS
GREEN TEAM ECOCHALLENGE[3]

3,750 CUBIC YARDS
MULCH DONATIONS[4]

[1] FROM 2017-2019
[2] FROM 2017 - Q2 2020
[3] FROM 2019 - Q2 2020
[4] IN 2019

SDG&E WATER CONSERVATION INITIATIVES

Our water conservation initiatives have reclaimed or conserved in excess of 1.7 billion gallons of water, with more than 1.5 billion since 2017 alone.

1.5 BILLION GALLONS

PALOMAR ENERGY CENTER RECLAIMED WATER USE[1]

192 MILLION GALLONS

SUBSTATION IRRIGATION IMPROVEMENTS[2]

28 MILLION GALLONS

FACILITY IMPROVEMENTS[3]

4 MILLION GALLONS

DROUGHT TOLERANT LANDSCAPING[4]

13,100 GALLONS

GREEN TEAM ECOCHALLENGE[5]

[1] SAVINGS FROM 2017-2019
[2] SAVINGS FROM 2004-2013
[3] SAVINGS FROM 2008-2011
[4] SAVINGS IN 2018
[5] SAVINGS FROM 2019 - Q2 2020

DECARBONIZING THE SDG&E FLEET

To achieve standards set forth in California's Zero-Emission Vehicles (ZEV)[1] goals, **SDG&E aims to:**

- **ELECTRIFY 100% OF OUR LIGHT DUTY FLEET BY 2030**
- **TRANSITION 30% OF OUR OVERALL FLEET TO ZERO EMISSION VEHICLES (ZEV) BY 2030**
- **OPERATE A 100% ZEV FLEET BY 2040**

PROOFPOINT

CALSTART Fleet Accreditation. In 2020, SDG&E obtained CALSTART Sustainable Fleet accreditation. This tiered accreditation program recognizes corporate fleet commitments and measures actions and progress toward a cleaner fleet. The Accredited Sustainable Fleet in Tier 2 indicates we have a Sustainable Fleet Plan, are tracking fuel and GHG emission data and demonstrating meaningful action to integrate sustainability into the fleet. We intend to improve our ranking by reducing idle times, improving fuel efficiency and increasing the number of Zero-Emission Vehicles in our fleet.

1. CPUC and CARB Zero-Emission Vehicle (ZEV) technologies definition includes full battery electric vehicles (BEV), plug-in hybrid electric vehicles (PHEV) and hydrogen fuel cell vehicles. Fleet goals contingent on original equipment manufacturer (OEM) vehicle availability and funding approval through the California Public Utilities Commission (CPUC).

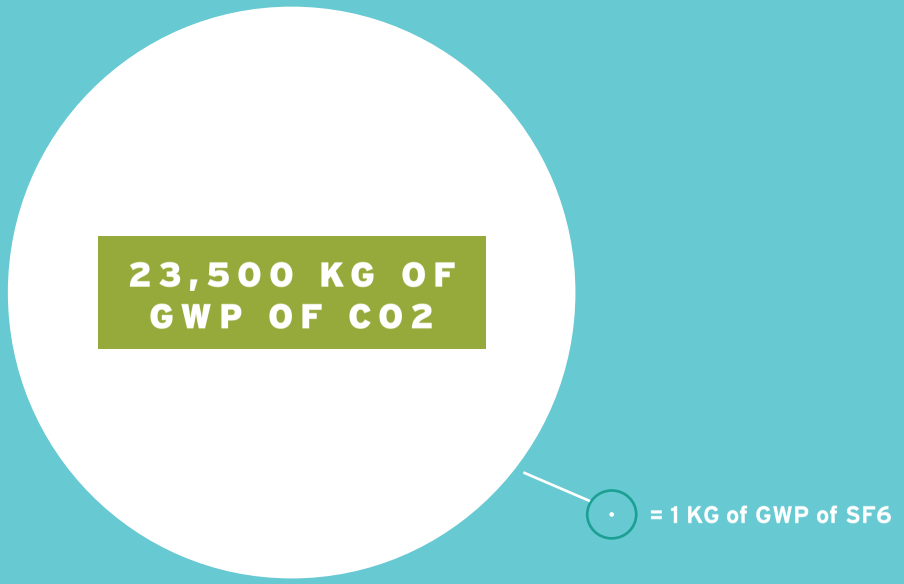
PHASING OUT SULFUR HEXAFLUORIDE

Used by electric utilities to insulate circuit breakers and distribution switches, sulfur hexafluoride (SF6) is the most potent greenhouse gas. With a global warming potential (GWP) 23,500 times of CO2 over 100 years and an atmospheric[1] lifetime of 3,200 years, phasing out its use is critical. SDG&E is pursuing an aggressive SF6 leak abatement strategy to:

- **DEPLOY 100% NON-SF6 EQUIPMENT, EVERYWHERE FEASIBLE BY 2040**

While the pace and scale of progress of eliminating SF6 emissions has been constrained by replacement technology availability, equipment form factor and cost, we are testing a new technology that is SF6 free as part of our abatement strategy. We are also collaborating with industry partners to develop non-SF6 technology for high-voltage transmission equipment and exploring ways to scale non-SF6 solutions as part of the utility infrastructure through a Joint Utilities Group membership.

WHY SHOULD WE WORRY ABOUT SF6?



1. Intergovernmental Panel on Climate Change AR4.

DECOMMISSIONING SAN ONOFRE NUCLEAR GENERATING STATION (SONGS)

As a 20% owner of SONGS, SDG&E is working with partners to help ensure that it is decommissioned safely and responsibly. That includes working with the California Coastal Commission and the U.S. Navy to develop plans and programs for the long-term stewardship of the site. The primary owner and former operator of SONGS, Southern California Edison, is scheduled to publish a long-term nuclear waste storage plan for the project in late 2020. SDG&E also works with Southern California Edison on the Wheeler North Reef Restoration Project and the San Dieguito Wetland Restoration Project as part of our environmental commitments related to this project. For example, The Wheeler North Reef near the San Onofre kelp beds will undergo expansion to restore fish stocks, an important part of supporting the reef's health.

LEADING THE NATION IN SAFETY

SDG&E has been recognized as an industry leader in occupational safety, emergency management and wildfire mitigation operations. Our approach to safety is strategic, deliberate and holistic. Safety is a top priority and is monitored by safety committees and safety performance metrics tracked as outlined by SMAP – Safety Model Assessment Proceeding by the CPUC. The proactive safety culture is strong at SDG&E, and we never stop improving in our efforts to protect employees, contractors and the public. We are also pursuing certification for the Cal OSHA Voluntary Protection Program for several of our facilities.

PROOFPOINT

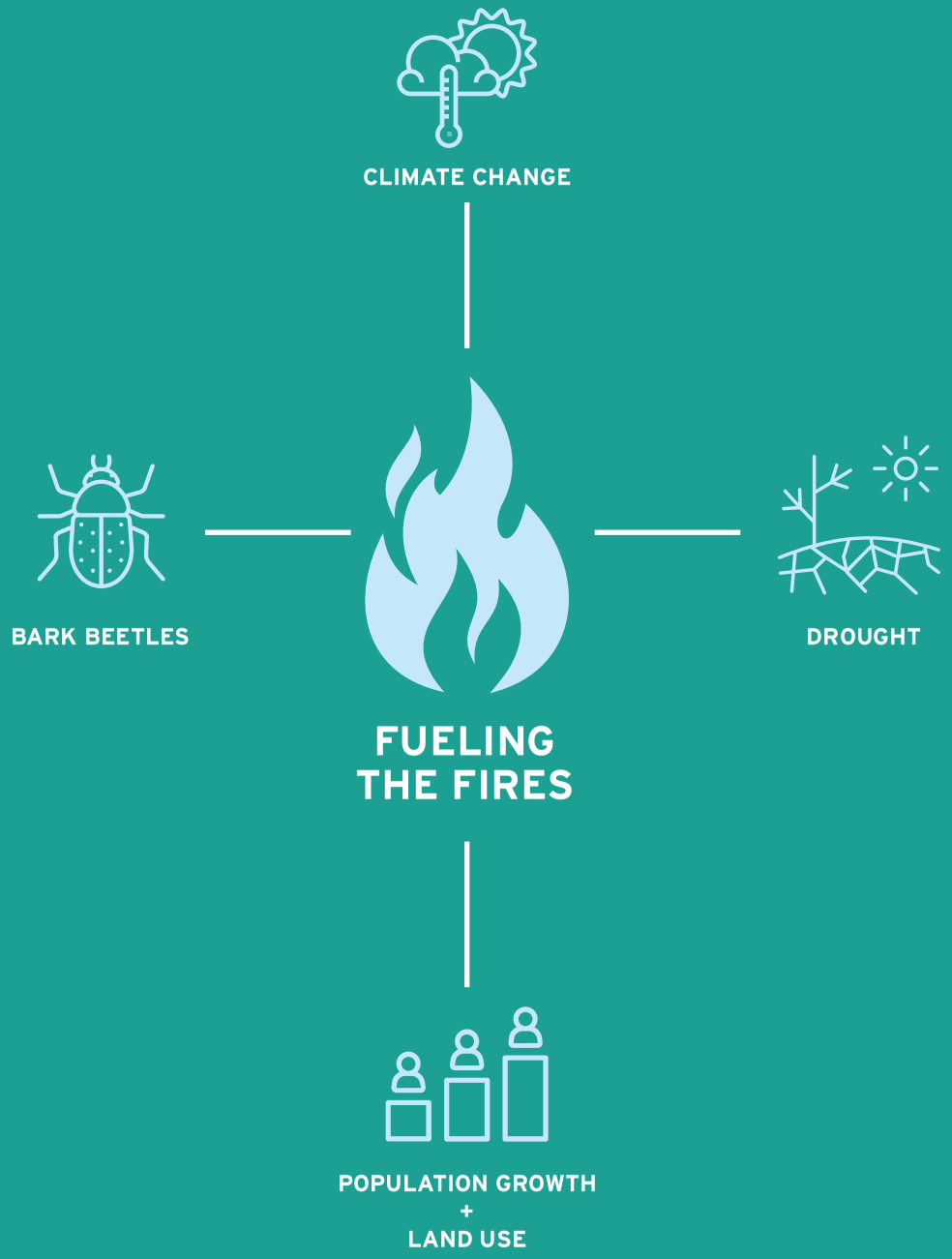
Managing the safety of a complex natural gas and electric system involves significant coordination to address multiple activities and dynamic circumstances. Pursuing SDG&E's goal of zero incidents requires a comprehensive, systemic effort. In early 2020, we became one of the first electric utilities to implement an enterprise-wide Safety Management System, or SMS. This holistic approach goes beyond traditional occupational safety by placing critical emphasis on strong interdependencies of risk, asset, incident response and operational management. Our SMS allows us to manage and reduce risks and hazards and helps enable continuous improvements in safety performance through deliberate and integrated processes. Through SMS, we aim to align current and future risk, assets, emergency and safety management improvement efforts; build upon the existing strong safety culture; and further commit to safety for employees and our customers.

COMBATING WILDFIRES

We are proud to be a national leader in wildfire-risk mitigation. We recognize that fire-season weather conditions, coupled with climate change, are making the length and intensity of wildfires in our service area more pronounced. Since 2007, we have invested over $2 billion in a variety of safety measures to prevent catastrophic wildfires – we were one of the first utilities in the country to develop a dedicated Fire Science & Climate Adaptation Department to combat this growing threat. Among other technological advancements, we have our own in-house modeling software. This software is designed to allow our employees and our partners to forecast fire threats so that we can be better prepared for weather conditions that can lead to fires.

WILDFIRES - CAUSE AND CONTAINMENT

A variety of factors – drought, bark beetle infestations, population growth and climate change, among others – have increased the threat and incidences of wildfires throughout California. Prolonged droughts in our service territory have contributed to exceptionally dry fuels. Combined with severe wind events, these factors can turn a containable wildfire into a rolling blaze, threatening lives, property and company facilities – and dramatically inflating the region's CO2 output. So, every time we avoid a catastrophic wildfire, we avoid thousands or millions of metric tons of black carbon emissions.



ATTACHMENT A

MANAGING WILDFIRE RISK – MAKING COMMUNITIES MORE RESILIENT

Approximately 64% of our service area is in High Fire Threat Districts (HFTD), which includes more than 206,000 customers. This fact alone has spurred the development of initiatives designed to mitigate the damage fires cause. Taking on this threat demands both aggressive and passive prevention and containment measures, organizational collaboration and programs that assist affected or at-risk communities.

CHARTING THE SOLUTIONS

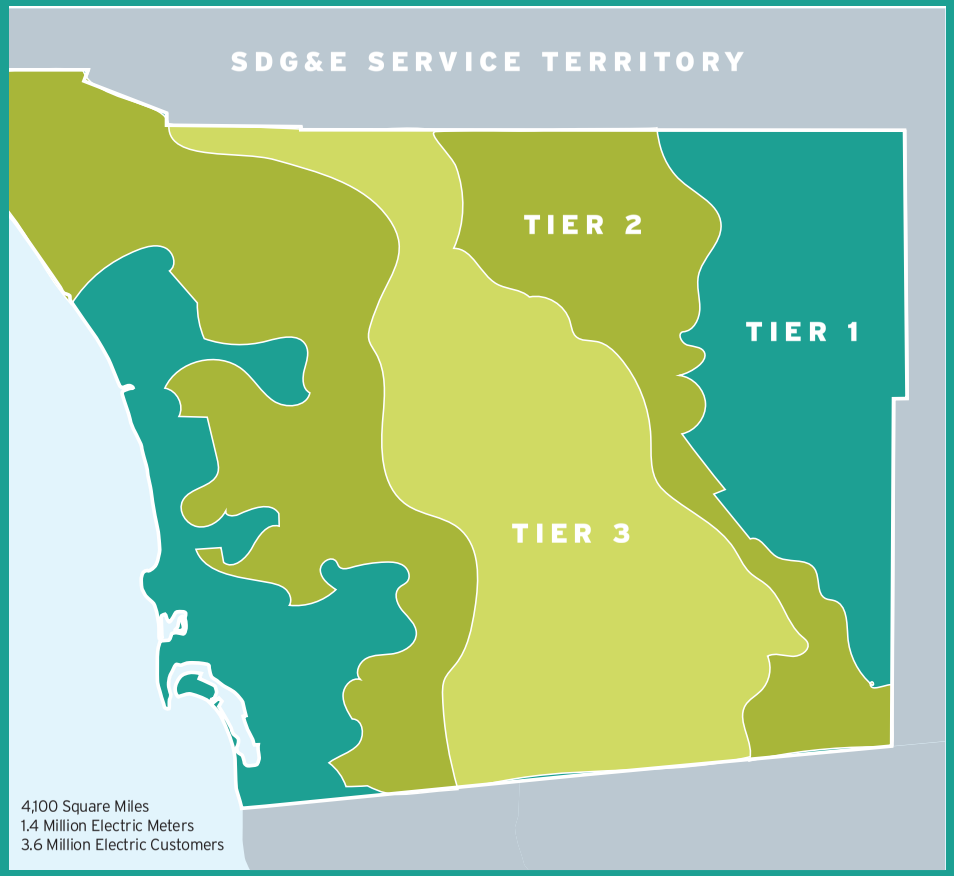
TO PROTECT OUR COMMUNITIES, WE ARE:

- Increasing undergrounding of overhead lines
- Creating fire-hardened interfaces between urban areas, wildlands and coastal canyons
- Accelerating vegetation management to reduce fire fuels
- Expanding our tool box for fire detection and early warning systems
- Partnering with telecoms to improve cellular reliability
- Expanding customer education, awareness, preparedness and resiliency efforts
- Installing additional cameras to boost detection in real time
- Installing 30 additional weather stations for <30-second data reporting
- Deploying satellite detection systems for <30-second fire notifications
- Equipping all power-line poles with smart-reporting technologies
- Deploying an Artificial Intelligence (AI) Forecasting System to speed alert times

MAPPING THE RISK

HIGH FIRE THREAT DISTRICTS INCLUDE:

- 64% of Our Service Area
- 206,000 Customer Accounts
- 3,500 Miles of Overhead Energy Miles
- 53% Trees Impacting Operations



Tier 1 - High Fire Hazard Zone
Tier 2 - Elevated Fire Threat Zone
Tier 3 - Extreme Fire Threat Zone

ED-B-24

MINIMIZING THE IMPACT OF PUBLIC SAFETY POWER SHUTOFFS

Our top priority is the safety of our customers and employees. So, during adverse weather conditions, we may need to execute a Public Safety Power Shutoff (PSPS) to help prevent potential wildfires. We are expanding upon or developing new programs and strategies and leveraging backup power to mitigate the risk associated with PSPS. These programs include improving resilient internet connectivity at fire stations, expanding our Community Resource Center Network and implementing a grant program for portable generators targeted to select residential customers.

THINKING OUTSIDE THE GRID

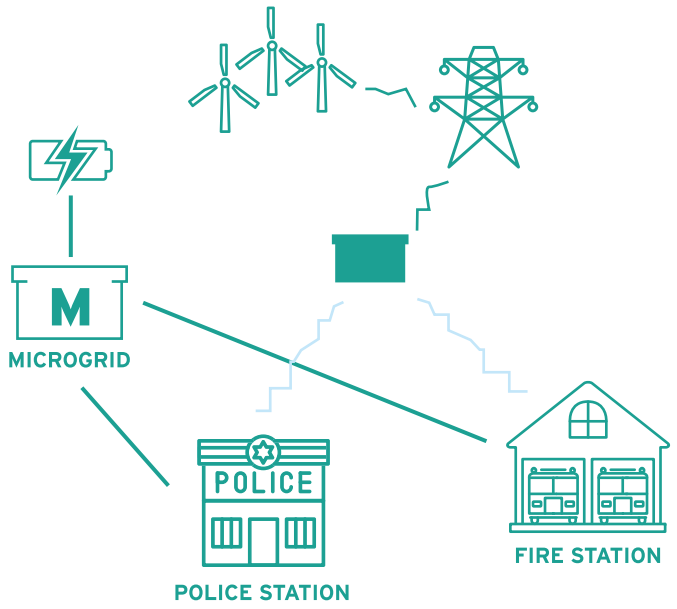
To mitigate the impacts of shutting off power, we have developed and continue to develop microgrids that can help keep our critical customers, often disadvantaged communities in our high fire threat districts, up and running during PSPS events, which may last for days at a time. Microgrids – basically mini power grids – use technologies such as energy storage to provide power to specific communities and neighborhoods if an outage occurs on the larger grid, including power for fire stations, police stations, hospitals and emergency community centers.

Working from the insights gained from our first microgrid in Borrego Springs, we plan to deploy one for the Ramona Air Attack Base in 2020 and have three others slated to go online in 2021 for the communities of Cameron Corners, Shelter Valley and Butterfield. These microgrids will provide power to customers and critical needs.

SOLUTIONS DEVELOPED TO DECREASE IMPACT OF PSPS EVENTS

SOLUTIONS	OUTCOMES
Sectionalizing Devices	25% Fewer PSPS Customers Impacted in 14 Communities which include:
Weather Stations	5 Schools
Undergrounding	4 Fire Stations
Grid Reconfiguration	1 Urgent Care Facility
Microgrids	33 Communication Sites
Local Generation	5 Water Facilities

USING MICROGRIDS TO MITIGATE PSPS EVENTS



THE NEXUS OF WILDFIRE MITIGATION AND VEGETATION MANAGEMENT

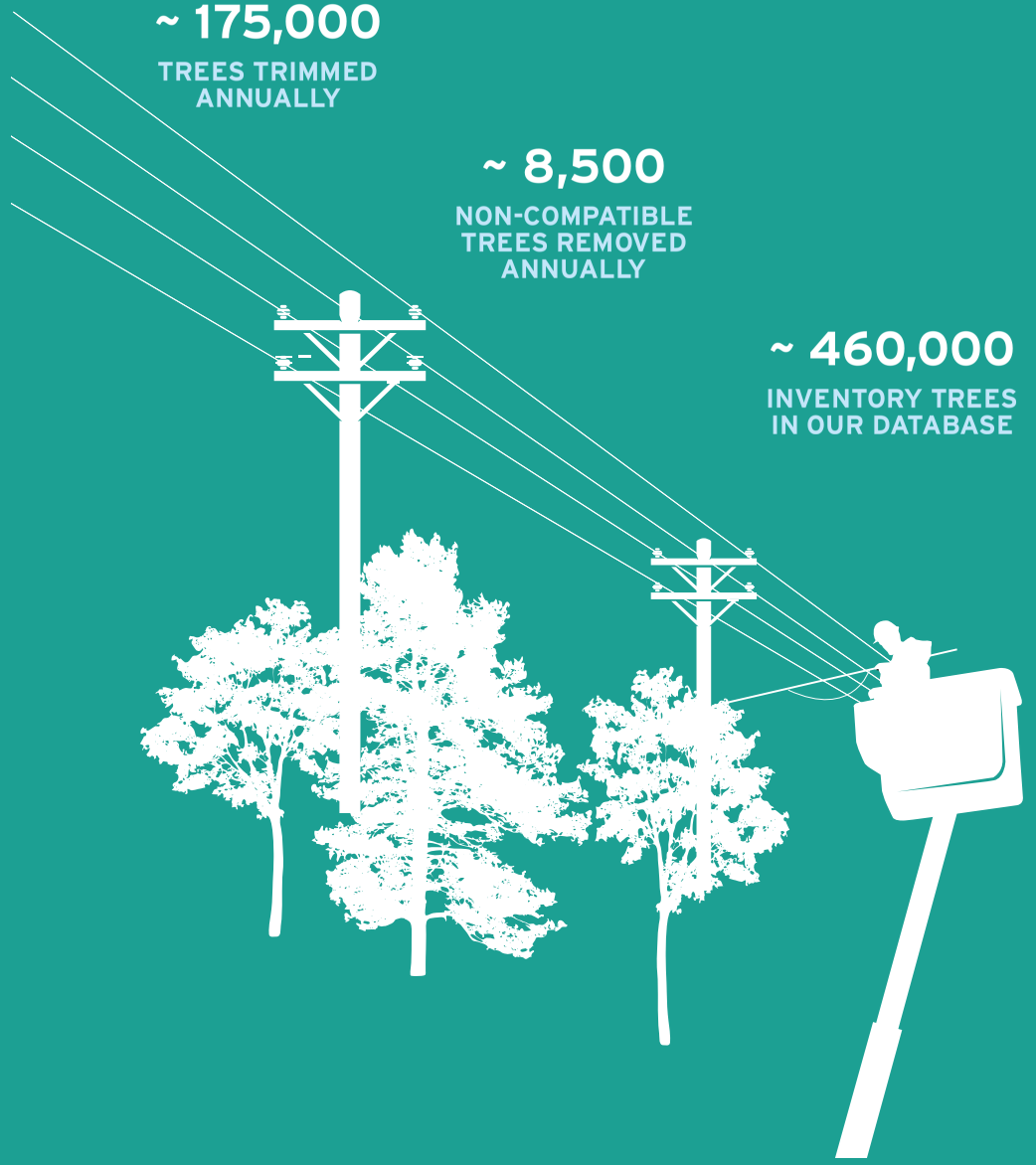
Our Environmental Services and Vegetation Management team has been thinning vegetation in high-risk wildfire areas and turning it into nutrient-rich mulch to be donated to local businesses and philanthropic organizations. Recycling this organic material allows us to help reduce carbon emissions and save landfill space.

Through our Sustainable Fuels Management Program, we have donated approximately 3,750 cubic yards of mulch to organizations throughout our service territory including local schools, farms, parks and nonprofit organizations, such as the Children's Nature Retreat Foundation.

Since tree trimming is central to vegetation management, SDG&E maintains an electronic tree database that tracks the inspection, trimming and auditing of approximately 460,000 trees in our service area. An inventory tree is one that could encroach the minimum clearance or otherwise impact our electrical facilities.

We have also diverted a third of our green waste to San Pasqual Valley Soils (SPVS) where it is turned into biochar and then used to make nutrient-rich compost sold for a profit. Each year, we aim to:

- **PLANT AT LEAST 10,000 TREES (STARTING IN 2021)**
- **SUPPORT LOCAL BIODIVERSITY WITH THE "RIGHT TREE, RIGHT PLACE" PROGRAM**
- **MAINTAIN INTELLIGENT WATER USE**



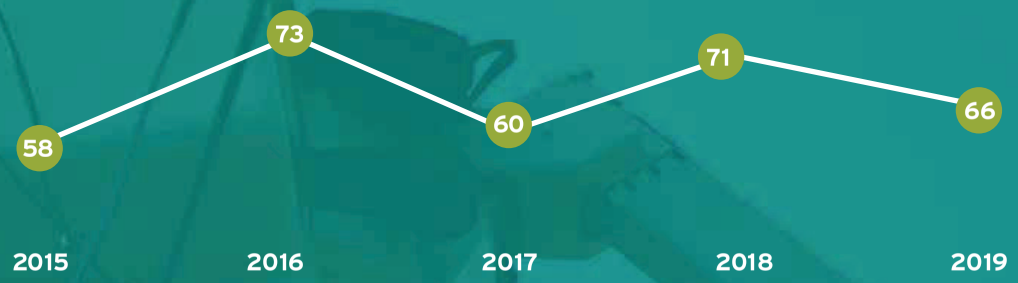
HELPING ENSURE CUSTOMERS CAN COUNT ON US

Maintaining reliability is the foundation of our day-to day operations. More than 4,000 employees commit themselves every day to providing clean, safe and reliable energy to our 3.6 million customers. This commitment is also reflected in our drive to modernize and redefine how to operate a highly reliable, intelligent power grid in an effort to provide the communities we serve clean, safe and reliable energy for generations to come.

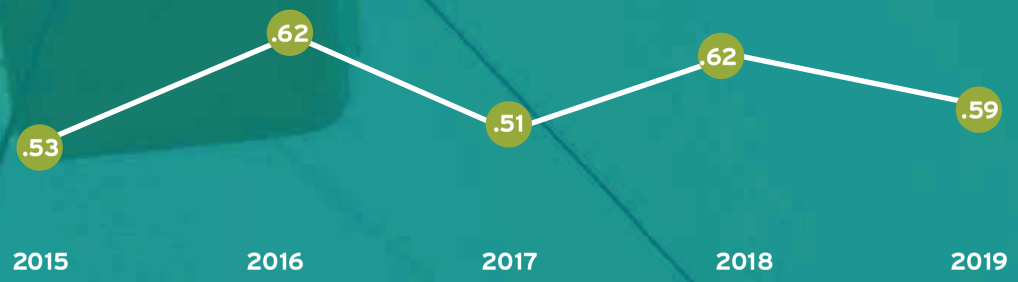
KEEPING THE POWER FLOWING

We are proud to share that over the years, we have worked to reduce both the duration and the frequency of power interruptions that our customers may experience. Our Systems Average Interruption Duration Index (SAIDI) and Systems Average Interruption Frequency Index (SAIFI) have demonstrated low energy loss by both number of minutes and customers affected.

AVERAGE OUTAGE DURATION, IN MINUTES (SAIDI)



AVERAGE NUMBER OF OUTAGES PER CUSTOMERS (SAIFI)



ATTACHMENT A

DELIVERING ENERGY SUSTAINABILITY

Our track record in reliability and other sustainability efforts has earned us recognition and awards from industry analysts and consultancies that provide benchmark comparisons to other energy providers nationwide.

2017

- Platts Global Energy Award for Industry Leadership in the Power Sector
- Energy Storage North America Innovation Award for what was then the world's largest energy storage facility
- Electric Power Research Institute Technology Transfer Award for developing a first-of-a-kind electric vehicle charging solution
- Project of the Year Award from Utility Dive for Escondido Energy Storage project
- Regional ReliabilityOne™ Reliability Award: Best in the West
- Outstanding Technology and Innovation Award for utilizing innovative technology to improve electric service

2018

- Regional ReliabilityOne™ Reliability Award: Best in the West
- National ReliabilityOne™ Excellence Award
- Edison Award from the Edison Electric Institute for enhancing wildfire preparedness and grid resiliency
- ESRI Enterprise GIS Award for leveraging geographic data to enhance emergency operations during an emergency event, as well as managing power outages
- Outstanding Technology and Innovation Award for the second year in a row for utilizing innovative technology to improve electric service

2019

- Edison Electric Institute Business Diversity Award for innovation in promoting diverse businesses
- Superior Partnership Award from California Governor's Office for supporting CERTS and emergency preparedness
- iCommute Diamond Awards Gold recipient
- Project of the Year from American Public Works Association (APWA) for the Chula Vista Electric Vehicle Charging Stations Project
- Real Heroes Community Partner Award from the American Red Cross of San Diego/Imperial Counties
- Tree Line USA Utility from The National Arbor Day Foundation
- Regional ReliabilityOne™ Reliability Award: Best in the West (14 years in a row)

2020 (TO DATE)

- Smart Electric Power Alliance Power Player: Investor-Owned Utility of the Year for Innovative Electric Vehicle Charging Program
- Industrial Environmental Association Environmental Excellence Award for the Sustainable Fuels Management Program
- iCommute Diamond Awards Gold recipient
- Corporate Partner of the Year from the Chicano Federation
- National Power of Purpose Award: Purpose Pioneer for our wildfire documentary

CHAMPIONING PEOPLE

SECTION 3

SUSTAINABILITY STARTS WITH PEOPLE

A sustainable world requires a persistent commitment to people – in their workplace, their homes and communities and the many places in between. Doing so demands building resiliency, inclusion and diversity into everything we do. At SDG&E, each one of us plays a role in sustaining each other by championing people – employees, customers, suppliers and others. Each year, we actively engage with a network of community-based, nonprofit stakeholders who can provide feedback and partner with us to help meet the needs of underserved and disadvantaged communities through sustainability initiatives.

This is especially true this year as COVID-19 impacts everyone's lives and livelihoods, the destructiveness of systemic racism is prevalent and the effects of climate change continue to take their toll on our environment. We must meet challenges by firmly living our values of doing the right thing, championing people and shaping the future.

WE STRIVE TO REFLECT THE DIVERSITY OF OUR COMMUNITIES

PUTTING EVERY EMPLOYEE FIRST

At SDG&E, we have made sustainability a central tenet of our organizational culture. Starting in 2020 we set in place policies designed to engage, act, measure and report our performance related to diversity, equity and inclusion by:

- **LEADING FROM THE TOP**
- **ACCELERATING EMPLOYEE ENGAGEMENT**
- **CREATING OPPORTUNITY**
- **DRIVING CONSCIOUS INCLUSION**
- **PARTNERING WITH THE COMMUNITIES WE SERVE**

Navigating through the pandemic is a great example of how we focus on our employees; we created flexible options for remote work and continue to support our employees who have to deal with evolving child care, distance learning or other special care needs.

While we still have more work to do, we are proud to share additional examples of how we put our employees first.

SUPPLIER DIVERSITY AMBASSADORS

Reaching beyond and through our many employees, ambassadors seek to identify opportunities to expand the diversity of suppliers in contract bids and mentor them to help ensure they remain competitive and can grow their businesses.

LOCAL DIVERSITY & INCLUSION COUNCILS (LDICS)

LDICs help employees understand and appreciate workplace diversity. These councils seek to move beyond simple tolerance to embrace and leverage the many-layered dimensions of diversity and inclusion – all of which advance our sustainability goals.

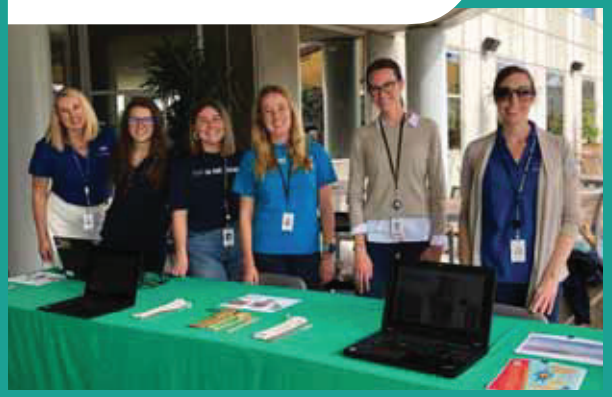
LEAN-IN CIRCLES

Our Lean-In Circles were established to help women achieve their ambitions. Its members include women of all ages, backgrounds and positions at SDG&E, offering each one the opportunity to help shape a world free of gender bias.

ELECTRIC VEHICLE (EV) AMBASSADORS

SDG&E provides company-sponsored training to employees who want to become EV ambassadors so they can grow the knowledge they need to share with colleagues, friends and the general public on current EV information, trends and initiatives.

GREEN TEAM



Green Team members work to identify opportunities to reduce our employees' and the company's impact on the environment. Members also organize volunteer opportunities for our employees throughout our communities to promote environmental stewardship.

BUILDING SUSTAINABLE COMMUNITIES

We support and actively encourage our employees to donate their time through our various volunteer programs, including #BeThatGirl and Environmental All Stars. Each year, more than 1,000 of our employees and their families volunteer for the causes that are meaningful to them.

#BETHATGIRL

Recognizing that women are underrepresented in STEM professions, SDG&E's #BeThatGirl initiative connects female SDG&E STEM professionals with schools and nonprofits as STEM mentors. Employees share their personal journeys, from grade school to STEM careers at SDG&E in engineering, meteorology, finance, biology and more. As an organization, we understand how STEM skills can influence young women's futures.

SAN DIEGO AUDUBON SOCIETY

SDG&E's Environmental All Stars employee volunteers have partnered with San Diego Audubon Society for nine years to restore critical habitat for the California Least Tern, an endangered migratory shorebird. Their volunteer efforts to prepare the site for the Terns to nest and rear their young has made this location one of the most successful breeding sites in the region.

BURN INSTITUTE

Since 2012, SDG&E employees have led efforts to raise more than $350,000 for Burn Institute fire prevention and burn survivor support programs. Employees participate in the annual "Fill the Boot Fundraiser," volunteer to install free lifesaving smoke alarms for qualified seniors in San Diego County and coordinate an annual holiday celebration for burn survivors.

INVESTING IN COMMUNITIES

SDG&E's current charitable giving areas include environmental education (SDG&E Environmental Champions), K-12 STEM education (Inspiring Future Leaders), safety & emergency preparedness (SAFE San Diego) and economic & workforce development in disadvantaged communities.

Through our charitable giving program, SDG&E Environmental Champions, we support more than 80 environmental nonprofit partners and organizations.

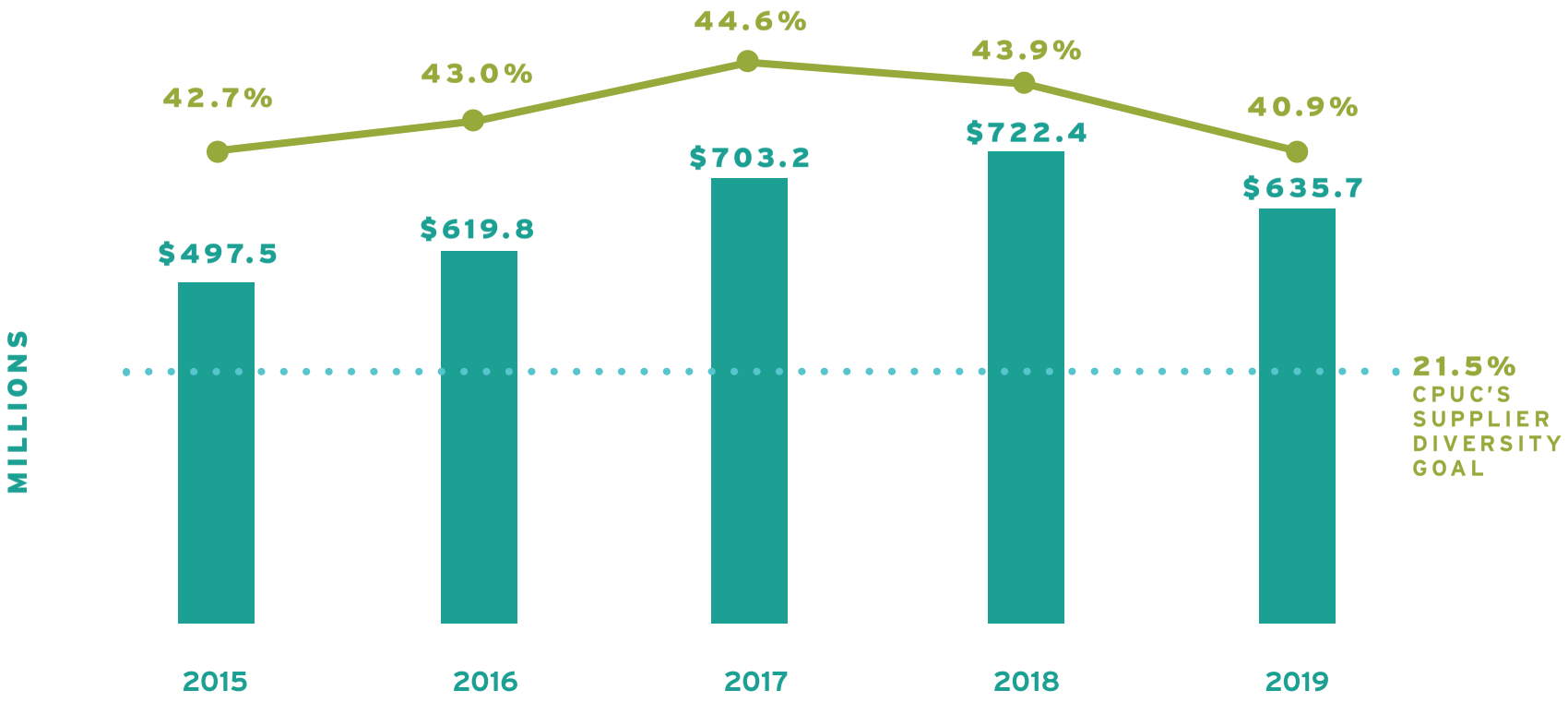
The SDG&E Environmental Champions initiative supports 501(c)3 nonprofit organizations whose programs promote environmental education, community engagement and stewardship to disadvantaged communities in San Diego County and Southern Orange County. To learn more, visit *sdge.com/community*.

BUILDING A SUSTAINABLE SUPPLIER NETWORK

Supply chain sustainability is central to our sustainability efforts at SDG&E. Our plans are to develop an energy-industry leading supply chain sustainability program by 2025 and assume a leading role in supplier diversity, resilience and safety to champion people outside of our own workforce.

2019 marked the seventh consecutive year that our supplier diversity spending has been above 40%, far exceeding the California Public Utilities Commission's (CPUC) goal of 21.5%.

SUPPLIER DIVERSITY SPENDING - 2015 TO 2019



ED-B-35

MAKING SUSTAINABILITY WORK FOR OUR CUSTOMERS

Our customers expect innovative solutions that increase their energy savings while decreasing their monthly bills – and providing critical assistance when they need it.

We are on track to meet state-mandated regulations for doubling energy efficiency savings by 2030, reaching 100% zero-carbon energy by 2045 and achieving zero net energy (ZNE) in buildings over the coming years. And we plan to do so while creating equitable impacts in our communities.

When we all use less energy, we reduce GHG emissions.

Energy efficiency programs include:

- **HELPING OUR CUSTOMERS SHIFT ENERGY USE TO TIMES WHEN RENEWABLE ENERGY MAKES UP A LARGER PORTION OF THE GRID**
- **RUNNING PEAK-DEMAND CAMPAIGNS SUCH AS "REDUCE YOUR USE" AND "DIAL IT DOWN"**
- **PROVIDING PROGRAMS AND INFORMATION TO HELP CUSTOMERS EQUIP THEIR HOMES WITH MORE EFFICIENT APPLIANCES, WEATHER STRIPPING AND OTHER UPGRADES**
- **OFFERING CLASSES AT OUR ENERGY INNOVATION CENTER TO BUSINESSES AND RESIDENTS**

SAVING ENERGY TO SAVE THE PLANET

2019 ENERGY & DOLLARS SAVED		GHG REDUCTION EQUIVALENTS
~243 gigawatt hours		~179,029 metric tons of CO2
~53 megawatts	=	~38,678 fewer cars
~3.27 million therms		
$64 million customer savings		

MAKING SUSTAINABILITY WORK FOR OUR CUSTOMERS

We believe customers should have a choice about where their energy comes from, how to access and promote renewable energy efforts and how to manage the cost of the energy they need.

SUPPORTING CUSTOMER CHOICE

ECOCHOICE IS A PRICING PROGRAM WHERE UP TO 100% OF ENERGY IS ALLOCATED FROM RENEWABLE SOURCES

3,000+ Residential customers
850+ Commercial customers

128,279 MWh delivered

Retired more than 128,280 renewable energy credits

Promoted installation of 50 MW renewable energy

ECOSHARE PROMOTES RENEWABLE ENERGY DEVELOPMENT IN LOCAL COMMUNITIES

Local economic benefits

Cheaper electricity prices

Clean air & better public health

NEW PROGRAMS PROVIDE 20% DISCOUNT TO PARTICIPANTS IN DISADVANTAGED COMMUNITIES (DAC)

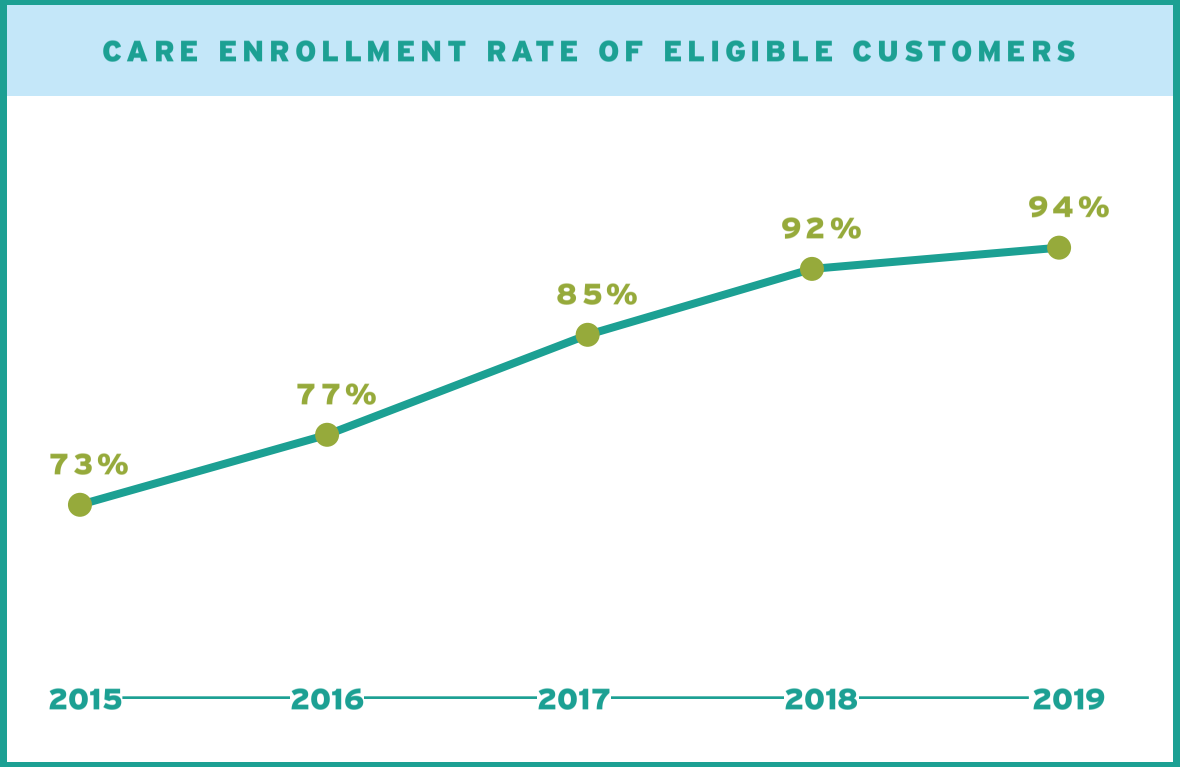
- Disadvantaged Communities Green Tariff allows SDG&E to sign 18 MW new solar generation in DACs
- Community Solar Green Tariff allows SDG&E to sign an additional 5 MW of solar generation in DACs

BRINGING EQUALITY TO SUSTAINABILITY

Climate change affects all communities. However, energy efficiency technologies can be cost prohibitive to communities that are particularly vulnerable to such effects. To help offset this imbalance, our Energy Savings Assistance (ESA) Program provides customers free energy efficiency measures based on eligibility established by Federal Poverty Guidelines. In 2019, SDG&E's ESA Program served more than 16,000 customers, saving more than 1.7 million KW and 22,000 therms – equivalent to reducing GHG emissions by 1,110 tons.

Other programs designed to address inequality in our service territory include the California Alternate Rate for Energy (CARE) and the Family Electric Rate Assistance (FERA). The CARE Program provides up to a 30% discount on energy bills for qualifying customers, including those who have recently become unemployed or are currently participating in public programs.

If customers do not qualify for CARE, SDG&E automatically checks to determine if they are eligible for FERA, which offers families of three or more individuals a discount of up to 18% off their electricity bill based on their income.



PROOFPOINT

COVID-19 Response and Resilience. COVID-19 has upended the lives of everyone in our community. To help customers – as well as employees and suppliers – we have undertaken a slate of efforts to minimize the effects of the pandemic.

- Providing flexible payment plans
- Donating $1 million to support the Neighbor-to-Neighbor Program to provide assistance for customer gas and electric bills
- Accelerating and repurposing $2.6 million in shareholder giving to nonprofits
- Donating personal protective equipment to small businesses in the San Diego Region
- In partnership with the San Diego Foundation, SDG&E launched the San Diego COVID-19 Community Response Fund and has contributed $3 million to the Fund to date
- Delaying or suspending certain planned service outages to maintain uninterrupted energy service
- Partnering with a local distillery to produce thousands of bottles of hand sanitizers
- Coordinating employee volunteer efforts to procure cloth and materials to make masks
- Responded to our employees by instituting new flexible policies for working parents

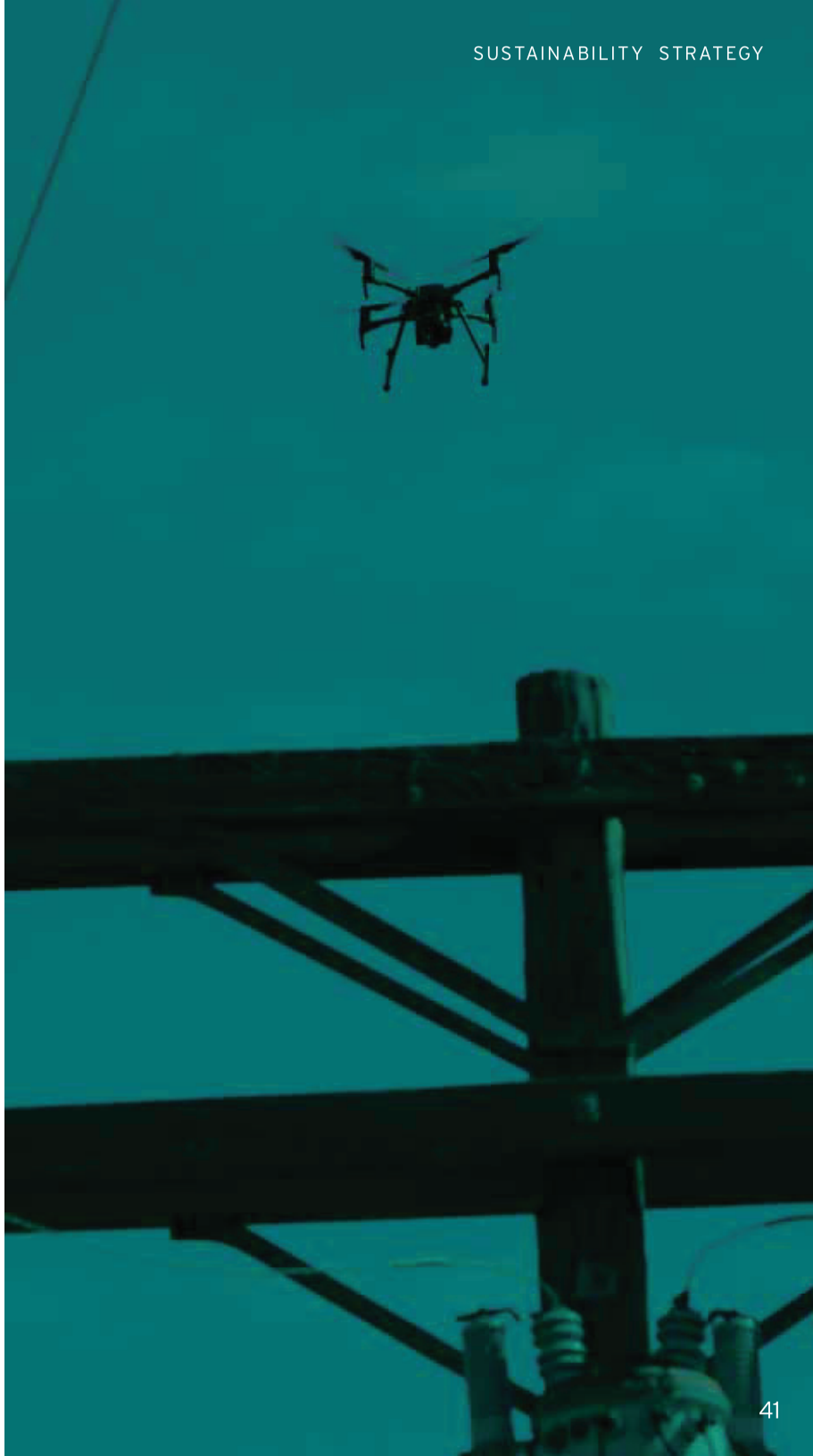
SHAPING THE FUTURE

SECTION 4

SHAPING A FUTURE FIT FOR EVERYONE

A future filled with promise for all depends on what all of us do today. At SDG&E, we are doing our part to shape a sustainable future through a host of initiatives aimed at addressing climate change and developing the means necessary to bring our long-term goals to fruition.

Innovative technology is in our DNA. By leveraging the power of artificial intelligence (AI), machine learning, cloud-based solutions and other emerging technologies, we have been able to increase the reliability, resilience and sustainability of our technology platforms. These investments can help us deliver an equitable and smooth transition to new forms of energy.



TRANSPORTATION REIMAGINED

The transportation sector represents the single largest GHG emissions source – more than half of the GHG emissions in San Diego County. To reduce those emissions, SDG&E installed more than 3,000 electric vehicle chargers at over 250 locations, including apartments, condominium complexes and offices. And we are expanding our programs to include charging for both light, medium and heavy-duty vehicles – all in an effort to encourage the adoption of more electric vehicles, which will reduce GHG emissions. More than 30% of the chargers we installed are in vulnerable communities – areas that suffer from high levels of air pollution given their proximity to freeways or industrial facilities.

To reimagine transportation in our region and beyond, we commit to:

- **SUPPORT CALIFORNIA'S GOAL TO TRANSITION TO ZERO-EMISSION VEHICLES BY ACCELERATING OUR STRATEGIC COLLABORATION OF KEY STAKEHOLDERS[1] TO DELIVER AN AMBITIOUS REGION-WIDE CLEAN TRANSPORTATION INFRASTRUCTURE GOAL**
- **ADDRESS AIR POLLUTION AND SOLIDIFY THE REGION'S LEADERSHIP ON THE GLOBAL TRANSPORTATION MAP**
- **CONTINUE TO SHAPE CONSTRUCTIVE POLICIES AND LEGISLATION TO ENSURE CUSTOMER ADOPTION AND FACILITATE AN EQUITABLE TRANSITION**

We will continue to promote policies and legislation to help ensure customer adoption and facilitate an equitable transition.

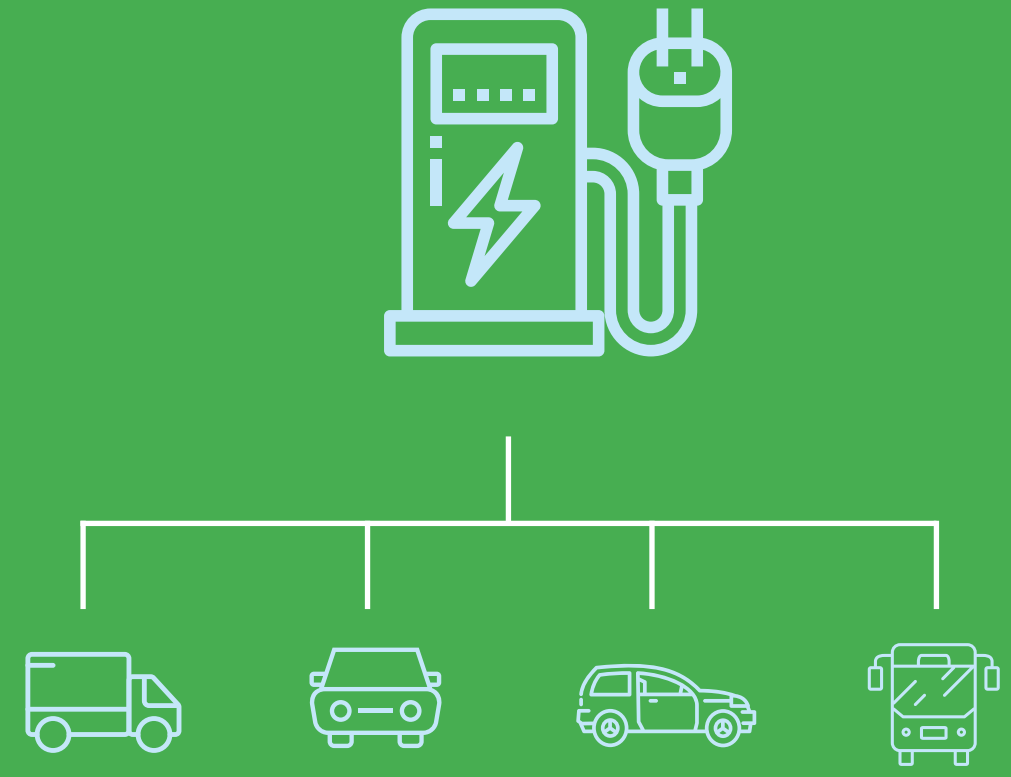
1. These stakeholders include local jurisdictions, regional agencies, utilities and other parties seeking to combat the effects of climate change.

"THIS IS THE MOST IMPACTFUL STEP OUR STATE CAN TAKE TO FIGHT CLIMATE CHANGE."

- CALIFORNIA GOVERNOR GAVIN NEWSOM

CHARGING AHEAD

More chargers in more places for more vehicles



EMPOWERING DRIVERS TO GO ELECTRIC

With our Power Your Drive (PYD) program, we were among the first utilities in the nation to deploy chargers at a large scale at workplaces and multi-unit dwellings.

PYD for homes and work provides an hourly dynamic vehicle grid integrated (VGI) rate, which encourages drivers to charge during grid-friendly times. Customers can set a maximum price they're willing to pay, and the charging station will stop charging once the hourly price exceeds their maximum price. PYD drivers pay, on average, around $0.19 per kilowatt-hour – equivalent to paying about $1.60 for a gallon of gas.

Over time, SDG&E has received CPUC approval for programs that further expand the EV charging network to meet customer needs. These programs focus primarily on the medium – and heavy-duty vehicle market – a critical sector that needs to be transitioned to clean technology. Because the needs of fleet operators are different from those of individual customers, we are working closely with stakeholders to design innovative rates to help enable a smooth transition.

POWER YOUR DRIVE

Growing the EV Network

2017

15 Sites

185 Chargers

- Workplaces, Apartments & Condos

2018

SB 350 Pilots

240 Sites

2,884 Chargers

- Workplaces, Apartments & Condos

2019

SB 350 Pilots

267 Sites

3,239 Chargers

- Workplaces, Apartments & Condos
- Fleets
- State Parks, Beaches & Schools

2020 (ESTIMATE)

SB 350 Pilots

274 Sites

3,330 Chargers

- Workplaces, Apartments & Condos
- Fleets
- State Parks, Beaches & Schools

PROOFPOINT

As a leader in EV adoption, we demonstrated our early commitment to reducing GHG emissions from transportation through a variety of pilot projects (in development).

Port Electrification
Chargers, circuits, load research meters and data loggers

Electrify Local Highways
Level 2 and DC Fast Chargers at four Caltrans Park-and-Rides

Dealership Incentives
EV education and incentives to increase EV sales and enhance the customer experience

Fleet Delivery
Charging for delivery vehicles

Green Shuttle
Dedicated charging infrastructure for fixed route shuttles

Airport Ground Support Equipment
Load research, charging ports, metering equipment and data loggers

Schools
Install chargers at schools for employees, students and visitors

Parks and Beaches
Install chargers for the public at State Beaches and City/County/State Parks

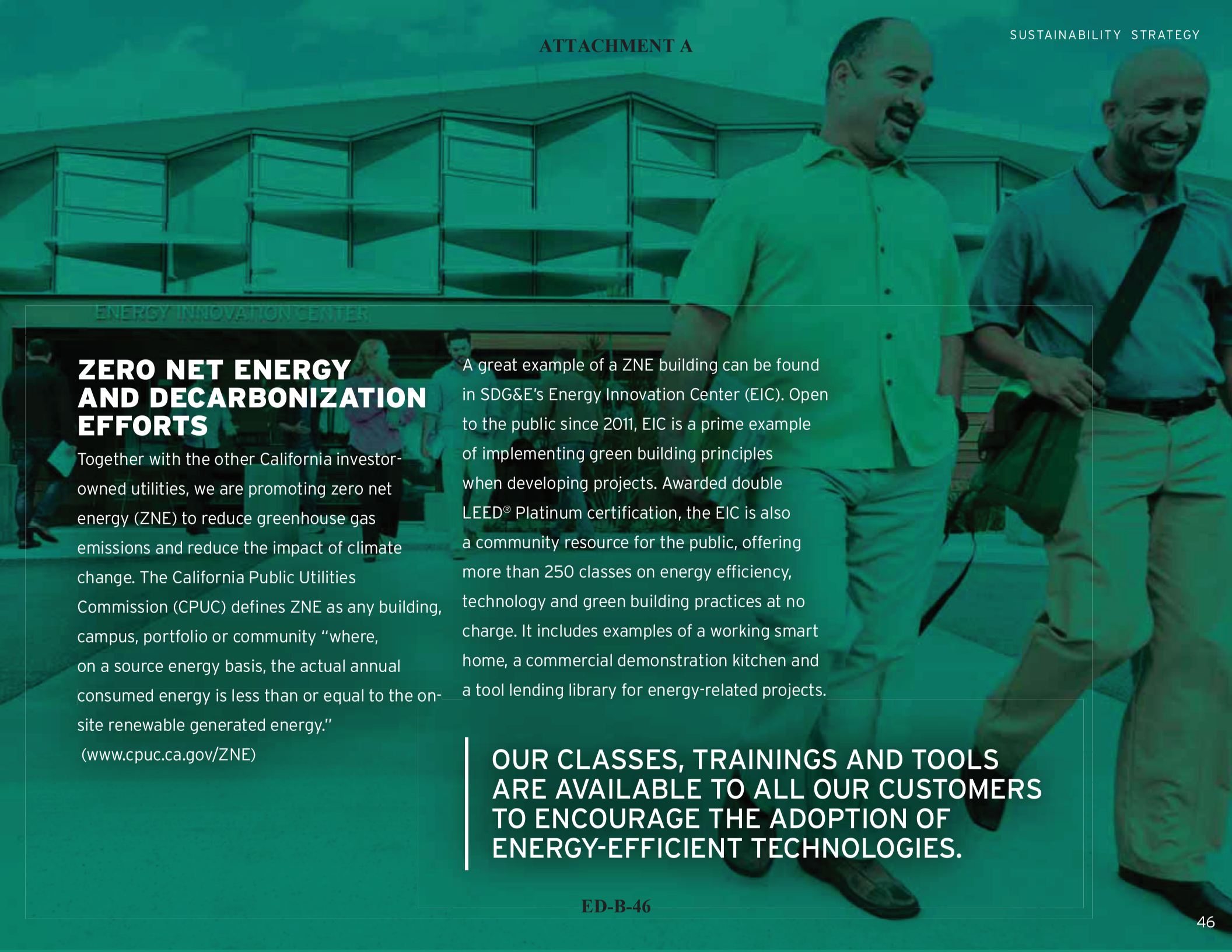
WORKING COLLECTIVELY TO ADVANCE CLEAN TRANSPORTATION

At SDG&E we believe EV adoption should start with us. And we're encouraging our employees to do their part through our **It's On to 1,000** initiative, with a goal to get 1,000 employees at SDG&E and Sempra driving electric by 2023. At the end of Q2 2020, more than 700 employees have purchased electric vehicles.

Going beyond our employee-based efforts, we are collaborating with local governments and community EV stakeholders on the Accelerate to Zero Emissions plan to help determine where charging is needed in our communities.

THE ACCELERATE TO ZERO COMMITMENT COLLABORATION INCLUDES:

- **DEVELOPING AND IMPLEMENTING AN EV STRATEGY**
- **ATTRACTING PUBLIC AND PRIVATE INVESTMENTS TO THE REGION AND MAXIMIZING THE EFFECTIVENESS OF REGIONAL CHARGER DEPLOYMENTS**
- **DEVELOPING PROGRAMS THAT ENABLE RESIDENTS, BUSINESSES AND PUBLIC AGENCIES TO PURCHASE EVs AND INSTALL CHARGERS**
- **ENCOURAGING EQUITABLE ACCESS TO EVs AND CHARGING INFRASTRUCTURE FOR ALL SAN DIEGANS**



ZERO NET ENERGY AND DECARBONIZATION EFFORTS

Together with the other California investor-owned utilities, we are promoting zero net energy (ZNE) to reduce greenhouse gas emissions and reduce the impact of climate change. The California Public Utilities Commission (CPUC) defines ZNE as any building, campus, portfolio or community "where, on a source energy basis, the actual annual consumed energy is less than or equal to the on-site renewable generated energy." (www.cpuc.ca.gov/ZNE)

A great example of a ZNE building can be found in SDG&E's Energy Innovation Center (EIC). Open to the public since 2011, EIC is a prime example of implementing green building principles when developing projects. Awarded double LEED® Platinum certification, the EIC is also a community resource for the public, offering more than 250 classes on energy efficiency, technology and green building practices at no charge. It includes examples of a working smart home, a commercial demonstration kitchen and a tool lending library for energy-related projects.

OUR CLASSES, TRAININGS AND TOOLS ARE AVAILABLE TO ALL OUR CUSTOMERS TO ENCOURAGE THE ADOPTION OF ENERGY-EFFICIENT TECHNOLOGIES.

MODERNIZING OUR GRID

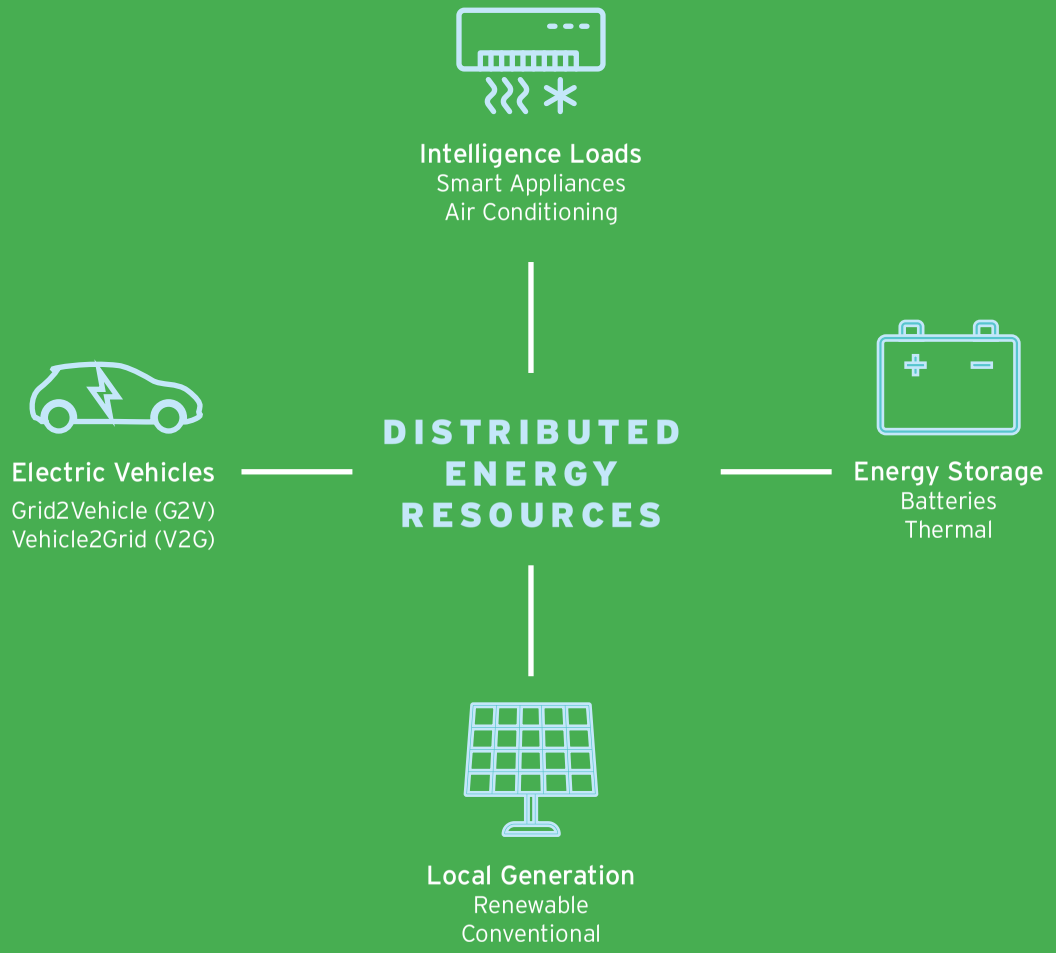
We view our role as a grid operator to be central to achieving California's climate agenda. And our goal is to innovate the grid to accelerate decarbonization and deliver value to all customers. We recognize the need to adapt our systems to further facilitate zero-carbon energy productions, storage and use.

These grid modernization efforts will require a holistic Distribution System Operator (DSO) strategy that advances the orchestration of Distribution Energy Resources (DERs), expands storage capabilities, integrates digital functionality when and where possible and provides customer communication and education.

Playing an important role in our grid modernization plans are intelligent DERs, especially when they are unified as a group and provide customers the means to optimize their energy futures. Doing so will allow them to use their DERs to fully participate in the grid, whether through energy generation, load or storage.

At SDG&E, we believe in taking a holistic view of grid modernization, breaking down traditional grid-management barriers and transforming passive customers into active *pro*sumers of energy.

GROWING THE GRID THROUGH DERs



INTEGRATING BITS AND WATTS FOR GRID FLEXIBILITY

Integrating "bits and watts" can help us progress toward our zero-carbon goals in an increasingly digital world. One integrative solution is the Local Area Distribution Controller (LADC), a software and hardware solution that provides control functionality for multiple types of DERs and other microgrid components. We use LADC to augment and interoperate our existing Advanced Distribution Management System and Supervisory Control and Data Acquisition (SCADA) System. Designed to coordinate and optimally control DERs and conventional grid management devices (e.g., capacitors, switches), LADC helps ensure reliable operation during both island and grid-connected situations.

Deployed locally at our Borrego microgrid location, LADC supports remote control, visibility and supervisory operation to all microgrids from SDG&E's distribution control center.

With this centralized ability to manage and control all microgrids, we seek to maintain timely, safe and reliable operations within our distribution system.

OUR HOLISTIC VIEW ON SUSTAINABLE ENERGY SUPPLY

A zero-carbon future hinges upon public policy support, technological breakthroughs, customer adoption and many sector-wide solutions. It also underpins our integrated resource plan (IRP) to balance varied supply-side resources and GHG goals without compromising reliability, flexibility and affordability.

The current IRP process is designed to help ensure that California's electric sector is on track to provide 60% of the electricity we deliver from renewable resources and reduce GHG emissions by 40% from 1990 levels by 2030 while maintaining reliability, flexibility and affordability. We are also exploring how to make sure that 100% of our retail sales supply comes from renewables and zero-carbon sources by 2045.

SDG&E-OWNED BATTERY STORAGE PROJECTS		
COMMERCIAL OPERATION DATE (COD)	MW / MWH	PROJECTS
CURRENT IN-SERVICE		
2012, 2013	6 MW / 17 MWh	Pala, Ortega Highway, Canyon Crest Academy, Borrego Springs
2017	39.5 MW / 158 MWh	Miguel Flow Battery – VRF; Escondido and El Cajon
FUTURE IN-SERVICE		
2020, 2021	112.3MW / 449.75 MWh	Miramar, Fallbrook, Kearny[1], Melrose[1], Cameron Corners, Ramona Air Attack, Agua Caliente, Shelter Valley
2022	8 MW / 16 MWh (Li-ion); 125 kW / 1 MWh (H2)	Borrego Springs
~166 MW/ 642 MWH		
These aren't the only storage projects we rely on to meet capacity/reliability needs, but they are projects that have been built because of the value they can provide to customers – co-location with our facilities and the ability to come online very quickly to meet an urgent need.		

1. Kearny and Melrose subject to CPUC approval.

SCALING ENERGY STORAGE TO MEET GRID DEMANDS

Energy storage at grid scale can help us mitigate the effects of renewable energy intermittency and energy shifting. When deeply integrated into the grid, energy storage can allow us to absorb grid disturbances while also providing a buffering capability to alleviate grid constraints. Over time, energy-storage and energy-shifting capabilities will need to expand to manage daily intermittency needs and mitigate the impact of lengthy weather events.

Our grid-scale battery energy storage systems at Escondido and El Cajon provide valuable early lessons for decarbonizing the electric grid over the next 25 years. Besides charging primarily when there is an overabundance of renewables and prices are low, and discharging later in the day when solar is coming offline, these batteries can provide ancillary services to maintain grid stability. And although these patterns will likely change over time as more energy storage and renewables are connected to the grid, they can inform planning for the next 25 years and beyond.

SDG&E is procuring close to 300 MW of battery storage by 2023 to meet local capacity needs identified by the CPUC. Of this, 150 MW is scheduled to come online by 2021.

SDG&E GRID MODERNIZATION GOALS + SOLUTIONS	
2022	Place two green hydrogen projects into service to offer long-duration energy storage, increase system resiliency and reduce carbon intensity
2025	Pilot a virtual power plant to further expand and leverage distribution-level demand response in order to reduce GHG emissions, advance resource adequacy and enhance grid resiliency
2030	Collaborate with industry leaders and implement at least one breakthrough solution that mitigates direct emissions from gas-fired generation

REDUCING GHG EMISSION CAUSED BY ENERGY LINE LOSSES

We have been seeking ways to increase efficiency by reducing line losses that result in GHG emissions. SDG&E has made substantial improvements in reducing its line losses, particularly by utilizing Invar cables with low resistance that transport electricity more efficiently. The Transmission Engineering and Design team also assesses opportunities to reuse structures whenever possible and incorporate materials that can be readily repurposed when infrastructure is upgraded, without needing to replace them entirely.

PROOFPOINT

Insulating Against Line Losses. Typically, transmission lines are rebuilt to increase the conductor size and improve its capacity. Our Transmission Engineering and Design team looks to reuse them as much as possible to increase efficiency and reduce waste. By using post insulators and drop tongue configuration, we have been able to increase the capacity of our structures by 50%. Drop tongue configuration provides easy changeouts, avoids conductor upgrades and prevents structure rebuilds, while reducing embodied carbon that would otherwise be present in structures no longer in use.

LIMITING GHG IMPACT OF NATURAL GAS

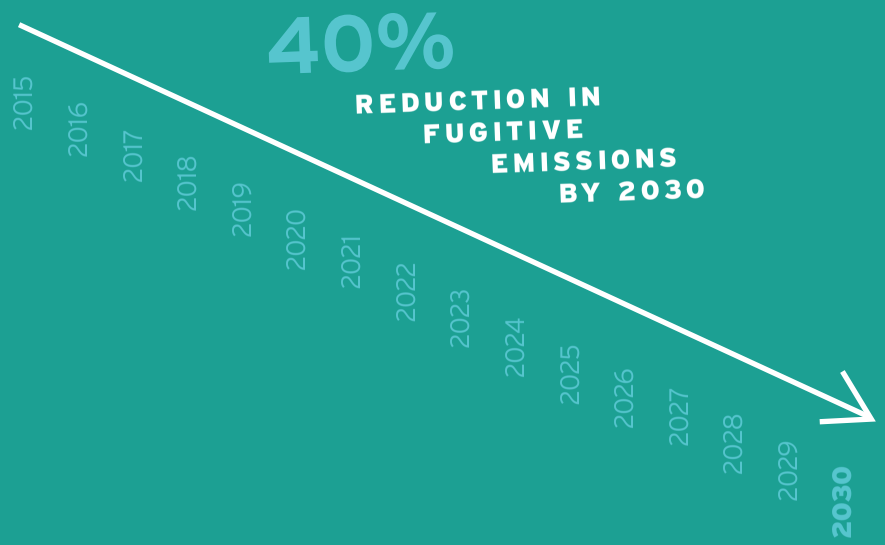
Natural gas consists mainly of methane, a potent greenhouse gas. Managing and mitigating any fugitive or process emissions related to natural gas within our network is a top priority for us. Every effort to curtail methane emissions enhances the sustainability of the gas we deliver to our customers. In 2019, we had zero leads for the third year in a row.

By 2030, we aim to:

- **REDUCE FUGITIVE EMISSIONS FROM OUR NATURAL GAS TRANSMISSION AND DISTRIBUTION SYSTEMS BY 40% FROM OUR 2015 BASELINE**
- **ELIMINATE 100% OF NATURAL GAS VENTED DURING PLANNED PIPELINE WORK**

SDG&E has utilized methane/natural gas recapture, expedited gas leak response rates, increased leak survey frequency, leveraged aerial leak detection with source pin-pointing and quantification, installed isolation valves for leak control and raised awareness of the "Call Before You Dig" campaign, among other tactics to reduce its fugitive natural gas emissions.

FIGHTING FUGITIVE GAS EMISSIONS



HOW NATURAL GAS FITS INTO A LOW-CARBON FUTURE

We believe natural gas and its related infrastructure will play a critical part in the transition to low-carbon economies globally. Currently, the gas system is providing dispatchable energy during volatile peak demand and ramping needs caused by increasing reliance on intermittent renewables and non-contracted imports in California. Our gas generation infrastructure has been invaluable to the reliability of the electricity system. As we transition to a net-zero carbon future, we believe technologies such as biomethane, hydrogen and gas with carbon capture will play an essential role in decarbonizing economic sectors currently seen as hard to abate. Governmental policy and public support will be needed to help achieve the scale these solutions demand to free us from dependence on resources fueling CO2 emissions. We believe strategic investments in these advanced technologies will help pave the way for a smooth and equitable transition to our clean energy future.

PROOFPOINT

Since 1963, the Point Loma Wastewater Treatment Plant has treated wastewater for more than two million San Diego residents – removing organic and inorganic materials from about 175 million gallons of wastewater each day before discharging it to the ocean. This process produces methane gas, which is captured and converted to renewable natural gas that is injected into SDG&E's gas pipeline system.

WE COMMIT TO LEVERAGING OUR GRID MODERNIZATION INVESTMENTS, SUCH AS OUR HYDROGEN PROJECTS, TO IDENTIFY OPPORTUNITIES FOR REDUCING NATURAL GAS EMISSIONS WHEREVER FEASIBLE. AND WE WILL CONTINUE TO PURSUE OPPORTUNITIES THAT ENABLE OUR CUSTOMERS TO REDUCE THE EMISSIONS ASSOCIATED WITH THEIR NATURAL GAS CONSUMPTION.

CLOSING THOUGHTS

This report provides our approach to the three elements of sustainability – Environmental, Social and Governance (ESG) at SDG&E. It also provides a modest, yet holistic overview of the sustainability-related actions we have taken or plan to take and the strategic investments necessary to achieve them.

We believe that now is not a time for debate, but instead collective action, guided by data and tangible evidence. All mitigation and adaptation measures count since we cannot afford to delay meaningful actions to address the climate crisis. And we will continue to align and extend our abilities in delivering clean, safe and reliable energy to help make California's ambition to achieve carbon neutrality by 2045 a reality.

THE TIME TO ACT IS NOW. SDG&E COMMITS TO WORKING WITH YOU TO SHAPE OUR SUSTAINABLE FUTURE TOGETHER.

For updates, more information or to share feedback, visit *sdge.com/sustainability*.

FORWARD-LOOKING STATEMENTS

This report contains statements that are not historical fact and constitute forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995. Forward-looking statements are based on assumptions with respect to the future, involve risks and uncertainties, and are not guarantees of performance. Future results may differ materially from those expressed in the forward-looking statements. These forward-looking statements represent our estimates and assumptions only as of the date of this report. We assume no obligation to update or revise any forward-looking statement as a result of new information, future events or other factors.

In this report forward-looking statements can be identified by words such as "believes," "expects," "anticipates," "plans," "estimates," "projects," "forecasts," "should," "could," "would," "will," "confident," "may," "can," "potential," "possible," "proposed," "target," "pursue," "outlook," "maintain," or similar expressions, or when we discuss our guidance, strategy, goals, vision, mission, opportunities, projections or intentions.

Factors, among others, that could cause our actual results and future actions to differ materially from those described in any forward-looking statements include risks and uncertainties relating to: California wildfires and the risk that we may be found liable for damages regardless of fault and the risk that we may not be able to recover any such costs from insurance, the wildfire fund established by California Assembly Bill 1054 or in rates from customers; decisions, investigations, regulations, issuances of permits and other authorizations, renewal of franchises, and other actions by (i) the California Public Utilities Commission (CPUC), U.S. Department of Energy, and other regulatory and governmental bodies and (ii) states, cities, counties and other jurisdictions in the U.S. in which we operate or do business; the success of business development efforts and construction projects, including risks in (i) the ability to make a final investment decision and completing construction projects on schedule and budget, (ii) counterparties' financial or other ability to fulfill contractual commitments, and (iii) the ability to realize anticipated benefits from any of these efforts once completed; the impact of the COVID-19 pandemic on our (i) ability to commence and complete capital and other projects and obtain regulatory approvals, (ii) supply chain and current and prospective counterparties, contractors, customers, employees and partners, (iii) liquidity, rates;

moves to reduce or eliminate reliance on natural gas; weather, natural disasters, accidents, equipment failures, computer system outages and other events that disrupt our operations, damage our facilities and systems, cause the release of harmful materials, cause fires and subject us to liability for property damage or personal injuries, fines and penalties, some of which may not be covered by insurance (including costs in excess of applicable policy limits), may be disputed by insurers or may otherwise not be recoverable through regulatory mechanisms or may impact our ability to obtain satisfactory levels of affordable insurance; the availability of electric power and natural gas and natural gas storage capacity, including disruptions caused by failures in the transmission grid, limitations on the withdrawal or injection of natural gas from or into storage facilities, and equipment failures; cybersecurity threats to the energy grid, storage and pipeline infrastructure, the information and systems used to operate our businesses, and the confidentiality of our proprietary information and the personal information of our customers and employees; the impact on competitive customer rates and reliability due to the growth in distributed and local power generation, including from departing retail load resulting from customers transferring to Direct Access, Community Choice Aggregation or other forms of distributed or local power generation, and the risk of nonrecovery for stranded assets and contractual obligations; volatility in interest and inflation rates and commodity prices and our ability to effectively hedge the risk of such volatility; the impact of changes to U.S. federal and state tax laws and our ability to mitigate adverse impacts; and other uncertainties, some of which may be difficult to predict and are beyond our control.

These risks and uncertainties are further discussed in the reports that San Diego Gas & Electric Company and its parent company, Sempra Energy, have filed with the U.S. Securities and Exchange Commission (SEC). These reports are available through the EDGAR system free-of-charge on the SEC's website, www.sec.gov, and on Sempra Energy's website, www.sempra.com. Investors should not rely unduly on any forward-looking statements.

Sempra North American Infrastructure, Sempra LNG, Sempra Mexico, Sempra Texas Utilities, Oncor Electric Delivery Company LLC (Oncor) and Infraestructura Energética Nova, S.A.B. de C.V. (IEnova) are not the same companies as the California utilities, San Diego Gas & Electric Company or Southern California Gas Company, and Sempra North American Infrastructure, Sempra LNG, Sempra Mexico, Sempra Texas Utilities, Oncor and IEnova are not regulated by the CPUC.

BUILDING A BETTER FUTURE

SUSTAINABILITY STRATEGY UPDATE

SDGE™

OCTOBER 2021

Table of Contents

3 ▸ Executive Message

7 ▸ Our Commitment

12 ▸ Shape the Future

22 ▸ Do the Right Thing

29 ▸ Champion People

36 ▸ Closing Thoughts

Executive Message

We have no time to waste.

That's how we feel about the urgency to transform the way we deliver energy to you, to help tackle humanity's greatest challenge — climate change — and to help shape a sustainable and equitable future for all. Having lived through another year defined by extreme weather, our resolve to help improve lives and protect communities with climate-resilient infrastructure is stronger than ever.

As daunting as climate change is, it has also been a powerful and long-standing source of inspiration for our employees to continuously innovate and collaborate. Our climate resilience journey began nearly 20 years ago with a singular determination to build a world-class wildfire mitigation program from the ground up. Today, SDG&E® is widely seen as an industry leader in wildfire safety, and we're also recognized as a pioneer in adopting digital innovations — such as fiber optic sensors, artificial intelligence and 5G-ready communications — to advance safety and reliability. We're looking to build on that history of leadership and innovation to fight the climate crisis.

In the following pages, you will learn about the progress we've made alongside our partners since the publication of our sustainability strategy in October 2020. Over the past year, we ramped up our investments in advanced technologies — green hydrogen, energy storage and microgrids — designed to strengthen grid reliability. At the same time, we expanded our efforts around environmental stewardship and doubled our charitable giving to help sustain residents hard hit by the ongoing pandemic.

As our workforce continues to provide essential services to our customers, we're also finding ways to push ourselves to do more, such as enhancing our climate goal of net zero greenhouse gas (GHG) emissions by 2045 and shortening our timelines to achieve goals for a zero-emission fleet and sustainable facilities.

Just as it takes a village to raise a child, it takes all of us to combat climate change. For that reason, we're thankful for the broad base of public, private, nonprofit and academic leaders and organizations working alongside us to advance sustainability. Multi-stakeholder, cross-sector collaboration is the key to unlocking innovations.

While we're proud of what we've done to date, it's just the beginning of a long journey. Together with our employees, customers, suppliers, innovators, investors, partners and community organizations, we can and will make a difference. We strive to build a better, more inclusive economy. Just as our region has established itself as a global leader in biotechnology, climate research and communication technologies, our region aspires to catapult to the forefront of climate adaptation and resiliency.

With our shared climate goals as our North Star, it's full speed ahead.

Caroline Winn
SDG&E Chief Executive Officer

Estela de Llanos
SDG&E Vice President,
Energy Procurement and Sustainability

Caroline Winn
SDG&E Chief Executive Officer

Estela de Llanos
SDG&E Vice President, Energy Procurement and Sustainability

Highlights

Investments for a Brighter Future

$750M inaugural green bonds issued in 2021

$872M in contracts with diverse suppliers in 2020

$30M dedicated to further San Diego's climate action and climate equity goals

$9.8M in charitable donations[1] in 2020 benefiting 551 nonprofits

Wildfire Mitigation and Climate Resilience

4,091 miles of power lines hardened against wildfires to date

37,000+ power poles in High-Fire Threat District inspected by drones to date

4 microgrids in development

11 wildfire safety/resilience fairs and webinars held in 2021

~3,000 renewable portable backup batteries provided to the most vulnerable residents in high-fire risk areas

Clean Transportation

3,260 chargers built to date

IN DEVELOPMENT

304 chargers at schools, parks and beaches

~2,000 chargers for workplaces and multi-unit dwellings

300 chargers to support 3,000 medium/heavy-duty vehicles

1. These are shareholder-funded, not recovered from customers.

Utility-Owned Energy Storage

3	1 storage facility added in 2021 and 2 under construction
3	mobile storage batteries acquired in 2021
6	different types of energy storage technologies
~145 MW	of utility-owned storage expected by the end of 2022

Environment

9,500+	trees planted
~15,000	pounds of e-waste diverted
~3,000	solar panels (12,000 pounds) recycled
3,000+	pounds of upcycled appliances, electronics and office supplies donated
10,000	pounds of metal materials recycled

Stakeholder Engagement

~3,500	customers, employees, partners, community leaders and critics engaged
21	languages to which SDG&E translated wildfire safety communications

Clean Energy

~27,600	rooftop solar systems (with capacity totaling 190 MW) interconnected to the grid in 2020

White House National Climate Advisor Lauds SDG&E's Wildfire Safety and Climate Resilience Advancements

In August 2021, White House National Climate Advisor Gina McCarthy visited SDG&E's Emergency Operations Center to learn about our pioneering work to reduce wildfire risk, strengthen climate resilience and protect public safety. She was joined by U.S. Representatives Scott Peters and Mike Levin for a demonstration of the high-tech tools we use to gain situational awareness, including artificial intelligence-based fire weather forecast models.

Left to right: SDG&E CEO Caroline Winn, White House National Climate Advisor Gina McCarthy, Congressman Mike Levin, Congressman Scott Peters and Sempra® Group President Kevin Sagara

> *They [SDG&E] have been working on this issue for 10 years...They are using all kinds of different technologies to both manage the fires once they're detected, but even more importantly to detect them early on. Look, these are all adaptations to our climate crisis that everyone should take a look at and start emulating.*
>
> ***– National Climate Advisor Gina McCarthy***

Our Commitment

Net Zero by 2045

In March 2021, we solidified our sustainability commitment with our goal to reach net zero GHG emissions by 2045. What that means is that we aim to remove as many GHG emissions from the atmosphere as we produce. Our commitment goes beyond reducing our own emissions and includes tackling those generated by our customers' energy use. In order to track progress, we are undertaking a rigorous, multi-year effort to build a comprehensive, verified GHG inventory. A complete baseline will provide us with insights on where we stand now and help shape our path forward.

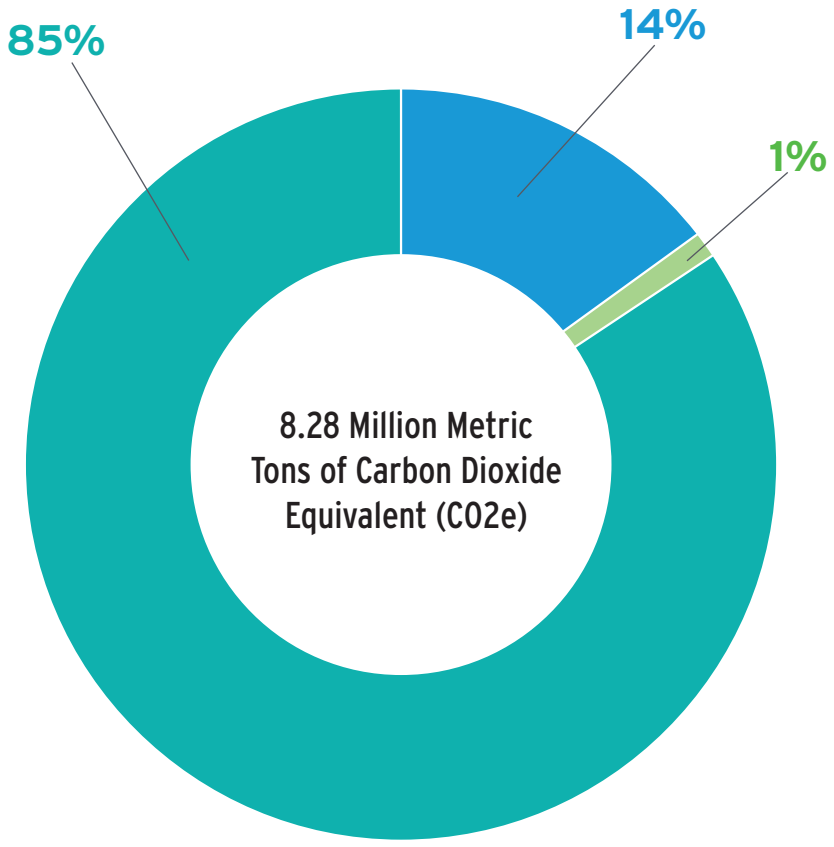
A holistic approach and understanding of economy-wide interdependencies will continue to inform our actions. SDG&E is undertaking an economy-wide GHG study supported by some of the leading third-party experts to inform our options for achieving net zero emissions by 2045 and to develop a decarbonization roadmap that maintains resiliency and reliability. We look forward to sharing the results and gathering feedback in 2022.

2019 SDG&E Greenhouse Gas Emissions Profile

Scope 1: 14%
Emissions from sources we control, e.g., company vehicles, owned power generation and pipelines, including fugitive emissions (unintentional releases of gases/vapors)

Scope 2: 1%
Emissions from generation of power used in our facilities, as well as power lost during transmission and distribution

Scope 3: 85%
Emissions from others that are the result of our business activities, e.g., purchased electricity that we deliver to our customers and our customers' combustion of natural gas



Scopes 1 and 2 emissions are third-party verified

Advancing Climate Equity

As we pursue our net zero goal, top of mind for us is climate equity — providing all of our customers equitable access to clean energy, and climate resilience tools and technologies. We value strategies that do not create disparate impacts or produce unintended social consequences. To that end, we are exploring the use of data and digital technologies with stakeholders inside and outside our organization. These technologies will help us measure, track and report how we serve vulnerable communities and to better understand which portions of our service territory are most impacted by GHG emissions. Additionally, this effort will help guide and prioritize our investments and decisions on energy infrastructure, outreach and communication to advance climate equity.

> *Climate change affects all of us, but the most vulnerable communities — those that are already struggling with health, income and educational disparities — are hit the hardest. As we work to shape the clean energy future, we need to understand the full impact of our actions, look at things from an equity lens and make sure we leave no one behind.*
>
> ***– Estela de Llanos, SDG&E Vice President of Energy Procurement and Sustainability***

SDG&E employees volunteered with a local nonprofit to install rooftop solar for homeowners in underserved communities.

The San Diego Climate Equity Fund

Under new franchise agreements finalized in June 2021 between SDG&E and the City of San Diego, we will contribute $30 million (shareholder-funded) for initiatives that focus on infrastructure improvements and solar adoption in underserved communities. The city's General Fund will receive $20 million to further its climate action and climate equity goals. The remaining $10 million will fund solar energy rebates in historically underserved neighborhoods.

Our Sustainability Goals

Since releasing our sustainability goals in October 2020, we have continued to refine them and to challenge ourselves to accelerate progress wherever possible. With climate conditions worsening, SDG&E recognizes the urgency to act and do more. Over the past year, we have set new and more aggressive timelines, as we aim to achieve some of our goals related to our fleet, facilities and advanced technology. In addition to our own sustainability goals, we are also guided by those set by Sempra, our parent company.

Do the Right Thing

Environmental Stewardship

Each year:
- Plant at least 10,000 trees (starting in 2021) supporting local biodiversity with the "Right Tree, Right Place" program, and intelligent water use

By 2030:
- Divert 100% of our organic green waste from entering landfills, especially green waste related to vegetation management
- Increase recycled water use to at least 90% at all our facilities

Sustainable Operations

By 2030:
- Electrify 100% of our Light-Duty Fleet
- Transition 30% of our overall fleet to Zero-Emission Vehicles (ZEV)[1]
- **Divert 100% of facilities-related waste from landfills**
- **Reduce facilities freshwater use by 50% (2010 baseline)**
- **Achieve zero net energy[2] for all owned facilities (current usage ~5.5 MW)**
- **Enable green miles via on-site charging with ~2,000 EV charge points**
- **Earn U.S. Green Building Council Leadership in Energy and Environmental Design (USGBC LEED®) (Silver+) certifications for all new construction**

By 2035:
- **Operate 100% ZEV fleet**

By 2040:
- Deploy 100% non-SF6 equipment everywhere feasible

Champion People

"Outside In" Community Outreach

Each year:
- Actively engage a growing network of external, community-based, nonprofit stakeholders who provide continuous constructive feedback and partner with us on meeting the needs of diverse and underserved communities through sustainability initiatives

Creating Opportunities through Diversity, Equity & Inclusion

Starting in 2020:
- We are advancing our commitment to engage, act, measure and report our performance related to diversity, equity and inclusion with greater transparency and urgency. Emphasizing five key pillars to track progress:

1. Leading from the top
2. Accelerating employee engagement
3. Creating opportunity
4. Driving conscious inclusion
5. Partnering with the communities we serve

Sustainable Supply Chain

By 2025:
- Develop an energy industry supply chain sustainability program

Shape the Future

Reimagine Transportation

Starting in 2020:
Support California's goal to transition to Zero-Emission Vehicles by accelerating our strategic collaboration of key stakeholders to deliver an ambitious region-wide clean transportation infrastructure goal, address air pollution and solidify the region's leadership on the global transportation map. We will continue to shape constructive policies and legislation to help ensure customer adoption and facilitate an equitable transition.

Grid Modernization & Breakthrough Solutions

By 2022:
- Place two green hydrogen projects into service to offer long-duration energy storage, increase system resiliency and reduce carbon intensity
- **Plan and pilot a Virtual Power Plant to further expand and leverage distribution-level demand response as a means to reduce GHG emissions, advance resource adequacy and enhance grid resiliency**

By 2030:
- Collaborate with industry leaders and implement at least one breakthrough solution that mitigates direct emissions from gas-fired generation

1. Zero-Emission Vehicle (ZEV) includes full battery electric vehicles (BEV), plug-in hybrid vehicles (PHEV) and hydrogen fuel cell vehicles. Fleet goals contingent on vehicle availability and California Public Utilities Commission (CPUC) funding.
2. CPUC definition of Zero Net Energy

New goals | To be completed 5 years ahead of previous timeline | To be completed 3 years ahead of previous timeline

Sempra Sustainability Goals[1]

Do the Right Thing		Champion People	Shape the Future
Achieving World-Class Safety	**Driving Resilient Operations**	**Championing People**	**Enabling the Energy Transition**
For our customers, employees, contractors and the communities we serve	To achieve consistent excellence in all we do	To create an inspired workforce	To provide affordable, lower-carbon energy in every market we serve
Each year, we aim to: • Achieve zero employee and contractor fatalities • Improve employee and contractor OSHA recordable injury rates and lost work-time incident rates • Participate in emergency planning processes in 100% of the communities we serve • Train 100% of critical employees in emergency management and response	**Each year, we aim to:** • Achieve electric reliability in top quartile • Work to identify and include new goals under Driving Resilient Operations in future reports	**Each year, we aim to:** • Achieve a voluntary employee turnover rate of 5% or less • Achieve a company-wide employee engagement survey score in the top quartile • Provide 30+ training hours per employee • Achieve or maintain workforce diversity consistent with that of the communities where we operate	**Each year, we aim to:** • Enroll 90% of eligible customers in alternative rates for energy programs (SDG&E and SoCalGas®) **By 2030, we aim to:** • Reduce fugitive emissions from our natural gas transmission and distribution systems 40% from our 2015 baseline[2] • Eliminate 100% of natural gas vented during planned transmission pipeline work (SDG&E and SoCalGas, excludes emergency repairs) **By 2045, we aim to:** • Deliver 100% renewable or zero-carbon energy to electric utility customers (SDG&E) **By 2050, we aim for:** • Net-zero GHG emissions across scopes 1, 2 and 3[3]

1. This chart shows goals released by Sempra in the 2020 Corporate Sustainability Report (CSR) and adopted by SDG&E. For more on Sempra Sustainability, please visit ***www.sempra.com/sustainability***.
2. SDG&E, SoCalGas and iEnova efforts contribute to this shared fugitive emissions reduction goal.
3. SDG&E's climate commitment is to reach net zero emissions by 2045.

Backing Up Our Commitment with $750M in Inaugural Green Bonds

In August 2021, we issued $750 million in green bonds, raising some of the capital needed to work toward the climate adaptation and resilience projects outlined in our sustainability strategy. This is our inaugural green bond issuance and demonstrates how our capital-raising activities are also founded on well-accepted sustainability principles.

Details of SDG&E's bond issuance pursuant to Sempra's sustainable financing framework can be found at ***sempra.com/sustainability/sustainable-financing***.

Framework for Getting To Net Zero

There is wide recognition that a broad suite of solutions, including electrification, clean fuels and carbon removal, will be needed to achieve net zero GHG emissions. Innovative technology, constructive policies, customer adoption of energy-efficient initiatives and multi-stakeholder collaboration across many sectors are all necessary to drive progress. Our framework for the energy transition is centered on decarbonization, diversification and digitalization, which is aligned with Sempra's long-term strategy to achieve net zero.

Shape the Future

Recognizing that existing technologies are insufficient to meet climate goals, we are piloting and evaluating emerging innovations. They include hydrogen-based, long-duration energy storage, 100% renewable energy microgrids and vehicle grid integration that enables electric vehicles to send electricity to meet high demand.

> *Around half of emissions reductions that are needed still require major innovation of clean technologies.*
>
> ***– International Energy Agency***

In 2020, SDG&E developed an award-winning intelligent image processing project, which uses Artificial Intelligence and machine learning to rapidly identify electrical infrastructure damage in near real time by analyzing millions of drone images. In the past, it would have taken 10 linemen to manually review 2,000 images per day. Now, 27,000 images can be analyzed per day. Repairs are made more quickly, increasing public and employee safety.

Grid Modernization & Breakthroughs

SDG&E is at the forefront of adopting and pioneering clean energy and climate resilience solutions that drive tangible progress toward a net zero future. Our focus remains on building a diverse portfolio of innovative solutions that transform the grid into a catalyst for clean energy.

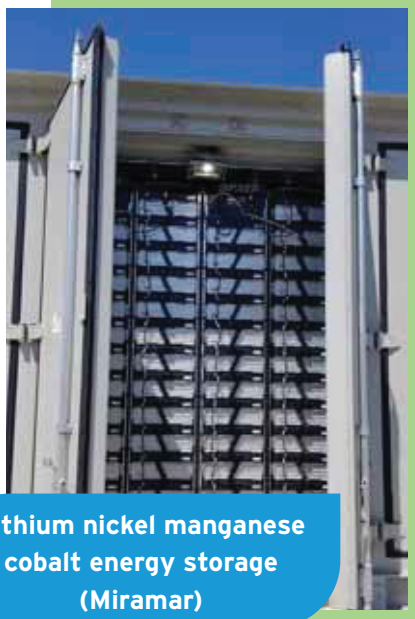
Energy Storage

Energy storage will continue to play a key role in integrating intermittent renewable energy as California moves closer toward its 100% carbon-free electricity goal. Over the past decade, SDG&E has integrated a growing and diverse portfolio of energy storage assets to support grid reliability and operational flexibility, as well as to maximize the use of the abundant solar energy available in California. Last summer, our grid operators leveraged our storage capacity to help mitigate rotating outages. In the coming years, our focus will be long-duration energy storage, which could enable us to align demand with supply not just across hours, but across days and seasons.

Diverse Energy Storage Portfolio

Vanadium redox flow battery (Bonita)

Lithium iron phosphate energy storage (Kearny Mesa)



Lithium nickel manganese cobalt energy storage (Miramar)

Top Gun Energy Storage

The Top Gun Energy Storage Facility located in the Miramar area of San Diego is the newest addition to SDG&E's owned energy storage portfolio. This 30 MW lithium-ion facility was commissioned in summer 2021 and can provide backup energy to about 20,000 residential customers for four hours. The facility is named to honor the famed Top Gun Navy Fighter Weapons School previously based at the Marine Corps Air Station Miramar.

Cutting-Edge Mobile Batteries for Backup Power

SDG&E has acquired three mobile batteries, including a 329 kW battery and a 15 kW battery, to help reduce the impact of Public Safety Power Shutoffs (PSPS), which are used as a measure of last resort to help prevent wildfires during very windy and dry conditions. Unlike traditional backup generators that run on diesel or natural gas, these batteries are zero emission. The 15 kW battery is designed as a four-wheel drive vehicle. In an initial use case, this battery will be deployed as backup power for a nonprofit food distribution center during PSPS events. It can also serve as backup power at Community Resource Centers, which SDG&E staffs during extended outages to provide water, snacks and a place to charge devices. Impacted residents can also use the battery to charge their electric vehicles. The 329 kW battery will be initially deployed to Cameron Corners, where SDG&E is building a permanent, fully renewable microgrid.

Long-Duration Green Hydrogen Energy Storage at Borrego Springs

In the remote desert town of Borrego Springs in east San Diego County, SDG&E is working to turn excess solar electricity into hydrogen, which can be stored as energy for eight or more hours. An electrolyzer will produce hydrogen when solar energy is abundant on the local circuit, and a fuel cell will convert the hydrogen into electricity when needed by the customers. The hydrogen will be integrated with the existing Borrego Springs Microgrid to help strengthen electric service reliability and community resiliency.

Wildfire Mitigation & Hardening

Wildfire mitigation is a top priority at SDG&E. Although we are recognized as an industry leader, our fire science and wildfire mitigation teams continue to innovate and improve to help keep our communities safe. We are now on version 4.0 of our Fire Safe program and always looking for innovative new ways to build greater resiliency.

SDG&E crews replaced more than 2,300 wood poles with fire-resistant steel poles in the Cleveland National Forest.

Cleveland National Forest Fire Hardening and Safety Project

Nearly a decade ago, SDG&E developed a plan to upgrade our electric infrastructure in and around the Cleveland National Forest to reduce fire risk. One of our first fire hardening programs, the Cleveland National Forest project, was completed in July 2021. Throughout the project, we worked closely with the U.S. Forest Service and Native American Tribal nations to mitigate impact. This project includes:

- Replacing 2,341 wood poles with new fire-resistant steel poles
- Installing 17 miles of new underground distribution cable and equipment
- Building 112 miles of transmission lines and 60 miles of overhead distribution lines and equipment
- Decommissioning 15 miles of old access roads on U.S. Forest Service land

Fire Safe 4.0

Weather + camera network

Artificial Intelligence

Satellite alerts

Risk-based decision tools

Strategic hardening

Community programs

Vegetation management

Microgrids

Microgrids are small grids that can operate in parallel with or independently of the larger electric grid to keep pre-defined areas powered during emergencies. They are an important tool to increase community resiliency, especially in regions that are subject to Public Safety Power Shutoffs. A pioneer in developing microgrid technology, SDG&E built America's first utility-scale microgrid in Borrego Springs in 2013 and is currently upgrading it with the intent that it run on 100% renewable energy. As we add four more microgrids to help lessen the impact of Public Safety Power Shutoffs and keep critical facilities powered, we are leveraging the lessons learned from the Borrego Springs Microgrid.

Cameron Corners Microgrid

Cameron Corners is a remote, vulnerable community located in a High-Fire Threat District in eastern San Diego County. To minimize the impact of Public Safety Power Shutoffs on this community, we are building a microgrid to help keep critical facilities, like a CAL FIRE station and a central telecommunications switching station, powered during extended outages and emergencies.

Key features of the project include:

- An 875 kW solar array to generate renewable electricity
- An ~2,400 kWh iron flow battery – a cutting-edge energy storage system that uses iron, salt and water as electrolytes, making it non-hazardous, non-flammable and fully recyclable
- An advanced microgrid controller to integrate all the distributed energy resources

These resources will provide additional benefits during normal grid operations by generating solar power and dispatching that energy via battery storage when it is needed by the California Independent System Operator (CAISO) to support grid stability and reliability.

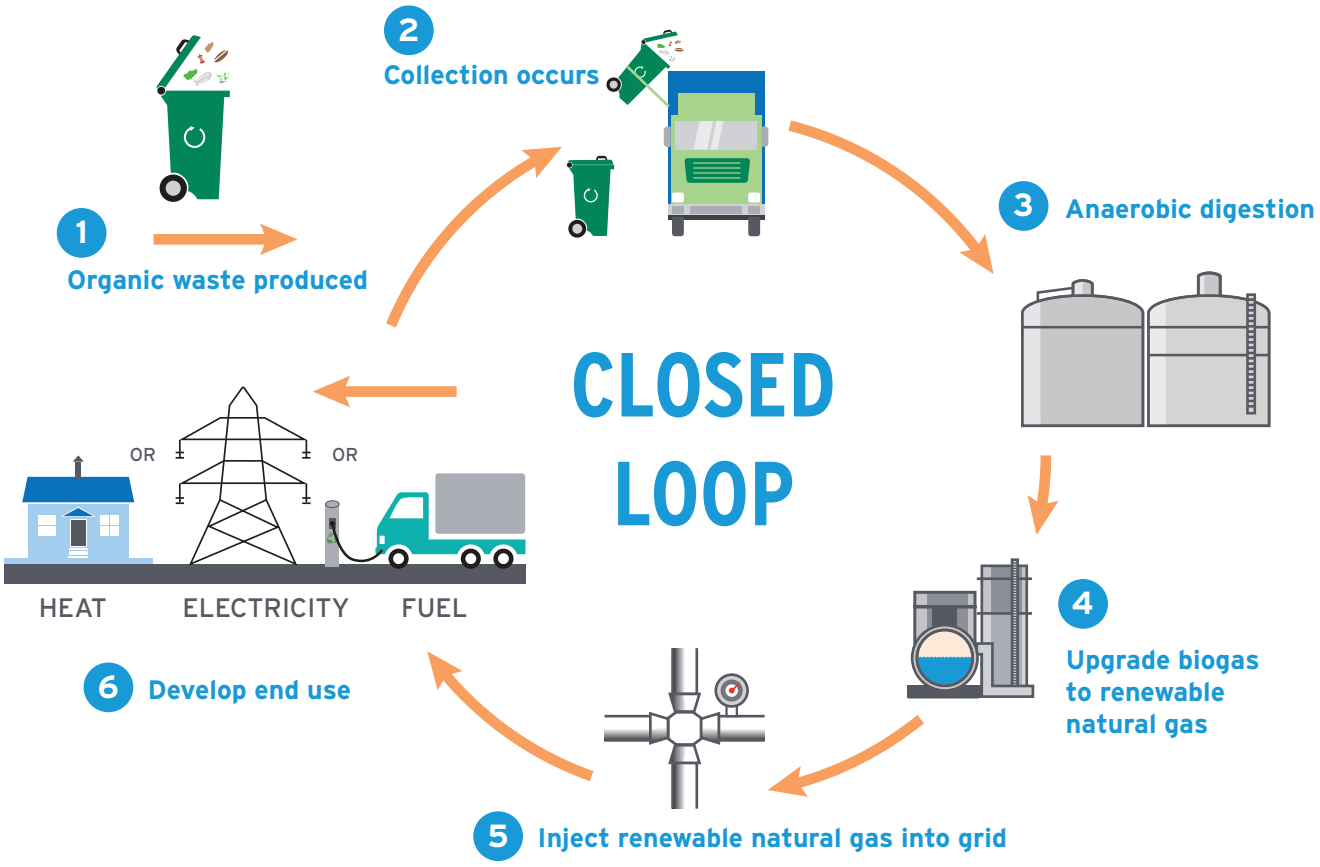
Solar array at the Cameron Corners microgrid.

Supporting Critical Community Resources

- Medical care facilities
- CAL FIRE station
- Telecom central office (switching station)
- Local food establishments
- Convenience stores
- Gas and propane stations

Renewable Natural Gas

As California looks to achieve carbon neutrality and reduce air pollution, the benefits of renewable natural gas (RNG) should not be ignored. Storable and easily transportable, RNG is derived from food waste, landfills, agriculture and other sources that release carbon emissions into the atmosphere. The leading use for RNG today is in the transportation sector, where 80% of the natural gas vehicles in California are fueled with RNG. SDG&E is exploring new ways to reduce the carbon intensity of our gas system by leveraging RNG.



ACCELERATED

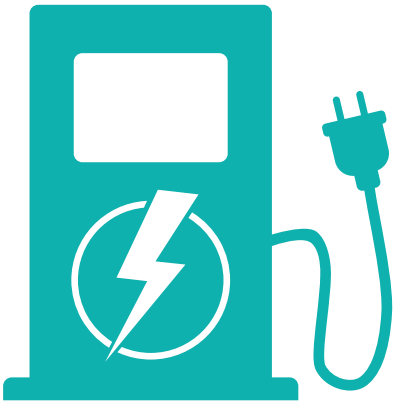
Virtual Power Plant

We have accelerated our timeline for delivering a Virtual Power Plant (VPP) from 2025 to 2022 to help boost grid reliability, flexibility and resiliency in a remote community. Planned for Shelter Valley in eastern San Diego County, where SDG&E is already developing a renewable energy-powered microgrid, this small-scale project will integrate customer-owned distributed energy resources, such as rooftop solar and energy storage, with a microgrid controller. During periods when electricity supplies are tight, this VPP can help by putting electricity on the grid. Lessons learned from the project will inform our thinking on how to safely and cost-effectively integrate customer-owned resources to meet future energy needs.

SDG&E engineer Stephanie Lomeli (left) and Team Lead Chequala Fuller (right) next to a large-scale mobile battery, which is being evaluated for different uses and sites.

Reimagine Transportation

Transportation is the backbone of the U.S. economy. However, it's also the largest contributor of GHG emissions in California and our region, in addition to being a major source of air pollution. Over the past decade, SDG&E has developed a robust portfolio of electric vehicle (EV) charging infrastructure programs to support the electrification of a full spectrum of vehicles and equipment – light, medium and heavy-duty, including trucks, school buses, transit buses and forklifts. To date, we have built about 3,260 chargers. In the coming years, we expect to build thousands more in our region to help meet California's ambitious clean transportation goals.



ATTACHMENT B

Accelerate to Zero Emissions

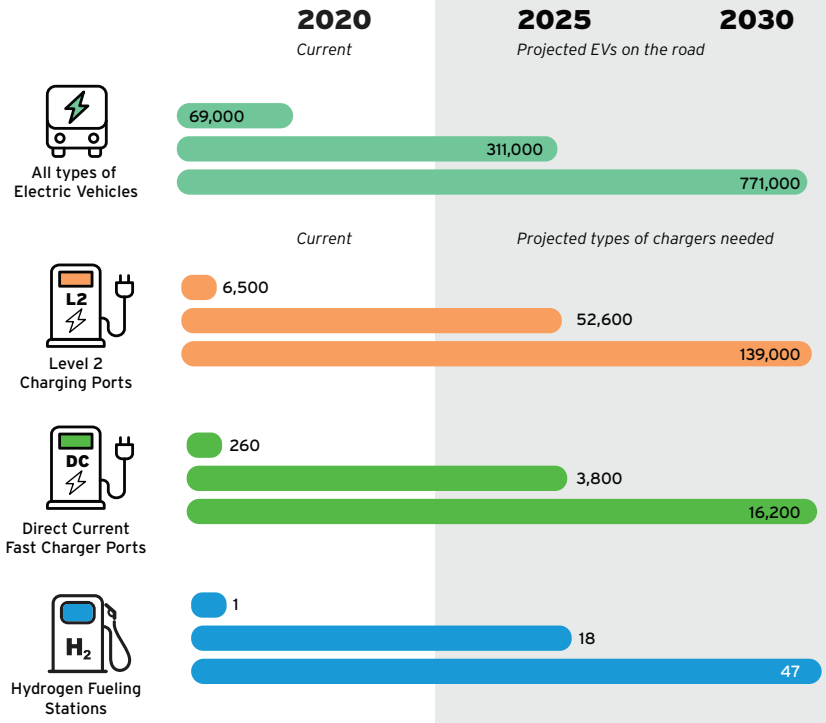
This year, SDG&E joined forces with key regional stakeholders to create the Accelerate to Zero Emissions (A2Z) collaborative dedicated to curbing air pollution and climate change through clean transportation. In July, a diverse group of local leaders announced the launch of A2Z and released the findings of a gap analysis; it identified barriers to widespread adoption of zero-emission vehicles (ZEV), particularly in underserved communities. The report also quantified for the first time how many EV chargers and hydrogen fueling stations are needed for the region to meet its share of California's clean transportation goal:

8 million ZEVs on the road by 2030.

The A2Z collaborative consists of 13 public, private and nonprofit organizations focused on:

- Attracting public and private investment and maximizing effectiveness of regional charger deployments
- Developing programs that enable locals to purchase EVs and install chargers
- Encouraging equitable access to EVs and charging infrastructure for all San Diegans
- Developing and implementing a Regional EV and Transportation Electrification Strategy

EV Infrastructure for San Diego Region



We can't combat the climate crisis alone – it's collaborative partnerships like this that will help us reach our city's climate action goals faster and deliver crucial air quality improvements for our communities. This important commitment to transforming our transportation sector will create good local jobs and protect our quality of life for the next generation and beyond.

– Todd Gloria, San Diego Mayor

ED-B-75

Vehicle-to-Grid Pilot Project

This year, we launched our five-year vehicle-to-grid (V2G) pilot project with the Cajon Valley Union School District that will test the flow of electricity from six electric school buses to the grid and vice versa. In September, crews finished construction of several 60 kW bi-directional DC fast chargers. The batteries onboard the buses will soak up energy during downtime and when clean energy is abundant on the grid (such as midday when solar energy production is at its peak) and discharge energy to the grid during peak hours in the afternoon and evening. The goal is to help ease strain on the grid, reduce energy costs for the school district and explore a new technology to support the pathway to net zero. Lessons learned from this project can pave the way for similar deployments with trucks in the future.

Electric school buses at the Cajon Valley School District are part of the vehicle-to-grid pilot project.

In March 2021, we energized the first charger installation under our Power Your Drive for Fleets program. The new charging equipment powers electric passenger vans at Outdoor Outreach, a nonprofit that works to reach youth from San Diego's most vulnerable communities and eliminates barriers to accessing outdoor spaces in southern California.

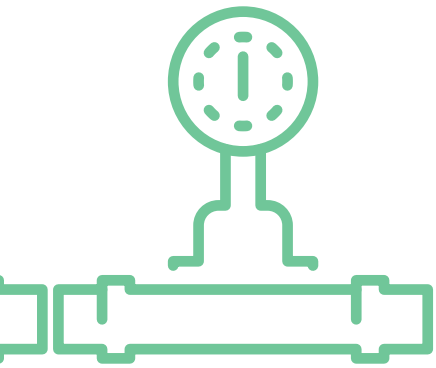
> *It's not just about the people in the vehicles benefiting from electrification, it's about the whole community benefiting from clean air as a byproduct of electrification of transportation.*
>
> ***– Jeni Reynolds, SDG&E Director of Clean Transportation***

Digital & Cloud Innovations

Under our Digital Energy initiative, we are leveraging the latest high-tech advancements, including artificial intelligence, machine learning, virtual reality and big data analytics to improve safety, reliability and efficiency. Project teams throughout our company are undertaking projects that we could have never imagined before. For example, we are building a private, 5G-ready LTE communications network to enable widespread rollout of our patented Falling Conductor Protection System. This system can help prevent wildfires by cutting off power to a broken power line at an average of 1.37 seconds, before it even hits the ground. Sixteen different use cases are being evaluated for the LTE network, including electric vehicle charging stations, Fault Location Isolation and Service Restoration (FLISR), wireless fault indicators and other grid-sensing technology.

Line 1600 Fiber Optic Sensing

As part of our project to upgrade a major gas transmission line called Line 1600, crews are installing approximately 43 miles of new modern pipe and adding a fiber optic sensing cable in the pipeline trench. This new sensing capability will help us address one of the biggest threats to pipelines: dig-ins by third-party excavators. The sensing technology enables us to monitor and locate vibrations near the pipe to protect against dig-ins, temperature changes that could indicate a leak and ground movement that could impact the integrity of the pipeline. Enhanced analytics from fiber optics will help us respond more quickly to issues and prevent natural gas from escaping into the atmosphere to protect public safety, enhance system reliability and reduce methane emissions.



Do the Right Thing

We hold ourselves to high standards – not just in serving our customers, but also in how we impact the economy, environment and society. We think it's particularly important that we lead by example and minimize the environmental footprint of our facilities. While proud of our progress to date, we know we must do more. That's why we have set more aggressive targets for resource conservation and zero-emission fleet vehicles.

Employees from across SDG&E and their families volunteer regularly for environmental causes in our communities.

Sustainable Operations

Our focus on environmental stewardship extends to the office buildings and other facilities where we work. Over the past decade, we have made significant progress to reduce, reuse and recycle. Recently, we updated our facilities goals to raise the bar even higher, as we look to achieve zero net energy for all facilities we own by 2030. Meanwhile, we've purchased renewable energy credits as an interim measure to help offset the emissions at our facilities. Our supply management team is also stepping up efforts to source more sustainable goods and services.

NEW Facilities Goals

By 2030:

- Divert 100% of facilities-related waste from landfills by reducing, reusing, recycling and recovering waste materials
- Reduce facilities freshwater use by 50% (2010 baseline) by investing in low-flow/waterless fixtures, rainfall and water recovery systems and drought-tolerant landscaping
- Achieve zero net energy for all owned facilities (current usage ~5.5 MW) by exploring new building decarbonization solutions, energy efficiency, renewable energy credits and on-site generation
- Enable green miles via on-site charging with ~2,000 EV charge points
- Earn U.S. Green Building Council Leadership in Energy and Environmental Design (USGBC LEED®) (Silver+) certifications for all new construction

2020 Facilities Metrics

3,102	tons of waste generated
46%	waste diversion rate
307 kW	solar at facilities
324	EV chargers at SDG&E facilities
14	USGBC LEED® certifications

Century Park East Remodel. Photo courtesy of photographer Jeff Durkin and RNT Architects.

Phasing Out Potent Greenhouse Gas

SDG&E is proactively working to remove SF6 – a very potent GHG – from 900 distribution switches and deploy only non-SF6 equipment by 2040. In 2021, SDG&E energized the first non-SF6, 69 kV dry air circuit breaker at our Glencliff Substation.

> *I'm proud to tell my daughter that mommy not only goes to work to keep the lights on, but also helps make the planet healthy for her generation.*
>
> ***- Kimberley Ng, SDG&E Electric Distribution Engineer dedicated to phasing out SF6***

ACCELERATED

Fleet Decarbonization

SDG&E is committed to reimagining transportation – the single largest source of GHG emissions in our state and in our region. This commitment includes transforming our own fleet of vehicles that travel all around the region and to neighborhoods every day. In fact, we are accelerating our goal by five years from 2040 to 2035, to operate a 100% ZEV fleet. By the end of 2021, 18% of our fleet is expected to be electrified.

SDG&E uses a fleet of cleaner and quieter hybrid bucket trucks to repair overhead power lines. Unlike conventional bucket trucks, these do not produce loud noises or fumes. Auxiliary functions, such as the bucket and crane, run on battery power.

Our work to decarbonize our fleet goes beyond purchasing ZEVs and also includes:

- Investing in tools that capture metrics to help us improve safety, sustainability and operational efficiency
- Monitoring idling activity and installing idle mitigation systems in more than 20 vehicles this year
- Continually evaluating new electric vehicles coming to market and working with manufacturers to support customizations for our fleet

Environmental Stewardship

Our commitment to environmental stewardship is broad, ranging from habitat conservation and tree planting, to employee volunteerism and tackling business challenges with nature-based solutions. Over the past 25 years, we have operated under a habitat conservation plan that we voluntarily developed with state and federal wildlife agencies. Our plan was designed to avoid or minimize any impacts from our activities and help preserve our region's ecosystems. This year we are expanding our work to include innovative ways to protect biodiversity, increase carbon sequestration potential and avoid GHG emissions across our region from the desert to the coast and everywhere in between.

Our goals for biodiversity and environmental stewardship vary by project and include:

- No net loss of wetlands or waters, including along the coast or sensitive upland vegetation communities, habitats and rare plants
- Net improvement in ecological conditions for any sensitive habitats that may have been temporarily impacted by operations
- Enhancement of existing habitats and the establishment of permanently protected preserves for important local animal species
- Net benefit to species listed as threatened or endangered by state or federal authorities, including the California Least Tern, an endangered migratory seabird that nests along our sandy coasts

"My children's love of nature strengthens my resolve to advance sustainability.

– Sandeep Aujla, SDG&E Senior Manager of Sustainability

Nature-Based Solution: Wildfire Mitigation With Goats

Approximately 220 goats are biting into potential wildfire ignition sources and carbon emissions. Our goat grazing pilot program utilizes goats to clear brush and other vegetation-ignition sources around electric infrastructure. The program is designed to help keep communities safe from potential utility-related wildfires.

Environmental benefits of goat grazing include maintaining open corridors, preventing the spread of invasive weeds and promoting the growth of native vegetation species. These goats can be utilized year-round for weed abatement without the risk of igniting fuels in high-fire risk areas.

Nature-Based Solution: SDG&E Supports Biodiversity with Trees

In our first sustainability report, we committed to planting at least 10,000 trees annually to support local biodiversity, improve air quality, sequester carbon and conserve water – all benefits to the local communities, including schools and tribal lands. We are well on our way to achieving our goal this year, having planted more than 9,500 trees to date through creative programs that engage our customers and community organizations. As part of this initiative, we are also educating the public about planting the right tree in the right place to avoid conflicts with overhead power lines.

In partnership with Healthy Day Partners and the Pala Tribe, 35 trees were planted on the Pala Reservation.

Clover Flats Seedbank Helping To Protect Biodiversity

Native plants are important to the success of habitat restoration efforts. However, it can be difficult to source local, native plant seeds in our region. To address this challenge, SDG&E helped develop a seedbank by leasing a portion of the Back Country Land Trust's Clover Flat property in southeastern San Diego County to grow native plants for seeding, harvesting, sorting and storage.

Our Ongoing COVID Response

As the COVID-19 pandemic extends into another year, SDG&E has taken a multi-pronged strategy to help local residents, the regional economy and our customers recover. This includes working jointly with community organizations and public agencies to enroll customers in utility and rent payment assistance programs; partnering with the San Diego Regional Economic Development Corporation to rally large employers to redirect their spending to local small businesses as a means to spur an inclusive economic recovery; and collaborating with the San Diego Workforce Partnership to create a new job training program.

COLLABORATION TO PROMOTE COVID ASSISTANCE PROGRAMS

$10M

In Emergency Rent & Utilities Assistance secured to help pay off local residents' outstanding energy bills

- San Diego Housing Commission
- San Diego & Imperial Counties Labor Council
- Other community-based organizations
- SDG&E

Our response to COVID-19 focuses on helping to keep our employees and their families, as well as our customers, healthy and safe. We have continually adapted to ever-changing conditions amid extraordinary challenges and implemented new programs to help our communities as we work together to recover from the pandemic.

Learn more about our COVID relief programs for residential and commercial customers respectively at ***sdge.com/covid*** and ***sdge.com/recovery***.

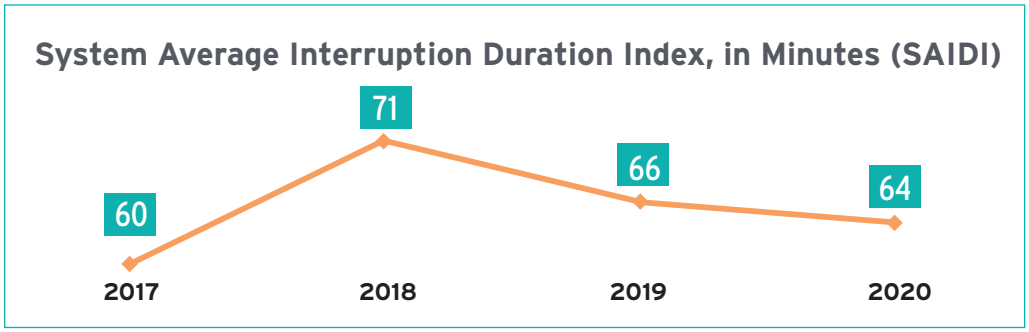
In 2020, our employees assembled more than 500 "We Care" boxes for delivery to local businesses. The kits contained items to help small businesses re-open safely. SDG&E also helped more than 2,000 small business customers with disconnection moratoriums, payment plan changes, energy audits and other programs to provide financial relief during the economic recovery.

Safety & Reliability

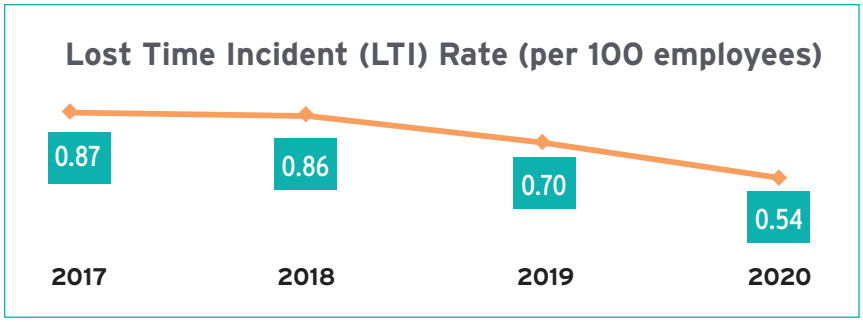
Safety and reliability are foundational to utility operations; our commitment to both is reflected in our drive to modernize our infrastructure and serve our customers in the face of a rapidly changing energy landscape and climate conditions.

Driving Resilient Operations

Our employees work 24/7/365 to provide reliable service for the 3.6 million people who count on us every day to power their lives. In 2020, for the 15th consecutive year, PA Consulting honored SDG&E with a ReliabilityOne® Award for Outstanding Reliability Performance in the West. PA Consulting also recognized SDG&E with awards for Outstanding System Resilience and Outstanding Technology and Innovation.



Due to our continuous efforts to improve safety, our injury rates and lost time incident rates (as defined by OSHA, the Occupational Safety and Health Administration) have declined year after year since 2017.



I am a big believer in creating a culture of psychological safety, where everyone, regardless of their title, feels comfortable raising questions and speaking up about concerns or mistakes.

– Kevin Geraghty
SDG&E Sr. VP of Electric Operations and Chief Safety Officer

Champion People

At SDG&E, our sustainability strategy is centered on people – our employees, our customers, our suppliers and our stakeholders. We are dedicated to delivering clean, safe, reliable energy to not just power our region, but improve it. By investing in our diverse communities and highly skilled workforce, we believe we can achieve our shared goals and together build a more inclusive and sustainable future.

SDG&E employees participated in a company-sponsored event focused on diversity, equity and inclusion.

Giving Back to Our Communities

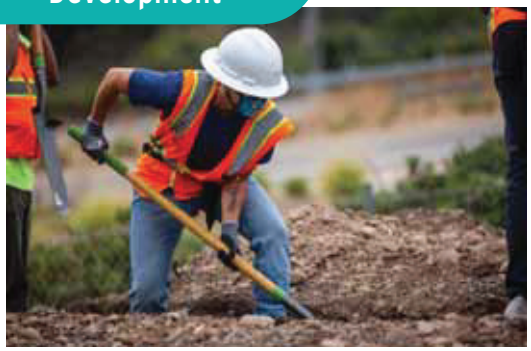
Recognizing that many nonprofit organizations were struggling to keep their doors open and serve the growing needs of their clients, we nearly doubled our shareholder-funded charitable giving in 2020, and accelerated the distribution of funds. More than half of our charitable contributions went to organizations that focus on K-12 education, health and human services, the environment and safety and emergency preparedness.

Our top areas of focus in our charitable giving include:

22%
Environment

Environment: Provides grants to local nonprofits focused on climate literacy, habitat restoration, tree planting, community gardens, trail building and other efforts

14%
Economic and Workforce Development



Economic and Workforce Development: Partners with local organizations to offer and expand job training and career development opportunities, and to promote an equitable economic recovery

20%
Safety and Emergency Preparedness

Safety and Emergency Preparedness: Supports emergency responders and organizations that educate and prepare communities for emergencies, especially underserved communities

15%
Education

Education: Supports K-12 STEM education, mentorship and leadership development programs, with a focus on helping the region's most vulnerable youth reach their full potential

11%
COVID-19 Community Support

COVID-19 Community Support: Supports multiple initiatives through the San Diego Foundation to help those impacted by the pandemic and struggling to meet basic needs

San Diego Black Nurses Association

SDG&E worked with the San Diego Black Nurses Association to fund community-driven vaccination events for communities of color. The San Diego chapter of the Black Nurses Association works to decrease healthcare disparities through advocacy, education and health promotion.

Black Community Investment Fund

In September 2020, SDG&E joined The San Diego Foundation and others to launch the Black Community Investment Fund. Through grants disbursed to local organizations, the fund invests in community-led, innovative efforts that increase racial equity and generational wealth for Black San Diegans. Grantmaking is focused on four key pillars impacting economic prosperity among Black San Diegans – education, employment, housing and entrepreneurism.

Education *Employment* *Housing* *Entrepreneurism*

Creating Opportunities Through Diversity, Equity and Inclusion

At the heart of our value "champion people" is our commitment to invest in people and create an inclusive environment both inside and outside SDG&E. Although diversity and inclusion have always been important pillars in our company, the death of George Floyd, the racial justice protests that followed and the pandemic have led to an even greater sense of urgency to act on addressing the vast inequalities and inequities within our society. We have taken several steps designed to improve equity in our workplace and in the diverse communities we serve, starting with listening and learning.

7	8	8	3,000
Diversity & Inclusion Educational Webinars	SDG&E Diversity & Inclusion Councils	Racial Justice Forums	Employees Engaged in Community Conversations

*Metrics are for Q1 and Q2 of 2021

> *Having a workforce that reflects the diversity of the communities that we serve and an inclusive environment where everyone has a sense of belonging, supports innovation and better problem solving. We believe a high-performance culture is predicated on us having a diverse workforce that approaches problem solving from multiple perspectives.*
>
> ***– Maggie Carter, SDG&E Director of Diversity & Inclusion***

Say Their Names Memorial Exhibit

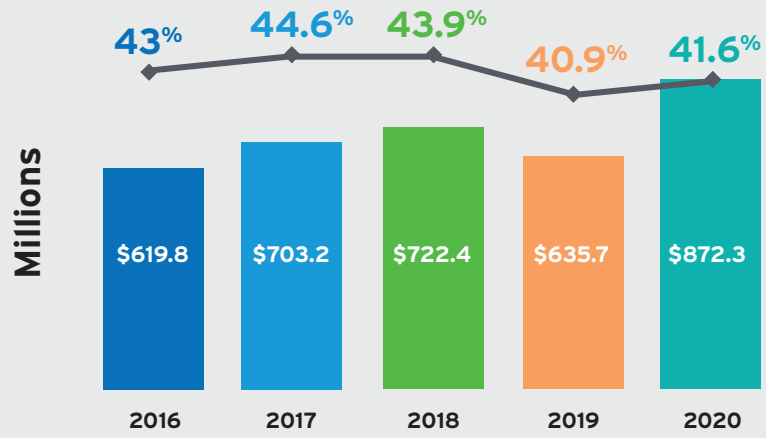
SDG&E was among the organizations that helped sponsor the "Say Their Names" memorial exhibit, which featured 200 photographs of Black victims who lost their lives to racial injustice. Members of SDG&E's Black Employee Business Resource Group, formed in February 2021, volunteered as docents for the exhibit.

Supplier Diversity

SDG&E has a long history of partnering with Diverse Business Enterprises (DBEs) that supply the goods and services we need to serve our customers. By working to build a more diverse supply chain, we continue to advance an inclusive culture and drive better business outcomes. During a time when the economy was devastated by the pandemic, SDG&E helped sustain many small and diverse suppliers by buying $872 million, nearly 42% of our total spend, in goods and services from DBEs in 2020. Last year marked the eighth consecutive year that SDG&E's supplier diversity spending surpassed 40%, about double the goal set by the California Public Utilities Commission (CPUC).

SDG&E DBE Cordoba Corporation employees at a company event.

Overall Supplier Diversity Spend



2020 Category Highlights

$455.4M – MINORITY BUSINESS ENTERPRISE (MBE)

$285.9M – WOMEN BUSINESS ENTERPRISE (WBE)

$120.5M – SERVICE-DISABLED VETERAN BUSINESS ENTERPRISE (DVBE)

$41.1M – MINORITY WOMEN BUSINESS ENTERPRISE (MWBE)

$10.4M – LESBIAN, GAY, BISEXUAL, TRANSGENDER BUSINESS ENTERPRISE (LGBTBE)

"SDG&E has an exemplary supplier diversity program that goes above and beyond to help small businesses succeed. Their procurement team provides the technical support we need to grow our business and compete for contracts. Seven years ago, we started as a subconsultant on an SDG&E project. Today, we are a prime contractor for several projects, employ 80 people in the San Diego area alone and occupy a 38,000-square-foot office building in Kearny Mesa.

– George L. Pla, Founder and CEO, Cordoba Corporation

Diversity, Equity and Inclusion

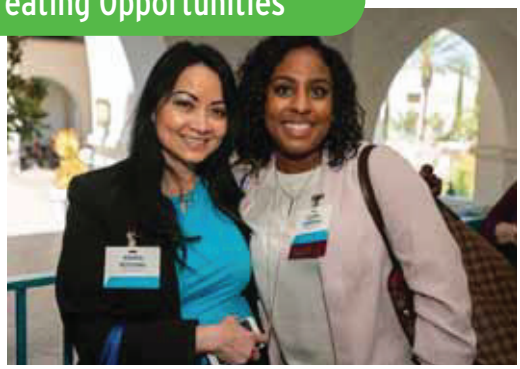
Although more than half of our workforce are people of color and more than a third are women, we recognize the work of building and maintaining a culture of inclusion, trust and respect is never done. After holding a series of community conversations with employees to create safe spaces to discuss race and racism, our company developed an action plan to increase racial equity.

Below are examples of our actions to advance diversity, equity and inclusion in our workplace. These five pillars are aligned with Sempra's enterprise-wide diversity, equity and inclusion framework.

Leading From the Top

Established Executive Diversity, Equity and Inclusion (DEI) Council and included D&I goals in executive compensation

Creating Opportunities

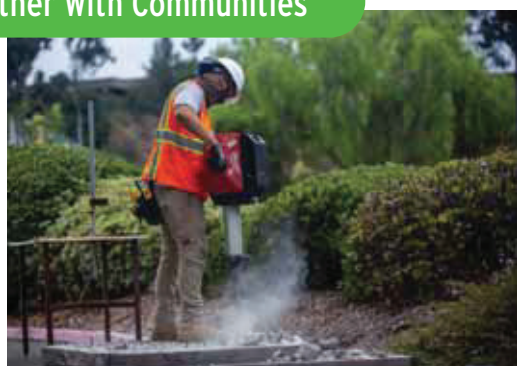


All officers will mentor at least one woman and/or person of color; interview panels will include people of color and/or women

Accelerating Engagement

Created Black Employee Business Resource Group with a focus on the recruitment, retention and advancement of Black employees

Partner With Communities



Sponsored San Diego Workforce Partnership's Construction Career Jumpstart Program

Drive Conscious Inclusion

Expand outreach to new organizations with a focus on people of color and women

Stakeholder Engagement

We engage with a wide cross section of more than 3,500 local stakeholders to listen, learn and find ways to improve. Having an active and engaged feedback loop is a key step in our "living" sustainability strategy as it helps us plan, prepare, act and evaluate our initiatives and continually improve our programs with the goal of creating impactful change for our region.

- Our employees, including our SDG&E Green Team
- Local, regional, state and federal policymakers and regulators
- Academics, researchers and scientists
- Tribal nations and organizations
- Community-based organizations
- Local businesses and business associations
- Customers and residents
- Local cities and counties
- Manufacturers
- Industry groups
- Labor groups
- Public agencies
- SDG&E Community Advisory Councils
- Individuals with access and functional needs

Closing Thoughts

Our business plan is to take climate action. There is no difference between the two. We are aligning our investments with the climate objectives of local cities, the region and state. We will continue to evolve our efforts to reflect stakeholder feedback, regulatory changes and technological breakthroughs. We believe we will get there … one project at a time.

SDG&E's commitment to sustainability is built into everything we do and we are holding ourselves accountable by providing regular updates on our work.

Follow our progress at ***sdge.com/sustainability*** *and* ***sdgenews.com****.*

Forward-Looking Statements

This document contains statements that constitute forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995. Forward-looking statements are based on assumptions with respect to the future, involve risks and uncertainties, and are not guarantees. Future results may differ materially from those expressed in any forward-looking statements. These forward-looking statements represent our estimates and assumptions only as of the date of this document. We assume no obligation to update or revise any forward-looking statement as a result of new information, future events or other factors.

In this document, forward-looking statements can be identified by words such as "believes," "expects," "anticipates," "plans," "estimates," "projects," "forecasts," "should," "could," "would," "will," "confident," "may," "can," "potential," "possible," "proposed," "in process," "under construction," "in development," "target," "outlook," "maintain," "continue," "goal," "aim," "commit," or similar expressions, or when we discuss our guidance, priorities, strategy, goals, vision, mission, opportunities, projections, intentions or expectations.

Factors, among others, that could cause actual results and events to differ materially from those described in any forward-looking statements include risks and uncertainties relating to: California wildfires, including the risks that we may be found liable for damages regardless of fault and that we may not be able to recover costs from insurance, the wildfire fund established by California Assembly Bill 1054 or in rates from customers; decisions, investigations, regulations, issuances or revocations of permits and other authorizations, renewals of franchises, and other actions by (i) the California Public Utilities Commission (CPUC), U.S. Department of Energy, U.S. Federal Energy Regulatory Commission, and other regulatory and governmental bodies and (ii) states, counties, cities and other jurisdictions in the U.S. in which we do business; the success of business development efforts and construction projects, including risks in (i) completing construction projects or other transactions on schedule and budget, (ii) the ability to realize anticipated benefits from any of these efforts if completed, and (iii) obtaining the consent of partners or other third parties; the resolution of civil and criminal litigation, regulatory inquiries, investigations and proceedings, and arbitrations; actions by credit rating agencies to downgrade our credit ratings or to place those ratings on negative outlook and our ability to borrow on favorable terms and meet our substantial debt service obligations; actions to reduce or eliminate reliance on natural gas, including any deterioration of or increased uncertainty in the political or regulatory environment for local natural gas distribution companies operating in California; weather, natural disasters, pandemics, accidents, equipment failures, explosions, acts of terrorism, information system outages or other events that disrupt our operations, damage our facilities and systems, cause the release of harmful materials, cause fires or subject us to liability for property damage or personal injuries, fines and penalties, some of which may not be covered by insurance, may be disputed by insurers or may otherwise not be recoverable through regulatory mechanisms or may impact our ability to obtain satisfactory levels of affordable insurance; the availability of electric power and natural gas and natural gas storage capacity, including disruptions caused by failures in the transmission grid or limitations on the withdrawal of natural gas from storage facilities; the impact of the COVID-19 pandemic on capital projects, regulatory approvals and the execution of our operations; cybersecurity threats to the energy grid, storage and pipeline infrastructure, information and systems used to operate our businesses, and confidentiality of our proprietary information and personal information of our customers and employees, including ransomware attacks on our systems and the systems of third-party vendors and other parties with which we conduct business; the impact on competitive customer rates and reliability due to the growth in distributed and local power generation, including from departing retail load resulting from customers transferring to Direct Access and Community Choice Aggregation, and the risk of nonrecovery for stranded assets and contractual obligations; volatility in inflation and interest rates and commodity prices and our ability to effectively hedge these risks; changes in tax and trade policies, laws and regulations, including tariffs and revisions to international trade agreements that may increase our costs, reduce our competitiveness, or impair our ability to resolve trade disputes; and other uncertainties, some of which may be difficult to predict and are beyond our control.

These risks and uncertainties are further discussed in the reports that the company has filed with the U.S. Securities and Exchange Commission (SEC). These reports are available through the EDGAR system free-of-charge on the SEC's website, ***www.sec.gov***, and on Sempra's website, ***www.sempra.com***. Investors should not rely unduly on any forward-looking statements.

This document may include market, demographic and industry data and forecasts that are based on or derived from third-party sources such as independent industry publications, publicly available information, government data and other similar information from third parties. We do not guarantee the accuracy or completeness of any of this information, and we have not independently verified any of the information provided by these third-party sources. In addition, market, demographic and industry data and forecasts involve estimates, assumptions and other uncertainties and are subject to change based on various factors, including those discussed above. Accordingly, you should not place undue reliance on any of this information. This document also contains links to third-party websites that are not hosted or managed by Sempra or its family of companies, including SDG&E. We are not responsible for, nor do we recommend, endorse or support, any information contained on any such third-party websites.

Sempra Infrastructure, Sempra LNG, Sempra Mexico, Sempra Texas Utilities, Oncor Electric Delivery Company LLC (Oncor) and Infraestructura Energética Nova, S.A.B. de C.V. (IEnova) are not the same companies as the California utilities, San Diego Gas & Electric Company or Southern California Gas Company, and Sempra Infrastructure, Sempra LNG, Sempra Mexico, Sempra Texas Utilities, Oncor and IEnova are not regulated by the CPUC.

Always Forward

SUSTAINABILITY UPDATE 2022

LETTER FROM OUR LEADERS

Caroline Winn

Estela de Llanos

Where there is a collective will, there is a way.

That's what Californians demonstrated during the recent historic heatwave that threatened to overwhelm the state's electric grid over ten consecutive days. Statewide rotating outages were avoided because everyone — residents, businesses, local government, the military, school districts and countless entities — took action to conserve electricity by turning up the thermostat a few degrees or delaying the use of major appliances.

That same kind of "we are all in this together" spirit is critical for the future of our region and state as climate change exacerbates extreme weather conditions.

Here in our region, we see the collective will to address climate change in action, as evidenced by multisector stakeholder collaborations in the following examples:

- Local school districts are transitioning to electric buses with the support of SDG&E's EV infrastructure programs. One of the districts, Cajon Valley Union — contributed to grid stability during the heatwave by discharging electricity back to the grid during peak hours from the batteries onboard its electric school buses.
- SDG&E, the City of San Diego and the nonprofit Center for Sustainable Energy came together to launch the San Diego Solar Equity Program to expand rooftop solar installations in low-income communities.
- SDG&E worked with CAL FIRE and the U.S. Forest Service to build a microgrid to provide backup power to the Ramona Air Attack Base — a key hub for regional aerial firefighting assets.
- In collaboration with UC San Diego, SDG&E recently submitted a proposal to the California Public Utilities Commission (CPUC) to study how blending hydrogen with natural gas in the existing system could help achieve a successful energy transition for all Californians.

There is no question our climate is changing, but we are also beginning to get more clarity on what we need to do to transition to a net zero future. SDG&E's economy-wide study, *The Path to Net Zero: A Decarbonization Roadmap for California*, lays out a path forward to meet California's goal to become carbon neutral by 2045, while also safeguarding electric grid reliability. Conducted with technical support from third-party experts, including UC San Diego Professor David Victor, the study concluded that a diversified decarbonization approach is necessary — clean electricity and clean fuels (such as clean hydrogen) along with carbon management.

Every day, our 4,600 employees work toward making that roadmap a reality, as you will see in the following pages about projects and programs that are underway or completed.

While we don't have all the answers, we are heartened by the fact that organizations and individuals across the public, private, nonprofit and academic sectors are coalescing around climate actions.

Where there is a collective will, there is a way. Together we will get there.

Caroline Winn
SDG&E Chief Executive Officer

Estela de Llanos
SDG&E Vice President,
Energy Procurement and Sustainability

PROGRESS HIGHLIGHTS

In 2020, SDG&E launched our living sustainability strategy, which contained a series of aspirational goals aligned with California's ambitious climate agenda. The table below reflects our progress through September 2022 as we operationalize sustainability at our organization. For the most recent goal language, please see pages 9 - 10 in SDG&E's 2021 Progress Update.

SAFER	
ACHIEVING WORLD CLASS SAFETY	700+ firefighters from 60 different agencies attended the County Wildland and Wildfire Drill to sharpen their skills in lifesaving emergency situations
	SDG&E worked with a leading U.S. balloon manufacturer to develop and test a balloon made of non-conductive, shiny material, and through collaboration with CA Assembly member Bill Quirk, helped pass legislation to phase out production and sale of balloons that can cause power outages and fires
WILDFIRE MITIGATION & CLIMATE RESILIENCE	In the High-Fire Threat District (HFTD), 900 transmission miles and 600 distribution miles (total of 1,500 miles) hardened since inception of the Wildfire Mitigation Plan
	~3,500 renewable portable backup batteries provided to customers with medical energy needs
	Seven microgrids in use or under construction to allow more communities and critical facilities to remain energized during a Public Safety Power Shutoff (PSPS) or emergency events
GRID MODERNIZATION & FLEXIBILITY	Launched Virtual Power Plant (VPP) pilot in Shelter Valley to help strengthen community resilience

2022 SUSTAINABILITY AWARDS

Arbor Day Foundation
Tree Line USA Utility – SDG&E

CIO 100
SDG&E's Community Impact Platform

E-Source Utility Ad Awards
EV Awareness Campaigns – SDG&E's Power Your Drive for Parks, Schools and Beaches LOVELECTRIC Campaign

Fast Company World Changing Ideas 2022
Honorable Mention for AI + Data and Climate categories – SDG&E's Community Impact Platform

Fire Safe Council of San Diego County
Partner of the Year – SDG&E

PA Consulting Reliability ONE Awards
Outstanding Grid Sustainability (2021) – SDG&E

San Diego Section of the American Planning Association
2022 Environmental Planning Excellence Awards – Accelerate to Zero (A2Z) coalition

San Diego Association of Governments (SANDAG)
iCommute Diamond Awards Bronze Tier – SDG&E

STRONGER	
"OUTSIDE IN" COMMUNITY OUTREACH	On track to invest more than $6 million in our communities, supporting over 500 nonprofit organizations in the San Diego and South Orange County regions in 2022. More than 80% went to diverse and underserved communities
	Three community advisory councils (CAC) – San Diego CAC, Wildfire Safety CAC and Boulder City CAC – held seven CAC meetings with 45 members of the public
	More than 400 customers, employees, partners, community leaders and critics engaged with SDG&E to learn more about our *Path to Net Zero* decarbonization roadmap
CREATING OPPORTUNITIES THROUGH DIVERSITY, EQUITY & INCLUSION	100% of SDG&E officers are mentoring at least one woman or person of color
	Rolled out Frontline Supervisor Academy that includes leadership on D&I training, psychological safety and hybrid workforce
	Launched Culture & Connections to build cross-cultural awareness
	Established two new employee-led resource groups (ERGs) – VOZ (Latino ERG) and VALOR (Veteran ERG)
	Sponsored several training programs to help build a diverse workforce
SUSTAINABLE SUPPLY CHAIN	$2.4 billion in total procurements, $936 million or 39% went to diverse suppliers (2021), up from $872 million (2020)
BREAKTHROUGH SOLUTIONS	At Borrego Springs Microgrid, SDG&E will test hydrogen for long-duration (eight hours or more) energy storage, which can be made available for dispatch by the microgrid or the California Independent System Operator (CAISO) to support grid reliability
	At Palomar Energy Center in Escondido, an electrolyzer and solar panels will be installed to produce hydrogen onsite and blend it with natural gas for electric generation. This hydrogen will also be used to fuel the first hydrogen vehicles in SDG&E's fleet and as a cooling gas at the facility
	SDG&E is actively working on executing the Palomar and Borrego hydrogen pilots, but a complex supply chain environment is causing delays to the original schedule. Completion of both projects is currently forecasted for 2023

SAFER, STRONGER, HEALTHIER TOGETHER.

HEALTHIER	
ENVIRONMENTAL STEWARDSHIP	On track to provide 10,000 trees to our community with 9,125 trees planted to date in 2022
	54% green waste diverted from landfills
	SDG&E was the first utility to develop a Habitat Conservation Plan under the Endangered Species Act in 1995 and submitted an update designed to increase biodiversity protections, environmental stewardship and conservation in 2022
SUSTAINABLE OPERATIONS	On track to electrify 20% of our fleet by year end. 21.7% of light-duty fleet electrified and 4.1% overall fleet zero-emissions vehicles out of 1,744[1]
	46% waste diversion rate at SDG&E facilities
	Total 2022 year-to-date water use ~510M gallons, 91% recycled water at SDG&E generation sites and facilities
	Responsibly recycled 1,252 solar panels and 3.5 MWh of lithium batteries when they reached the end of their useful life
	On track to achieve zero net energy at SDG&E facilities and are investing in RECs to offset 100% emissions[2]
	655 kW solar at facilities (12% of current electricity usage of ~5.5 MW)
	318 EV chargers installed at SDG&E facilities[3]
	14 U.S. Green Building Council (USGBC) LEED® certifications at SDG&E facilities
	31 out of 900 SF6 (a very potent greenhouse gas) units removed on the distribution system
REIMAGINING TRANSPORTATION	3,404 EV charging ports at 291 sites in our service territory
	In collaboration with Nuvve and the Cajon Valley Union School District, deployed bidirectional vehicle-to-grid (V2G) technology connecting eight electric school buses to six 60 kW bidirectional DC fast chargers
	Strategic collaborations advancing clean transportation in the region include Dole, MTS and U.S. Department of Energy Vehicle-to-Everything (V2X)
ENABLE THE ENERGY TRANSITION	2021 marks the fifth consecutive year SDG&E has achieved zero leak repair backlog, supporting efforts to reduce methane emissions
	Aerial methane mapping using helicopter-mounted LiDAR technology and drones for leak detection and repair
	Released economy-wide *Path to Net Zero* decarbonization roadmap with one of the first utility industry standard reliability analyses
	SDG&E's Renewable Portfolio Standard (RPS) is 55%[4]
	SDG&E has 20% rooftop solar penetration in our service territory, among the highest in the U.S. More than 259,000 rooftop solar systems, with a capacity of 1,794 MW, are interconnected to the grid (cumulative as of Sept. 2022)
	Completed Kearny Energy Storage – a 20 MW utility-owned facility
	Collaborated with two active Community Choice Aggregators (CCAs) in SDG&E's service territory – Clean Energy Alliance and San Diego Community Power – to transition customers to their electric generation service

1 Zero-Emissions Vehicle (ZEV) includes full battery electric vehicles (BEV), plug-in hybrid vehicles (PHEV) and hydrogen fuel cell vehicles. Fleet goals contingent on vehicle availability and CPUC funding.

2 CPUC definition of Zero Net Energy

3 SDG&E is updating EV chargers with smart meters at our facilities to closely track energy usage and improve billing reliability.

4 SDG&E annual RPS compliance likely to vary year-over-year due to portfolio rebalancing related to portfolio allocations to customer load departure to local CCAs. 55% represents 2021 data.

SAFER

Safety is always our top priority at SDG&E and we work hard to help keep our community safe. This includes working to make our region more resilient to climate change and the increased risk of wildfires, as well as strengthening our energy systems to reliably deliver clean energy when and where it's needed.

CLIMATE ADAPTATION AT SDG&E

When we think about sustainability for our region, climate adaptation is foundational. Because extreme weather and climate conditions are expected to be more frequent and severe in the future, we are working today to prepare for whatever may come tomorrow. SDG&E is aligning our investments to advance sustainability for our region and our customers. In fact, 100% of the net proceeds from our inaugural issuance of $750M in Green Bonds in August 2021 were allocated to eligible projects addressing the growing needs for climate adaptation, community resilience and clean energy solutions, including wildfire mitigation efforts and developing microgrids.

"As solar panels and battery energy storage systems are retired, we are working hard to responsibly recycle these materials – to recover chemicals and precious metals for as much reuse as possible. Earlier this year, we decommissioned one of our first energy storage facilities, and in the process we collaborated with a vendor to create a streamlined, closed loop recycling process that helped recover up to 95% of useful materials for future use."

Donald Balfour, SDG&E Advanced Clean Technology Program Manager

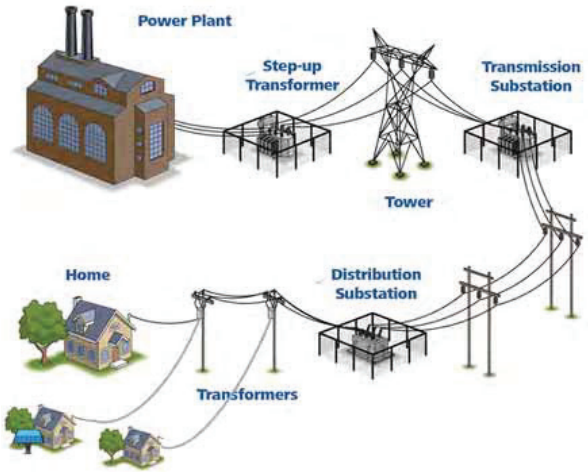
SDG&E LEADERSHIP IN WILDFIRE MITIGATION

SDG&E's culture of wildfire safety and focus on continuous improvement is demonstrated by the following differentiating elements of our wildfire mitigation strategy.

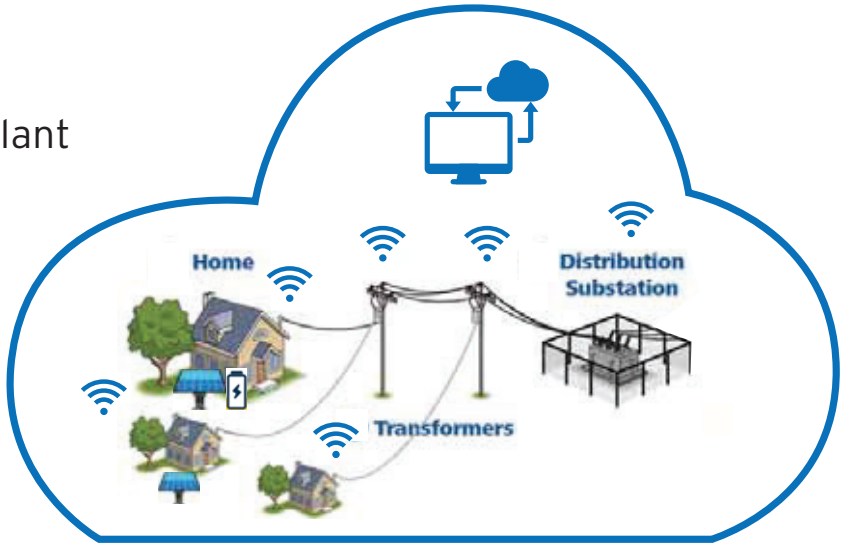
- **Grid & Infrastructure Enhancements**
- **Academic Partnerships**
- **Vegetation Management**
- **Situational Awareness**
- **Advanced Protection Systems**
- **PSPS Execution, Resilience & Customer Support**

VIRTUAL POWER PLANTS TO BOOST RELIABILITY

Traditional Power Plant



Virtual Power Plant



In 2022, SDG&E launched a Virtual Power Plant (VPP) pilot to help strengthen community resilience and electric reliability in the unincorporated community of Shelter Valley in East San Diego County. A VPP is a collection of energy resources that are interconnected and operated together via the cloud. During periods of increased energy demand, these distributed energy resources can be accessed by a utility provider to put electricity on the grid.

BUILDING STRONGER COMMUNITIES TOGETHER.

MICROGRIDS TO SUPPORT FIREFIGHTING & COMMUNITY SERVICES

Ramona Microgrid

In April 2022, SDG&E completed a new microgrid to provide backup power to the Ramona Air Attack Base, home to CAL FIRE and U.S. Forest Service's aerial firefighting assets dedicated to protecting rural communities. The microgrid produces zero emissions as it is powered by 500 kW / 2000 kWh of battery storage and was built in collaboration with the two agencies it supports.

"We are grateful for the strong working relationship we have with SDG&E. It gives us peace of mind to have backup power for a critical facility like the Ramona Air Attack Base, especially given the fact that fire season in California has become year-round."

Tony Mecham,
San Diego County Fire Chief,
CAL FIRE

PROTECTING BIODIVERSITY FOR FUTURE GENERATIONS

Providing Native Seeds for the Community

SDG&E's environmental stewardship extends beyond our operations, and our employees are integral to these efforts. In collaboration with San Diego Audubon Society, we unveiled a native seed library at our Kearny Mesa office campus in May 2022. This seed library enables our employees to take an active role in supporting regional biodiversity by taking seeds to grow native plants in the community – providing both food and shelter to important pollinators like the monarch butterfly, hummingbirds and other bird species.

"This project allows me to share my passion for the environment as well as help create a critical habitat that can serve as a buffer to climate change and biodiversity loss."

Mackenna Kull,
SDG&E Environmental
Sustainability Advisor

STRONGER

SDG&E is a people company first, focused on delivering energy with purpose to the communities where we also live. We help build a stronger community and economy by investing in climate-resilient energy infrastructure, expanding access to clean energy and providing quality jobs and training to help foster a more diverse and inclusive workplace.

BUILDING COMMUNITY RESILIENCE

Local Utility-Owned Energy Storage and Microgrids

We are committed to helping our communities and our regional grid be more resilient, especially in the face of increasing threats from climate change. For more than a decade, SDG&E has invested in microgrids, new energy storage facilities and fire hardening our infrastructure to help keep our communities safe and energized through an extended wildfire season and increased extreme heat waves.

SDG&E recognizes that climate action in this decade is critical. Our 2024-2027 budget proposal (known as a General Rate Case) focuses on three key elements of sustainability: climate adaptation, climate mitigation and energy grid transformation.

PILOTING HYDROGEN – A CLEAN FUEL OF THE FUTURE

WHERE INNOVATION IS A RENEWABLE RESOURCE.

In our efforts to reach net zero by 2045, SDG&E is exploring cleaner fuels like hydrogen. Clean hydrogen is expected to play a vital role in helping decarbonize California's economy, including the potential to become a key source of clean, firm and dispatchable power.

University of California San Diego – Hydrogen Blending

In September 2022, SDG&E submitted a proposal to the CPUC to conduct a hydrogen blending pilot on the campus of UC San Diego. The project plans to study the feasibility of injecting up to 20% hydrogen by volume into our existing natural gas system to help develop a renewable hydrogen blending standard for California.

MAKING ELECTRIC VEHICLES ACCESSIBLE TO ALL

To help make electric vehicles accessible to everyone, SDG&E and the Challenged Athletes Foundation hosted an adaptive electric vehicle ride and drive event in July 2022. The first for the region, the event welcomed community members with functional and access needs to learn a new sport or try an EV. Hundreds of people visited community information booths, took part in adapted sports like sitting volleyball and wheelchair basketball and test drove EVs – many for the first time.

"Never assume limitation – with a little creativity there is always an adaptation, if there's a will."

Brett Palser,
SDG&E Strategic Vendor Management Advisor
and CrossFit Podium Finisher

SDG&E AND CENTER FOR SUSTAINABLE ENERGY EXPAND SOLAR ACCESS

SDG&E, in conjunction with the City of San Diego and the nonprofit Center for Sustainable Energy, launched the San Diego Solar Equity Program in August 2022. The program funds rooftop solar installations for income-qualified homeowners in City of San Diego communities that face the highest risk from climate change — and yet historically have had lower access to renewable energy. SDG&E dedicated $10 million in shareholder, non-ratepayer funds to create the 10-year program, fulfilling a key commitment made under our franchise Energy Cooperation Agreement with the City of San Diego. The program aims to cover 100% of solar installation costs for systems up to 6.5 kW. It also aims to cover up to $3,500 for electrical panel upgrades for homes that need additional preparation for a solar installation.

WHERE GIVING BACK REWARDS EVERYONE.

EMPLOYEE ENGAGEMENT AT SDG&E

SDG&E is proud of our approach to engagement, which includes purpose-driven volunteering and a focus on creating opportunities for advancement. From our hiring process to our executive goals, we are driving sustainable change for diversity, equity and inclusion at our company and in the community.

Examples of our recent actions include:

Accelerating Engagement
Established two new employee-led resource groups – VOZ (Latino ERG) and VALOR (Veteran ERG)

Driving Conscious Inclusion
Rolled out Frontline Supervisor Academy that includes leadership on D&I training, psychological safety and hybrid workforce

Leading from the Top
Launched Culture & Connections to allow employees to increase our cultural awareness through sharing aspects of their culture and heritage

Creating Opportunities
100% of SDG&E officers are mentoring at least one woman or person of color; launched refreshed M-Power mentorship program

Partnering with Communities
Sponsored several training programs to help build a diverse workforce

"I am proud to lead SDG&E Engineering Associate and Intern Recruiting, a program that has hired more than 300 interns and associates in the last 20 years. I have been involved representing SDG&E with many of our diverse organizations. This has afforded me the opportunity to reach top talent potential recruits for our company."

Lisa Zelkind, SDG&E Senior Staffing Advisor

DEVELOPING THE WORKFORCE OF THE FUTURE

Arborist Training Program

As wildfires continue to grow in frequency and intensity, one of the best lines of defense to prevent these catastrophes is to help ensure that trees and other vegetation around electrical infrastructure are properly inspected and pruned. Programs like the Utility Line Clearance Arborist Training are designed to build a diverse, qualified and talented workforce of skilled personnel to help keep our region safe. In July 2022, candidates completed their five-week, 200-hour training program, developed in collaboration with the Utility Arborist Association, San Diego Community College District and California Conservation Corps. The idea is that once participants complete the training, they become a part of the local Union (IBEW Local 465) and are eligible for hire by SDG&E tree contractors.

Construction Career Jumpstart

The San Diego region has seen significant growth in the construction and technology sectors. Now in its third year, Construction Career Jumpstart offers students, who may not have had previous access to job training and education, the opportunity for paid training in energy, construction and utility careers. Launched by SDG&E and offered through the San Diego Workforce Partnership, the program boasts a career placement rate of 70% for participants.

Competitive Edge

SDG&E is collaborating with company contractors to expand workforce development opportunities in the construction and utility trades. Competitive Edge offers candidates a paid, six-week train-to-hire program on real-world construction projects with an SDG&E contractor. Upon successful completion of training, graduates are hired into a regular full-time position with benefits. The program was developed by SDG&E vendor Jingoli Power, a local contractor that often recruits its trainees from the communities where they develop and manage projects. The majority of the first cohort in San Diego came from Southeast San Diego and are all of African-American descent. Another cohort is planned for 2023.

HEALTHIER

At SDG&E we are committed to helping enable a just and equitable energy transition that reduces greenhouse gas emissions, improves air quality and provides energy reliability and affordability.

REIMAGINING TRANSPORTATION FOR FLEETS

Transportation is the largest contributor of greenhouse gas emissions in California and also a major source of air pollution – particularly in communities located along busy transportation corridors. SDG&E is driving our region's transition to electric and zero-emissions vehicles by helping develop a robust network of charging infrastructure to power anything from passenger vehicles and trucks of all sizes, to buses, forklifts and everything in between.

"San Diego is a transportation hub with an international port and one of the nation's busiest border crossings. Helping to electrify these large vehicles means cleaner air and better health outcomes for our community."

Lianna Rios,
SDG&E Clean Transportation
Customer Solutions Manager

COLLABORATING TO CREATE CLEANER FLEETS

DOLE

SDG&E is helping Dole Foods and the Port of San Diego electrify their terminal and cargo-handling equipment. SDG&E is supporting the transition by preparing electric infrastructure for 20 new EV chargers that will be installed to power Dole's full fleet.

San Diego Metropolitan Transit System (MTS)

SDG&E broke ground on a new overhead electric bus charging system for the San Diego Metropolitan Transit System (MTS). The new system is expected to be capable of charging 24 electric buses at a time. Buses can be parked in the depot and fully charged in a few hours.

U.S. Department of Energy Vehicle-to-Everything (V2X)

In April 2022, SDG&E signed the U.S. Department of Energy's (DOE) Memorandum of Understanding (MOU) to help advance V2X technology. The MOU brings together cutting-edge resources from DOE, National Labs, state and local governments, utilities and private entities to help integrate bidirectional charging into energy infrastructure.

VEHICLE-TO-GRID GOES LIVE IN SAN DIEGO COUNTY

In July 2022, SDG&E flipped the switch on our region's first vehicle-to-grid (V2G) project at Cajon Valley Union School District. The project connects eight electric school buses to the grid through six bidirectional chargers that enable the buses to "fuel up" to run routes as needed and serve as batteries discharging energy back to the grid when parked. With larger batteries than standard EVs and a predictable schedule of operations, electric school buses are an innovative way to help reduce strain on California's grid when electricity supplies are tight, such as during a heatwave. As a bonus, school districts can get paid for load reduction during grid emergencies, as was the case during the September 2022 heat emergency.

"This pilot project is a great example of our region being at the forefront of testing and adopting innovative technologies to reduce greenhouse gas emissions and strengthen the electric grid."

Miguel Romero,
SDG&E Vice President
of Energy Innovation

ELECTRIFYING OUR FLEET

SDG&E is on track to convert our entire fleet to zero-emissions vehicles by 2035 — and we expect to have more than 21% of our light-duty fleet electrified this year with the addition of several electric work trucks. We are prioritizing fleet vehicle replacement in communities that are hardest hit by pollution, using an award-winning digital mapping tool called the Community Impact Platform.

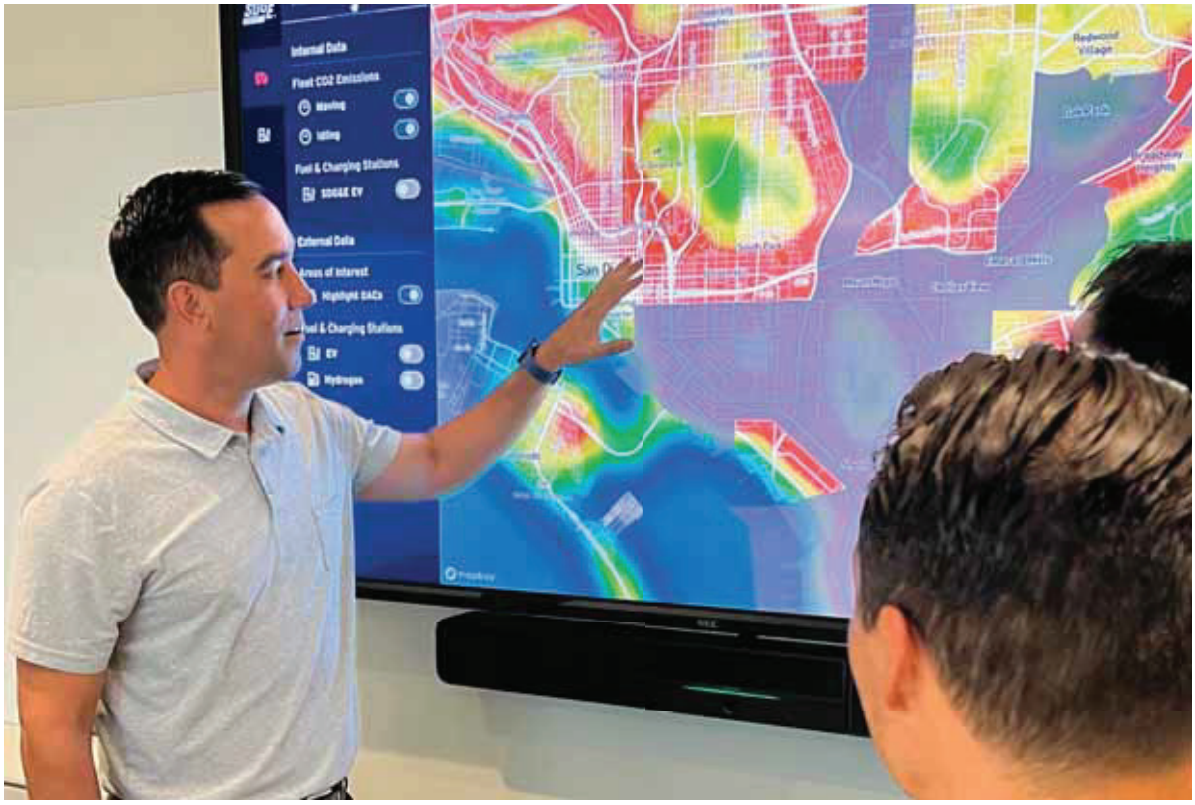
"Our fleet team takes pride in the work our crews and vehicles do in our communities every day — making repairs, strengthening our infrastructure and serving our customers. They are a visible reminder that SDG&E is helping to enable an equitable clean energy transition."

Patrick Charles, SDG&E Fleet Operations Manager

WHERE EV MEANS EVERYWHERE.

"At SDG&E, we are committed to helping improve lives and communities by delivering clean, safe and reliable energy with purpose. Innovative tools like the Community Impact Platform are a perfect example of how we engage technology to reduce emissions in our communities and build a more sustainable and equitable future for all."

Gabe Mika, SDG&E Director of Innovation and End User Experience



WHERE PEOPLE ENERGY POWERS EVERYTHING.

FORWARD LOOKING STATEMENTS

This document contains statements that constitute forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995. Forward-looking statements are based on assumptions with respect to the future, involve risks and uncertainties, and are not guarantees. Future results may differ materially from those expressed or implied in any forward-looking statement. These forward-looking statements represent our estimates and assumptions only as of the date of this document. We assume no obligation to update or revise any forward-looking statement as a result of new information, future events or other factors.

In this document, forward-looking statements can be identified by words such as "believes," "expects," "intends," "anticipates," "contemplates," "plans," "estimates," "projects," "forecasts," "should," "could," "would," "will," "confident," "may," "can," "potential," "possible," "proposed," "in process," "construct," "develop," "opportunity," "initiative," "target," "outlook," "optimistic," "maintain," "continue," "progress," "advance," "goal," "aim," "commit," or similar expressions, or when we discuss our guidance, priorities, strategy, goals, vision, mission, opportunities, projections, intentions or expectations.

Factors, among others, that could cause actual results and events to differ materially from those expressed or implied in any forward-looking statement include risks and uncertainties relating to: California wildfires, including the risks that we may be found liable for damages regardless of fault and that we may not be able to recover all or a substantial portion of costs from insurance, the wildfire fund established by California Assembly Bill 1054, in rates from customers or a combination thereof; decisions, investigations, regulations, issuances or revocations of permits or other authorizations, renewals of franchises, and other actions by (i) the California Public Utilities Commission (CPUC), U.S. Department of Energy, U.S. Federal Energy Regulatory Commission, and other governmental and regulatory bodies and (ii) the U.S. and states, counties, cities and other jurisdictions therein in which we do business; the success of business development efforts and construction projects, including risks in (i) completing construction projects or other transactions on schedule and budget, (ii) realizing anticipated benefits from any of these efforts if completed, and (iii) obtaining the consent or approval of partners or other third parties, including governmental and regulatory bodies; civil and criminal litigation, regulatory inquiries, investigations, arbitrations and other proceedings; changes to laws and regulations; cybersecurity threats, including by state and state-sponsored actors, by ransomware or other attacks on our systems or the systems of third-parties with which we conduct business, including to the energy grid or other energy infrastructure, all of which have become more pronounced due to recent geopolitical events, such as the war in Ukraine; failure of our counterparties to honor their contracts and commitments; our ability to borrow money on favorable terms or otherwise and meet our debt service obligations, including due to (i) actions by credit rating agencies to downgrade our credit ratings or place those ratings on negative outlook and (ii) rising interest rates and inflation; the impact on our cost of capital and the affordability of customer rates due to (i) volatility in inflation, interest rates and commodity prices and our ability to effectively hedge these risks, and (ii) departing retail load resulting from additional customers transferring to Community Choice Aggregation and Direct Access; the impact of energy and climate policies, laws, rules and disclosures, as well as related goals and actions of companies in our industry, including actions to reduce or eliminate reliance on natural gas, any deterioration of or increased uncertainty in the political or regulatory environment for California natural gas distribution companies and the risk of nonrecovery for stranded assets; the pace of the development and adoption of new technologies in the energy sector, including those designed to support governmental and private party energy and climate goals, and our ability to efficiently incorporate them into our business; weather, natural disasters, pandemics, accidents, equipment failures, explosions, acts of terrorism, information system outages or other events that disrupt our operations, damage our facilities or systems, cause the release of harmful materials, cause fires or subject us to liability for damages, fines and penalties, some of which may not be recoverable through regulatory mechanisms, may be disputed or not covered by insurers, or may impact our ability to obtain satisfactory levels of affordable insurance; the availability of electric power, natural gas and natural gas storage capacity, including disruptions caused by failures in the transmission grid or limitations on the withdrawal of natural gas from storage facilities; the impact of the COVID-19 pandemic on capital projects, regulatory approvals and the execution of our operations; changes in tax and trade policies, laws and regulations, including tariffs, revisions to international trade agreements and sanctions, such as those that have been imposed and that may be imposed in the future in connection with the war in Ukraine, which may increase our costs, reduce our competitiveness, impact our ability to do business with certain counterparties, or impair our ability to resolve trade disputes; and other uncertainties, some of which are difficult to predict and beyond our control.

These risks and uncertainties are further discussed in the reports that the company has filed with the U.S. Securities and Exchange Commission (SEC). These reports are available through the EDGAR system free-of-charge on the SEC's website, www.sec.gov, and on Sempra's website, www.sempra.com. Investors should not rely unduly on any forward-looking statements.

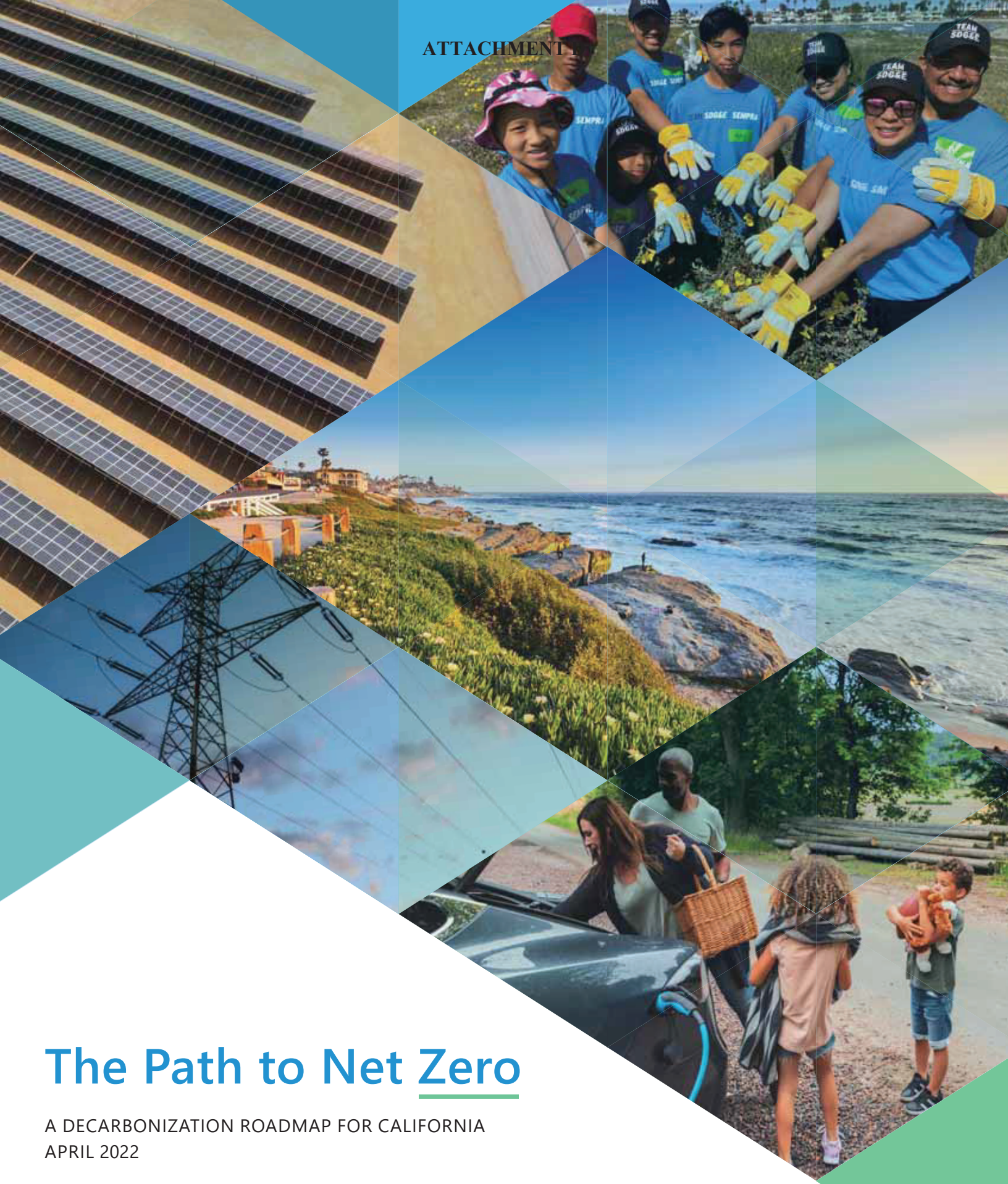
Sempra Infrastructure, Sempra Texas, Sempra Mexico, Sempra Texas Utilities, Oncor Electric Delivery Company LLC (Oncor) and Infraestructura Energética Nova, S.A.P.I. de C.V. (IEnova) are not the same companies as the California utilities, San Diego Gas & Electric Company or Southern California Gas Company, and Sempra Infrastructure, Sempra Texas, Sempra Mexico, Sempra Texas Utilities, Oncor and IEnova are not regulated by the CPUC.

SAFER, STRONGER, HEALTHIER TOGETHER.

Follow our progress and share feedback at ***sdge.com/sustainability***.

P.O. Box 129831 | San Diego, CA 92112-9831 | 1-800-411-7343 | Connect at **sdge.com**

ATTACHMENT 1



The Path to Net Zero

A DECARBONIZATION ROADMAP FOR CALIFORNIA
APRIL 2022

SDGE BCG BLACK & VEATCH

About the contributors

SDG&E®

SDG&E is an innovative San Diego-based energy company that provides clean, safe and reliable energy to better the lives of the people it serves in San Diego and southern Orange counties. The company is committed to creating a sustainable future by providing its electricity from renewable sources; modernizing natural gas pipelines; accelerating the adoption of electric vehicles; supporting numerous nonprofit partners; and, investing in innovative technologies to ensure the reliable operation of the region's infrastructure for generations to come. SDG&E is a subsidiary of Sempra (NYSE: SRE). For more information, visit SDGEnews.com or connect with SDG&E on Twitter (@SDGE), Instagram (@SDGE) and Facebook (https://www.facebook.com/SanDiegoGasandElectric).

BCG

Boston Consulting Group (BCG) partners with leaders in business and society to tackle their most important challenges and capture their greatest opportunities. BCG was the pioneer in business strategy when it was founded in 1963. Today, we work closely with clients to embrace a transformational approach aimed at benefiting all stakeholders — empowering organizations to grow, build sustainable competitive advantage and drive positive societal impact.

Our diverse, global teams bring deep energy and functional expertise and a range of perspectives that question the status quo and spark change. BCG delivers solutions through leading-edge management consulting, technology and design and corporate and digital ventures. We work in a uniquely collaborative model across the firm and throughout all levels of the client organization, fueled by the goal of helping our clients thrive and enabling them to make the world a better place.

Black & Veatch

Black & Veatch is a 100-percent employee-owned global engineering, procurement, consulting and construction company with a more than 100-year track record of innovation in sustainable infrastructure. Since 1915, Black & Veatch has helped clients improve the lives of people around the world by addressing the resilience and reliability of our most important infrastructure assets. Its revenues in 2021 exceeded $3.3 billion. Black & Veatch's global professionals include experienced industry executives, senior analysts and technology experts from across the electric, water, oil, natural gas and technology industries. This experience, combined with seamless access to the company's professional engineering, procurement, construction and operations capabilities, executives and internationally respected subject matter experts, makes Black & Veatch particularly qualified to assist clients with their most complex challenges. Its advisory solutions span financial, process, and technology solutions, and many of Black & Veatch's experienced professionals possess cross-functional skills that include asset management, cost of service/rate design, business process, analysis and implementation services.

David G. Victor

David Victor is a professor of innovation and public policy at the School of Global Policy and Strategy at University of California (UC) San Diego. He co-directs the campus-wide Deep Decarbonization Initiative, an effort to understand how quickly the world can eliminate emissions of warming gases. He is an adjunct professor in Climate, Atmospheric Science & Physical Oceanography at the Scripps Institution of Oceanography and a professor (by courtesy) in Mechanical and Aerospace Engineering. Prior to joining the faculty at UC San Diego, Victor was a professor at Stanford Law School where he taught energy and environmental law. He has been heavily involved in many different climate- and energy-policy initiatives, including as convening lead author for the Intergovernmental Panel on Climate Change (IPCC), a United Nations-sanctioned international body with 195 country members that won the Nobel Peace Prize in 2007. His Ph.D. is from the Massachusetts Institute of Technology and A.B. from Harvard University.

Table of Contents

4 Executive summary

7 Introduction

9 Achieving net zero

16 Decarbonization can be affordable and equitable

18 Proactive policy support is essential

21 SDG&E is ready to partner

23 Acronyms and abbreviations

24 Glossary

1. Executive summary

California has set ambitious climate goals by adopting into law Senate Bill (SB) 100, which requires 100% zero-carbon energy by 2045, and is committed to achieving a just and equitable energy transition on its path to carbon neutrality (Net Zero).[1] The state must undertake a significant transformation and decarbonize at 4.5 times the pace it has over the past decade to achieve carbon neutrality by 2045 and help mitigate the negative impacts of climate change. California already serves as a global sustainability leader. Given its decarbonization experience, innovative spirit and commitment to equity, its carbon neutrality goal presents California with an opportunity to demonstrate how a major economy can decarbonize in a reliable, affordable and equitable way.

The Path to Net Zero: A Decarbonization Roadmap for California (*Roadmap*) examines the implications of this transition for the state and the region San Diego Gas & Electric (SDG&E) serves. It also includes SDG&E's recommendation for California to achieve carbon neutrality, and is the first publicly available analysis to use the industry standard for electric reliability and industry modeling software in modeling how to decarbonize California by 2045.

As many other studies have highlighted, electricity is expected to play a central role in decarbonization. But there are also critical roles for other forms of clean energy, including renewable natural gas and hydrogen. While the *Roadmap* recognizes uncertainties that require new, flexible approaches to technology and policy, it also highlights areas where the priorities are clear. These include the need to expand electrification and supplies of solar and wind power, invest in a diverse set of electric generation resources that will help ensure the electric grid is reliable and lastly, to provide much larger volumes of clean fuels.

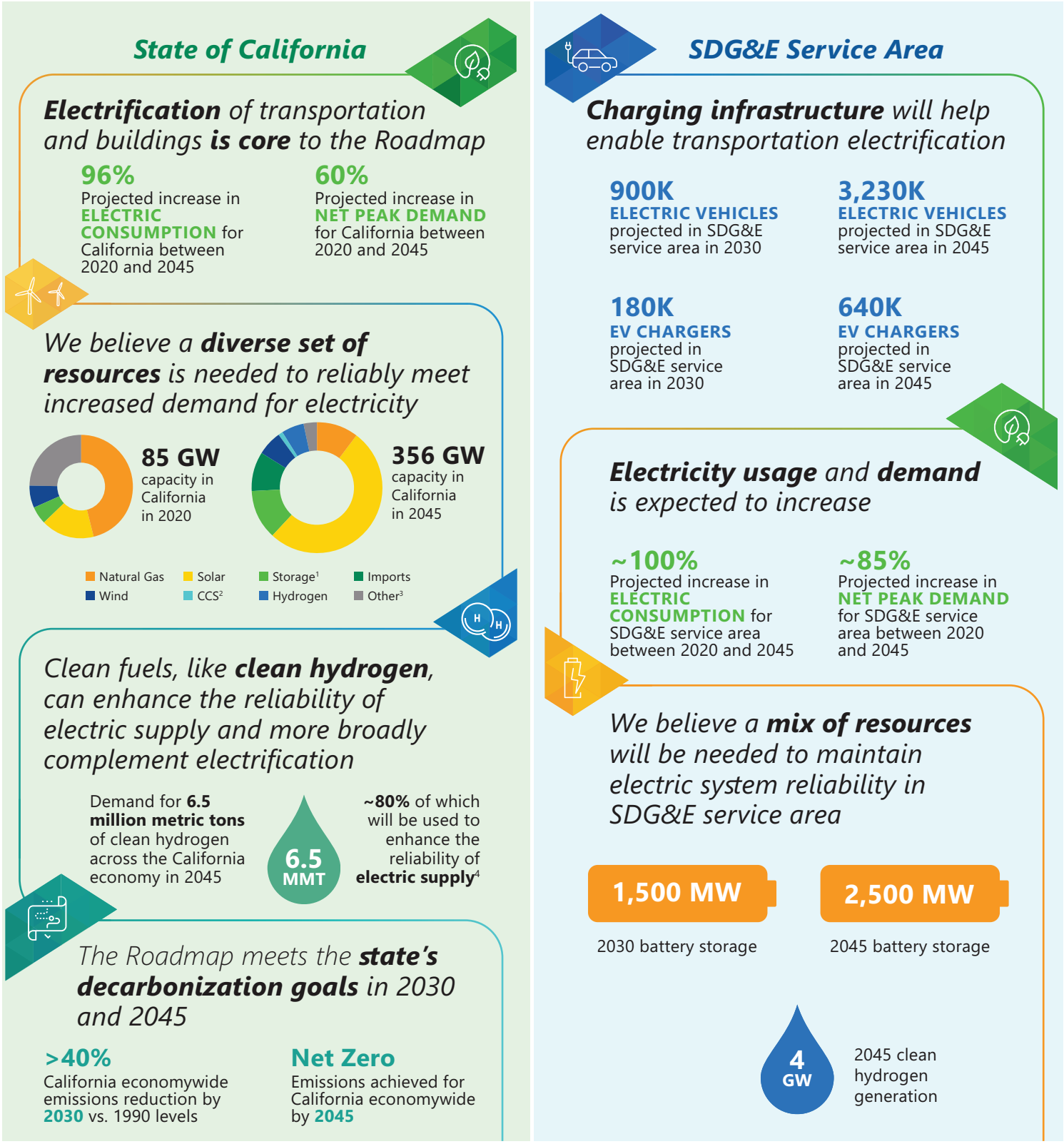
Electrification is central to decarbonizing the transportation and building sectors under the *Roadmap*. It is estimated that electric generation capacity will need to increase to 356 gigawatts (GW) by 2045 in California to meet this increasing demand for clean electricity, approximately four times the capacity that existed in 2020. The *Roadmap* foresees in-state solar and wind generation providing the bulk of this capacity.

Wind and solar are excellent resources for providing low-cost clean energy, but to help ensure reliability, the California electric system must also develop more flexible resources, such as energy storage and clean dispatchable generation.[2] This is especially important as the need for clean, reliable electricity increases from transportation and building electrification. We believe this will require installing 40 GW of new battery storage as well as 20 GW of dispatchable generation from 100% clean hydrogen generation by 2045.[3] Moreover, in addition to existing natural gas generation, we believe that 4 GW of electricity from natural gas with carbon capture and sequestration (CCS) will be needed to support reliability as the electric sector decarbonizes. Combined, these flexible resources can provide clean electricity when the sun is not shining and the wind is not blowing and ensure that high electricity demand during the summer months can be reliably met.

Having clean dispatchable resources that can provide carbon-free electricity when needed will be critical to help ensure a clean, reliable electric supply for a decarbonized California. Developing the necessary technology and infrastructure to enable clean dispatchable resources will be a tremendous undertaking. For example, the California electric system currently has no electric generation from 100% clean hydrogen generation.

[1] SB 100 requires that 100% of retail sales of electricity in California be served by eligible renewable energy resources and zero-carbon resources by 2045.
[2] Clean dispatchable generation refers to resources that do not produce greenhouse gas (GHG) emissions and are available any time electricity is needed, in contrast to weather-dependent wind and solar generation. These attributes are necessary to help ensure a clean and reliable electric supply, and SDG&E recommends an inclusive approach as clean dispatchable technologies continue to develop.
[3] 100% clean hydrogen generation is a type of clean dispatchable resource that burns "green" hydrogen fuel produced using renewable electricity.

FIGURE 1
The Path to Net Zero: Key Results



[1] Includes both battery energy storage and pumped hydroelectric storage.
[2] Natural gas generation with CCS. Includes new builds and retrofits.
[3] Other includes oil, coal, geothermal, biomass, hydroelectric, and nuclear.
[4] The remaining portion is used for pipeline blending of hydrogen and fuel cell vehicles.

As electricity consumption increases, additional electric infrastructure will be necessary for California to support decarbonization. This infrastructure will support reliability and allow California to access an estimated 34 GW of imported renewable power by 2045, which should enable the geographic diversification of renewable power and minimize the impact of localized weather events.

Resource diversity is essential to reliable, resilient and affordable decarbonization. The *Roadmap* calls for critical roles across the economy not only for clean electricity but also for clean fuels. In addition to supporting electric system reliability, clean fuels make it possible to decarbonize emissions from sources that cannot be easily electrified, such as heavy-duty trucks and many industrial processes. The *Roadmap* also requires the use of carbon removal technologies so that the GHG emissions that remain in 2045 and beyond can be removed and the goal of Net Zero achieved.

This *Roadmap* aims to provide what we believe is a reasonable and appropriate starting point for implementation and prioritization based on current knowledge, feasibility and market conditions. But the challenges, technologies and solutions associated with decarbonization are constantly evolving. The *Roadmap* will therefore need to be revisited as uncertainties are narrowed. For example, there are still unknowns about consumers' future adoption rate of electric vehicles (EV) and all-electric household appliances, as well as how the associated increase in electricity usage will impact the electric system. There are also uncertainties about the cost of decarbonization technologies. By pursuing multiple technological options for decarbonization, the *Roadmap*'s diversified approach should provide California with the necessary flexibility to adapt its path to carbon neutrality. Done right, we believe the California clean energy system can be affordable to consumers. Indeed, our modeling projects that economywide decarbonization spending as a percent of California gross domestic product (GDP) decreases over time.

Implementing the *Roadmap* will require regulatory and political support focused on four key considerations:

1. **Maintaining affordability and enhancing equity.** Policymakers and regulators will need to manage cost and equity impacts by changing how electricity and gas are priced, particularly for average and lower-income households who carry a greater burden today. Achieving the state's goals will require contributions from all Californians and the equitable allocation of benefits and costs must be prioritized. Funding sources for state priorities should be reevaluated as well. For example, funding state-mandated public purpose programs from the state's budget instead of electric and gas bills should promote more equitable recovery of program costs. Additionally, the state should perform an immediate evaluation of all GHG reduction programs and policies to determine which deliver the greatest benefits relative to the cost, and then phase out ineffective programs.

2. **Prioritizing electric sector reliability.** Policymakers, regulators and electricity providers will need to do more long-term planning and develop updated tools to help ensure electric system reliability as the state decarbonizes. This will require a longer planning horizon, early approval of long-lead transmission projects, updated methods for assessing reliability and fair compensation for reliability services.

3. **Enabling deployment of decarbonization infrastructure.** California residents must adopt the use of significant numbers of electric vehicles and appliances to achieve state goals. Importantly, the electric system must be ready to provide clean and reliable electricity for these new uses. By clearing challenges to approving, siting, permitting and interconnecting necessary decarbonization infrastructure, policymakers and regulators can help pave the way for faster development and mobilization.

4. **Incentivizing innovation and adaptability.** Near-term investments in innovation are important to lower future costs and improve future performance of new technologies envisioned by the *Roadmap*, including clean dispatchable electric generation, clean fuels and carbon removal technologies such as direct air capture.

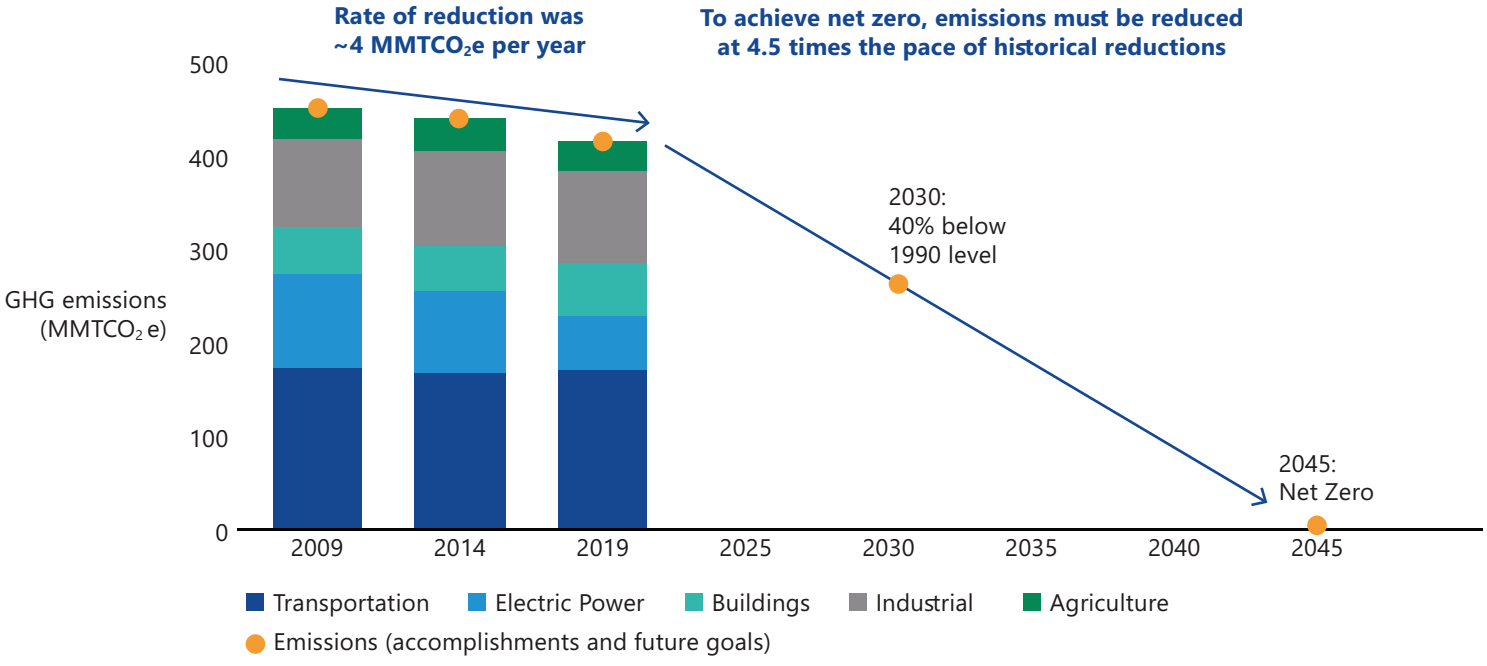
2. Introduction

California has set an ambitious target of achieving carbon neutrality by 2045, with an intermediate requirement to reduce GHG emissions to 40% below 1990 levels by 2030.[4] We believe that the state has the capabilities and experience to not only build the clean energy economy of the future, but also demonstrate an economically and socially sustainable decarbonization model for other states and countries. To do so, it must move much faster than ever before. Although the state reduced GHG emissions by ~36 million metric tons (MMT) from 2009 to 2019 (see Figure 2), it will need to reduce emissions at 4.5 times the pace of historical reductions going forward to reach Net Zero by 2045.

Reliability is the key to enhancing energy resiliency. When the electric system is unreliable, energy users often must turn to ad hoc and costly backup generation (diesel generators, for example) to provide resiliency.[5] The *Roadmap* presents SDG&E's recommendation for California to decarbonize in a reliable, affordable and equitable way.

The *Roadmap* aims to advance current research on California's decarbonization pathways. This is the first publicly available analysis to model California decarbonization through 2045 using the industry standard for evaluating electric system reliability and industry modeling software, yielding new insights about the clean dispatchable generation capacity and technologies required to decarbonize reliably.[6]

FIGURE 2
California's decarbonization accomplishments and future goals



Note: California Air Resources Board (CARB) 2000-2019 GHG Inventory (2021 edition, by economic sector), $MMTCO_2e$: Million metric tons of carbon dioxide equivalent

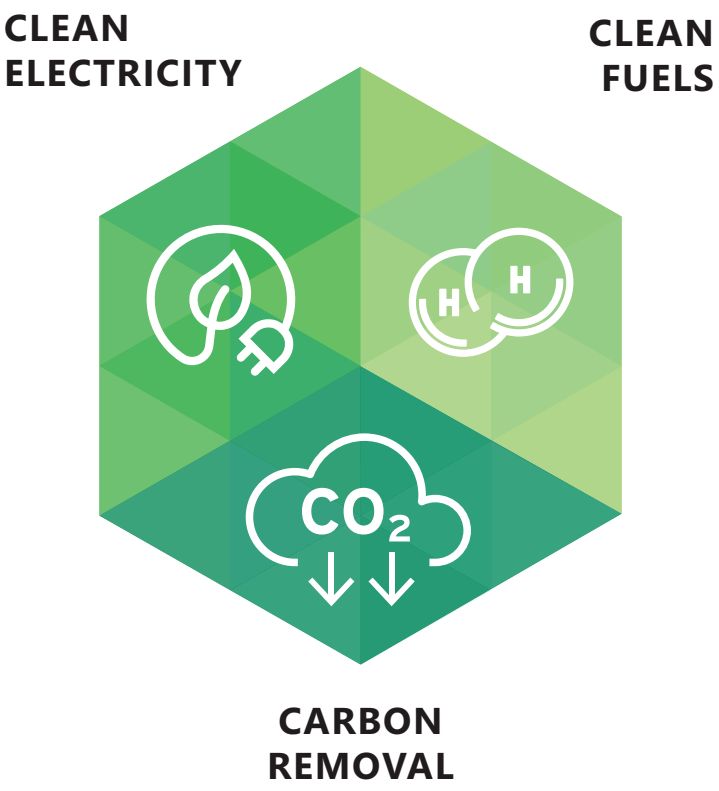
[4] SB 32 ordered a reduction in economywide emissions of 40% below 1990 levels by 2030. Executive Order (EO) B-55-18 established a statewide goal to achieve carbon neutrality by 2045.

[5] See the 2017 National Academies report, Enhancing the Resilience of the Nation's Electricity System, for a longer discussion on reliability and resiliency, available at (https://www.nap.edu/catalog/24836/enhancing-the-resilience-of-the-nations-electricity-system).

[6] The analysis applies the North American Electric Reliability Corporation (NERC) "one day in ten year" loss of load expectation (LOLE) standard.

This *Roadmap* employs a diversified approach, with roles for clean electricity, clean fuels and carbon removal technologies, as shown in Figure 3.[7] Rapidly decarbonizing the energy system in a way that ensures reliability, resiliency, affordability and equity will require investments in both existing and emerging decarbonization technologies, including long-term battery storage and clean dispatchable generation, as well as related infrastructure. Given the need for emerging technologies, California must foster innovation and permit adaptability along the journey, adjusting accordingly as the state learns more about people's behavior and decarbonization technologies.

FIGURE 3
Our Roadmap recommends a diversified approach



2.1 *Roadmap* development

Three primary approaches will contribute to economywide decarbonization: (1) the consumption of energy from clean electricity, (2) the consumption of energy from clean fuels and (3) the use of carbon removal technologies.[8] The first two approaches provide end users with decarbonized sources of energy. The third approach directly removes carbon from the atmosphere in situations where clean electricity or clean fuels are cost-prohibitive or technologically infeasible. While reliance on one approach over the other may vary across the different sectors, effective economywide decarbonization will employ a combination of these approaches.

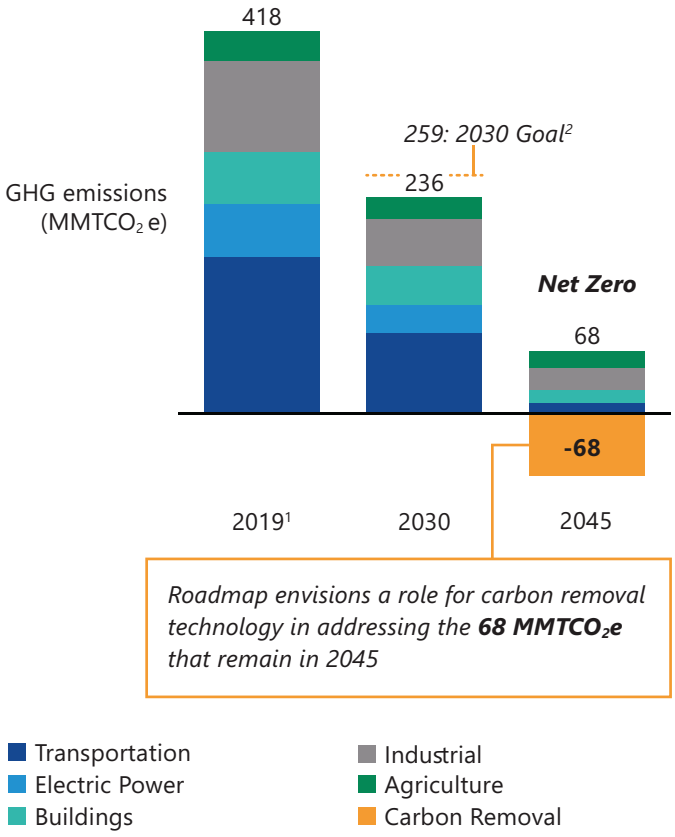
The *Roadmap* was developed by modeling combinations of strategies for decarbonizing each sector of the California economy to achieve the state's goals. As decarbonization strategies were applied, modeling provided insight on the resulting demand for different types of energy, including clean electricity, clean fuels, traditional fossil-fuel based resources and cost. For the electric sector, a cost-optimized electric generation portfolio that both decarbonizes the electric sector and achieves the industry standard of reliability was developed. Finally, while all the combinations of decarbonization strategies evaluated achieved California's 2030 emissions requirement and carbon neutrality by 2045, the study compared the different approaches on reliability, feasibility and affordability to arrive at the *Roadmap* described herein.

[7] While carbon removal technologies are not explicitly modeled in the *Roadmap*, they are the most obvious candidate today to address emissions that will remain in 2045.
[8] "Clean fuels" are low-carbon fuel substitutes (clean hydrogen or renewable natural gas, for example) for traditional fossil fuels. They are distinct from "clean electricity", which provides energy in the form of decarbonized electrical power.

3. Achieving net zero

The diversified approach recommended in the *Roadmap* acknowledges that the exact combination of technologies and investments is unknowable today, and that a diversity of options must be preserved. Figure 4, which illustrates the emissions reduction trajectory across the economy, highlights this point by showcasing the role of carbon removal technologies in addressing 68 MMT of GHG emissions that are not abated with clean electricity or clean fuels.

FIGURE 4
Statewide projected emissions

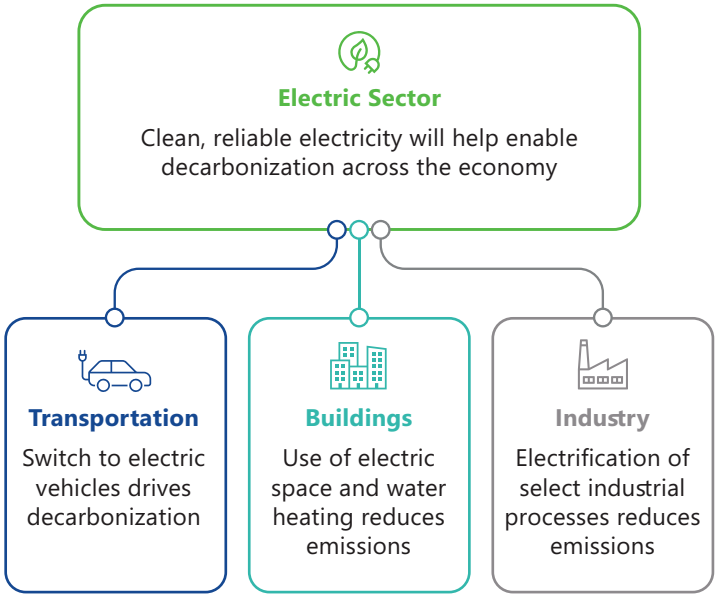


[1] Latest data available from CARB at time of analysis.
[2] Implied cap of emissions to comply with the goal of a 40% reduction, relative to 1990 GHG emissions.

3.1 A clean, reliable electric sector is central to decarbonizing California

California's path to Net Zero hinges on reliably decarbonizing the electric sector, as illustrated in Figure 5.

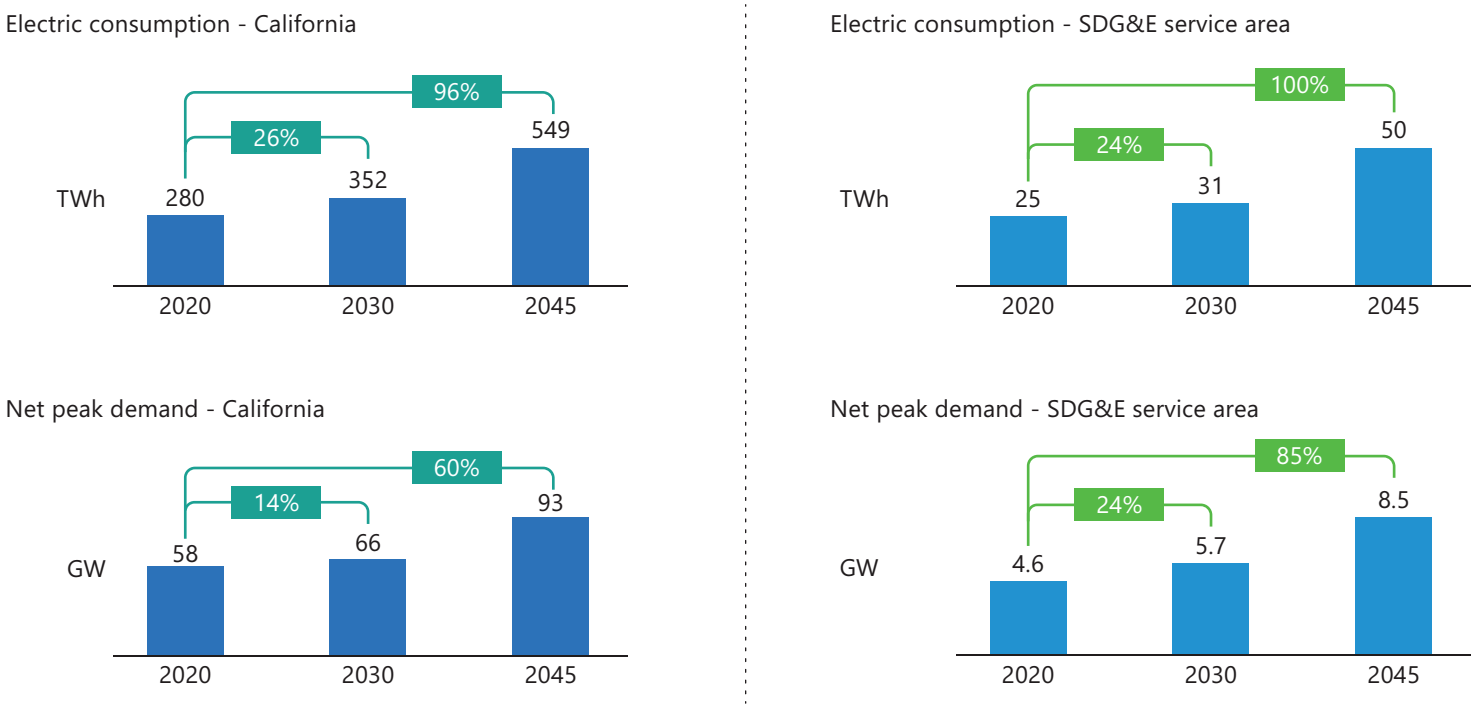
FIGURE 5
The electric sector is expected to be a key enabler to decarbonizing California's economy



The California electric sector is already on a path to reach the goal of 100% of electricity coming from zero-carbon resources by 2045 and has reduced emissions by 42% over the past decade.[9] In 2019, the electric sector accounted for only 14% of California's emissions. As other sectors of the economy electrify, clean and reliable electricity will enable decarbonization more broadly. Figure 6 highlights the transformational growth in electricity demand both in California and the SDG&E service area.

[9] Calculation based on CARB 2000-2019 GHG Inventory (2021 edition, by economic sector).

FIGURE 6
Estimated growth in electric consumption and net peak demand



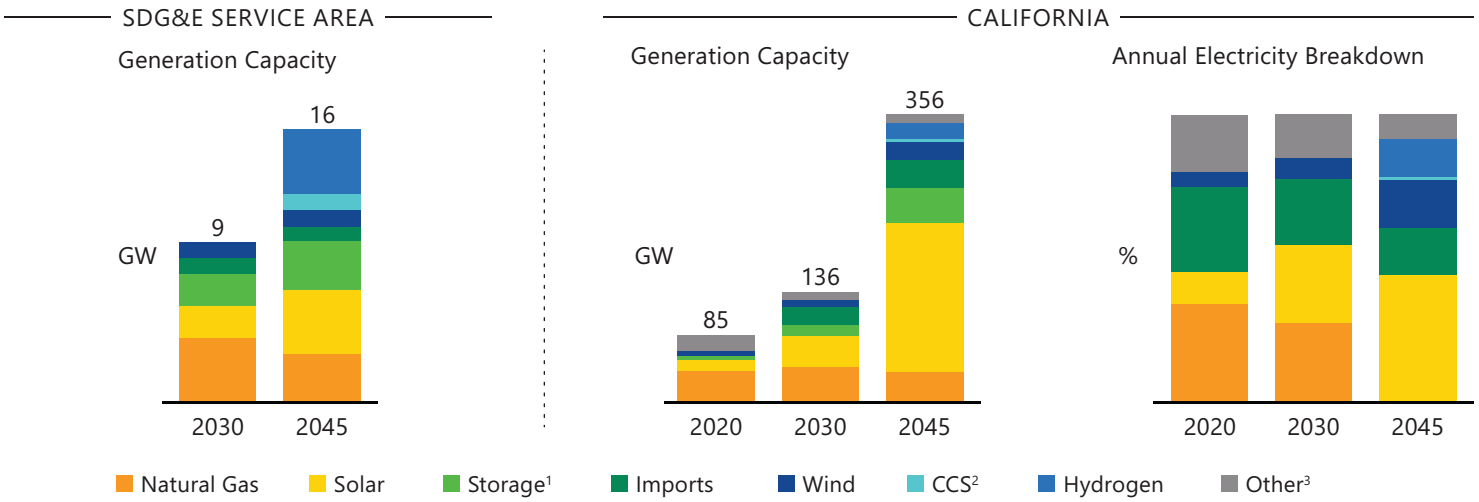
Note: Values represent the difference between base load and behind the meter generation. Values for 2030 and 2045 are based on an average weather year.

To design an electric system capable of reliably meeting the growing demand for electricity, the modeling for the *Roadmap* applied the industry standard for electric reliability – the "one day in ten year" loss of load expectation (LOLE) standard.[10] Notably, ours is the first study to use this industry standard in modeling how the electric sector must support full decarbonization of the California economy through 2045. As most decarbonization pathways depend on a reliable electricity grid, studies that evaluate different decarbonization strategies should also appropriately model electric reliability.

The *Roadmap* envisions deploying a diverse mix of 356 GW of electric generation capacity by 2045. Figure 7 illustrates the envisioned generation capacity mix for California and SDG&E's service area. It projects that 205 GW of in-state solar and wind capacity will comprise 58% of statewide electric generation capacity in 2045, allowing the electric sector to continue to decarbonize while electricity usage increases. The *Roadmap* also recommends the installation of 40 GW of battery storage by 2045.

[10] LOLE is defined as the expected number of days per time period (usually a year) for which the available generation capacity is insufficient to serve the demand at least once per day. LOLE counts the days having loss of load events, regardless of the number of consecutive or nonconsecutive loss of load hours in the day. The study applies the industry standard of 0.1 days per year, or one day in ten years.

FIGURE 7
We believe a diverse set of resources is needed to reliably meet electricity demand



[1] Includes both battery energy storage and pumped hydroelectric storage.
[2] Natural gas generation with CCS. Includes new builds and retrofits.
[3] Other includes oil, coal, geothermal, biomass, hydroelectric and nuclear.

Clean dispatchable electric generators are most critical for keeping the electricity grid reliable while meeting emissions reduction goals. They can both quickly provide electricity to meet customer needs and use a clean fuel source, such as green hydrogen. Resources with these attributes are imperative because they can provide clean energy whenever needed, complementing significant amounts of weather-dependent solar and wind generation.

The intermittency of renewables is one variable that drives the need for clean dispatchable generation. As such, the *Roadmap* envisions 20 GW of 100% clean hydrogen generation as a critical technology needed for the state to maintain electric reliability while satisfying increased demand for clean electricity.[11] To serve this clean dispatchable generation, the *Roadmap* envisions that California will need 6.5 MMT of clean hydrogen in 2045, of which 80% would be for the electric sector.[12] Moreover, in addition to existing natural gas generation, 4 GW of electricity from natural gas with CCS are projected to be needed to support reliability as the electric sector decarbonizes.

As electricity consumption increases, additional electric infrastructure will be necessary for California to support decarbonization. This infrastructure will support reliability and allow California to access 34 GW of imported renewable power by 2045, which should enable the geographic diversification of renewable power and minimize the impact of localized weather events. The *Roadmap* suggests that a larger interconnected western grid is critical to help ensure long-term reliability in California.

The *Roadmap* evaluated several different decarbonization strategies and many of the uncertainties that will affect the future. One area of commonality was the need for California to rapidly expand the construction of wind and solar generators to provide enough clean electricity. Adding these intermittent renewable generation sources requires that the state sustain a diverse generation mix along with many complementary investments that help keep electricity reliable. For instance, every combination of strategies examined also deployed significant amounts of battery storage to support the rapid shift to renewables.

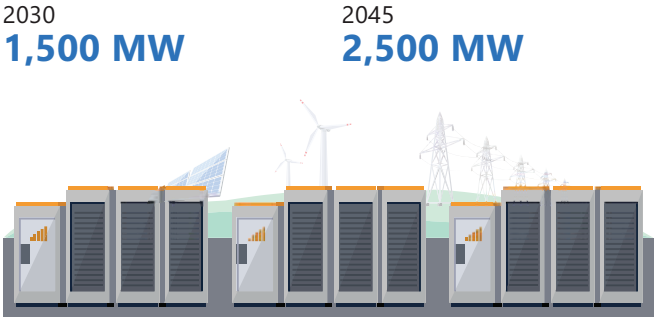
[11] The latest available information was used to inform electric sector modeling and generator characteristics for this analysis, and SDG&E supports a technology-inclusive approach as technology continues to advance for clean dispatchable resources.
[12] The remaining hydrogen is used for hydrogen fuel cell vehicles (HFCV), and for pipeline blending to support decarbonization in the building and industrial sectors.

SPOTLIGHT 1

SDG&E investments in utility-scale battery storage will help ensure reliable power in the SDG&E service area.

At the end of 2020, a combined 331 megawatts (MW) of utility-owned and third-party battery storage were located in SDG&E's service area. To support the reliability of electricity supply, the Roadmap envisions a combined 2,500 MW of utility-owned and third-party battery storage in SDG&E's service area by 2045.

FIGURE 8
Projected battery storage in SDG&E service area



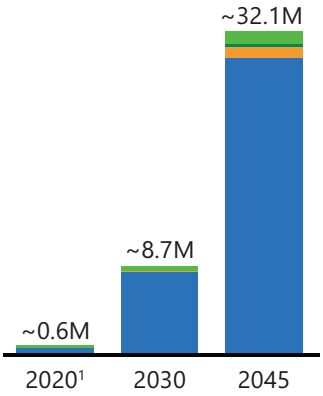
3.2 Transportation electrification is key

As of 2019, the transportation sector, which accounts for approximately 41% of California's emissions, is the state's largest source of GHG emissions.[13] The projected transformational shift to electric vehicles, aligned with state policy and driven by the rapid decline in total cost of owning electric vehicles, will decarbonize a significant portion of the transportation sector.[14] The impact will be considerable for all vehicle types, but particularly so for light-duty cars and trucks (LDV). This shift, however, will create unprecedented demand for electricity. As electrification occurs, it will be critical to learn when Californians charge their vehicles and how they respond to the price of electricity at different times, as their behavior will have a large impact on the electric system. Increasing demands on the electric system can also be managed through advanced vehicle-to-grid integration technologies.[15]

The *Roadmap* anticipates that some portions of the medium-duty vehicle (MDV) and heavy-duty vehicle (HDV) transportation sectors, particularly those requiring long distances and short refueling times, will decarbonize by using clean fuels such as hydrogen.

Figure 9 summarizes the increase in zero-emission vehicles (ZEV) across the state, with a central role for clean electricity and a complementary one for clean fuels.

FIGURE 9
Projected California zero-emission vehicle adoption



	2020[1]	2030	2045
Share, LDV ZEV	2%	27%	87%
Share, MDV + HDV ZEV	-	25%	86%

LDV PHEV + BEV
MDV + HDV BEV
LDV HFCV
MDV + HDV HFCV

[1] 2020 represents actuals based on CEC (2021) Zero-Emission Vehicle and Infrastructure Statistics (for light-duty vehicles only). Note: 2030 + 2045 shown are projected ZEVs (for light-duty, medium-duty, and heavy-duty vehicles).

[13] CARB 2000-2019 GHG Inventory (2021 edition, by economic sector).
[14] EO N-79-20 requires 100% of in-state sales of light-duty vehicles to be zero emission by 2035. BCG, April 21, 2021: *Why Electric Cars Can't Come Fast Enough*, available at https://www.bcg.com/publications/2021/why-evs-need-to-accelerate-their-market-penetration.
[15] Vehicle-to-grid integration technologies were not directly evaluated as part of this study.

SPOTLIGHT 2

SDG&E investments in infrastructure will help enable transportation electrification.

Transportation electrification is estimated to require ~640,000 electric vehicle chargers in SDG&E's service territory by 2045, as shown in Figure 10.[16] SDG&E plans to enable the installation of electric vehicle chargers by deploying the necessary electric infrastructure, which includes utility-side equipment such as transformers. To enhance the equity implications of these investments, SDG&E will continue to work with its customers and partners in diverse, underserved and disadvantaged communities to understand how best to distribute charging infrastructure to meet their transportation needs.

FIGURE 10
Expected EV penetration and charger requirements in SDG&E service area

	2030	2045
Electric vehicles	900K	3,230K
EV chargers	180K	640K

Note: Electric vehicles only. Charger counts represent LD and MD/HD public, workplace and multi-unit dwelling chargers.

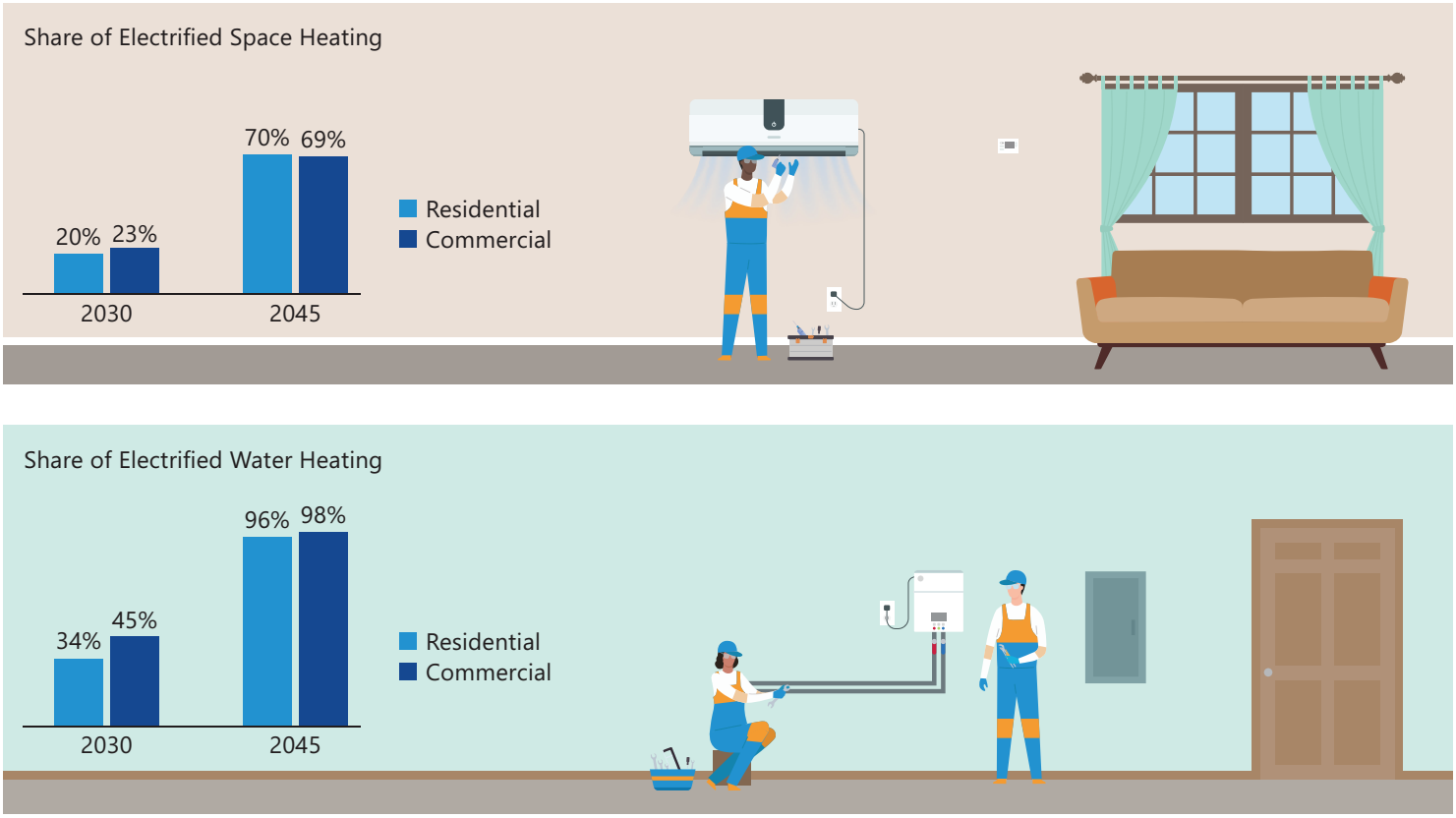
3.3 Clean electricity and clean fuels decarbonize the building sector

The building sector accounts for approximately 14% of California's emissions, primarily from the use of natural gas for space and water heating.[17] These emissions can be decarbonized by electrifying space and water heating equipment or substituting the burning of natural gas with clean fuels. Figure 11 (on the following page) summarizes the penetration of electric space and water heating in residential and commercial buildings needed through 2045 to meet the state's GHG goals.

While the *Roadmap* recommends a substantial role for electrification, it also acknowledges that electrification of appliances can be challenging in certain circumstances. In older homes and some multi-family buildings, substituting a gas appliance with an electric one may require updates to wiring and other electrical infrastructure — an expense and time delay that not all customers can bear. For example, more than half of homes in San Diego County were built in 1979 or earlier, which may require more significant upgrades.[18] This may present an equity concern, as lower-income residents are more likely to live in older homes which may not be able to support electric space and water heating without significant upgrades.[19] Where electrification is not feasible, clean fuels such as renewable natural gas and hydrogen provide a viable approach to decarbonization.[20]

[16] Includes public, workplace and multi-unit dwelling chargers to support light, medium and heavy-duty vehicles.
[17] CARB 2000-2019 GHG Inventory (2021 edition, by economic sector) and 2019 CEC Residential Appliance Saturation Survey (RASS).
[18] Data from the U.S. Census Bureau, 2019 American Community Survey (ACS) 5-Year Estimates Data Profiles, Table DP04, available at https://data.census.gov/cedsci/table?q=housing&g=0100000US_0400000US06_0500000US06073&tid=ACSDP5Y2019.DP04.
[19] Li, Sijei. Where Is the Aging Housing Stock in the United States? Freddie Mac, June 1, 2021, available at https://my.sf.freddiemac.com/updates/news/news~where-is-the-aging-housing-stock-in-the-united-states.
[20] See Rocky Mountain Institute, *The Economics of Electrifying Buildings*, available at https://rmi.org/insight/the-economics-of-electrifying-buildings/.

FIGURE 11
Projected electrification of space and water heating in California and SDG&E service area



SPOTLIGHT 3

SDG&E will explore ways to assist residential customers in electrifying their space and water heating.

Changes in water and space heating appliances can be disruptive and expensive. Contractors and customers may be unfamiliar with electric solutions like heat pump products. One way SDG&E can support the electrification of water and space heating would be to sponsor contractor and consumer education programs to be run by a third-party. Contractors could obtain a "green" certification to market their knowledge of electric solutions. Such programs could be tied to incentives for residential customers to switch appliances, which may improve access to electrification for lower-income households. SDG&E also plans to work with municipal partners, community organizations and community choice aggregators (CCA) on regional policies, funding sources and building reach codes designed to encourage residential electrification. Additionally, SDG&E is developing an innovative rate option to make electrification more attractive to residential customers who may be considering electric heat pumps, among other technologies.

3.4 The industrial sector will require a diverse set of strategies

California is the number one manufacturing state with some of our nation's largest ports.[21] California's industrial sector accounts for 24% of state emissions, stemming from a variety of sources such as manufacturing, petroleum refining and waste management.[22] Decarbonizing this sector will require a combination of approaches.

Electrification is appropriate for a small segment of applications, such as industrial processes involving low-temperature heat. Clean fuels are critical for further reducing emissions from industrial and building uses that cannot be electrified. The *Roadmap* envisions that by 2045 the combination of gaseous fuels flowing through the gas pipeline to homes and businesses will be very different than it is today, as illustrated in Figure 12. While overall throughput in the natural gas pipeline is projected to decrease 65% by 2045, it is projected that almost half of the gas remaining in the pipeline is comprised of hydrogen and renewable natural gas, resulting in lower emissions. This reduces emissions from industrial processes and building appliances that cannot feasibly be electrified.

FIGURE 12
Projected composition of pipeline gas in 2045

[21] BEA manufacturing employment 2020 data by metropolitan area (March 2022).
[22] CARB 2000-2019 GHG Inventory (2021 edition, by economic sector).

4. Decarbonization can be affordable and equitable

The *Roadmap* estimates California will need a relatively small share of state GDP on an annual basis through 2045 to reliably achieve its decarbonization goals.[23] This is based on an assessment of investments needed in electric vehicles, electric appliances and electric infrastructure, as well as the ongoing cost of electricity and fuel, such as gasoline.[24]

The estimated cost of decarbonization is primarily comprised of investments in equipment stock such as the purchase of a new electric vehicle or appliance by consumers. The remainder of the costs include the costs for fuel and electric generation. Decarbonization efforts must be carefully planned to help ensure that California residents, businesses and organizations can afford costs and realize benefits in an equitable manner. Successfully achieving an equitable outcome will be contingent on customer acceptance of clean technologies, innovation and policy incentives.

SDG&E is acutely aware of the financial challenges facing consumers and the above-average inflation trends experienced over the past two decades.[25] Balancing the rising costs of decarbonization with affordability is a challenge that must be addressed.

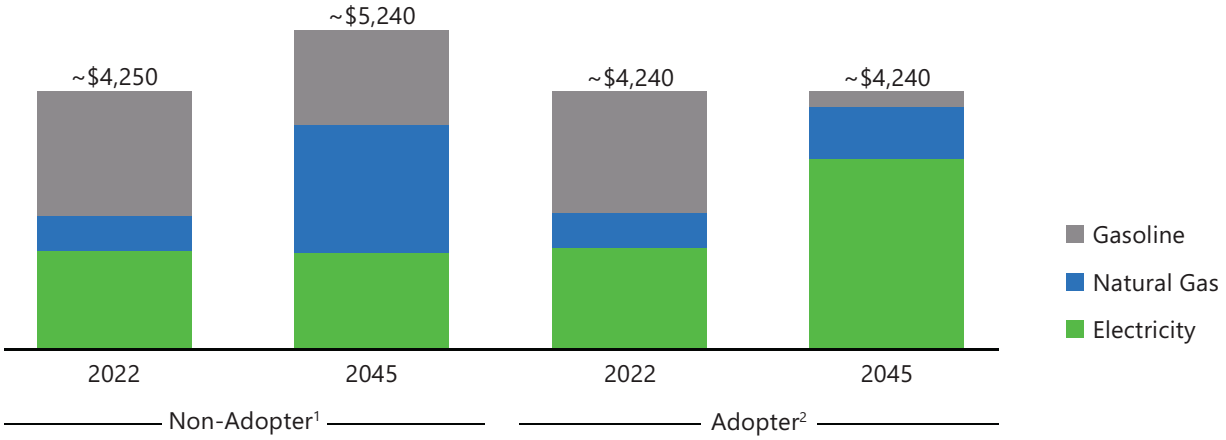
Illustrative changes in SDG&E residential customers' total annual energy expenditures in 2045 were evaluated to better understand future impacts of decarbonization on affordability and equity. This analysis included projected ongoing costs (electric utility bills, gas utility bills and gasoline costs).[26] Two distinct customer types were analyzed – a "Non-Adopter" who makes no changes to their base 2022 electricity and natural gas consumption and owns gasoline vehicles, and an "Adopter" who adopts electric appliances and vehicles at the average rate of the *Roadmap*.

[23] Costs are estimated using methods detailed in the technical appendix. The share of state GDP declines from 8% in 2022 to 6% in 2045. 2021 California GDP was grown by 2.7% annually through 2045 (represents 10-year historical real growth rate), per the U.S. BEA GDP by State SQGDP2.
[24] Investments are in real 2021 dollars. They are not incremental to a business-as-usual case and therefore include costs that are likely to be spent regardless of decarbonization efforts (i.e., purchasing a car or appliance).
[25] 20-year CPI CAGR of 2.6%, 2.5% and 2.2% for San Diego, California and the U.S., respectively. 2001 – 2021 data from U.S. BLS and CA Department of Industrial Relations.
[26] Does not include upfront capital costs of electric vehicles and appliances.

Figure 13 illustrates that a customer can decarbonize according to the *Roadmap* and pay approximately the same annual energy costs in 2045 compared to 2022, excluding the impact of inflation. While the two customer types start at roughly the same household annual energy costs in 2022, an "Adopter" is projected to have 19% lower annual energy costs compared to a "Non-Adopter" by 2045, as shown in Figure 13.[27]

It is important to note that a customer may not be a "Non-Adopter" by choice. Lower-income customers are some of the least likely candidates to be able to adopt electrification technologies due to financial constraints and other obstacles. This highlights the need to help ensure all customers can adopt new technologies to avoid potentially disproportionate financial impacts. To help ensure an affordable and equitable outcome, policymakers, regulators and SDG&E must consider how changes across the economy will affect different households, especially those of average and lower-income customers.

FIGURE 13
Illustrative SDG&E residential customer projected annual household energy spend



[1] Non-Adopters are those customers who make no changes to their base 2022 electricity and natural gas consumption and own gasoline vehicles.
[2] Adopters are those customers who adopt electrified appliances and electric vehicles at the average rate of the Roadmap.
Note: Figures shown represent real 2021 dollars (excludes inflation effects). Analysis is for ongoing costs only (does not include upfront capital costs of electric vehicles and appliances). Please see technical appendix for additional details.

[27] Represents real 2021 dollars. Excludes future inflation effects. Please see technical appendix for additional details.

5. Proactive policy support is essential

The *Roadmap* recommends four types of regulatory and political support to achieve successful implementation: (1) maintain affordability and enhance equity, (2) prioritize electric system reliability, (3) enable deployment of decarbonization infrastructure and (4) incentivize innovation and adaptability.

1. **Maintain affordability and enhance equity.**

   a. **Reform electric and gas pricing, as well as explore alternative funding and cost recovery mechanisms.** Historically, electric rates in California have been designed to promote conservation by collecting nearly all costs through volumetric rates. As a result, electricity rates in California are some of the highest in the country, creating a disincentive for additional electrification. As the energy landscape and customer usage patterns evolve, so should electric rate design. Changing how electricity is priced to encourage the electrification of vehicles and appliances, while promoting bill stability, will be key to managing the costs of decarbonization. To help ensure an equitable outcome for all customers, electric rate design that creates subsidies from one group of utility customers to another in an effort to incentivize specific decarbonization technologies should be avoided.

      Regarding natural gas customers, a similar overhaul of gas rates should be considered. As residential and commercial buildings increasingly electrify, natural gas throughput is projected to decline. Therefore, customers that continue to use gas will pay a disproportionate share to maintain a safe and reliable gas grid. Changes to gas rate design can mitigate these impacts and help ensure fairness across different types of customers.

      Moreover, the cost of decarbonizing California should be shared equitably. Alternative funding and recovery mechanisms will need to be explored to help reduce the costs borne by utility customers. For example, California's energy policy framework should be set up to maximize its ability to leverage federal funding, including in the recently passed Infrastructure Investment and Jobs Act, and more generally from the Department of Energy. State funding mechanisms should be reevaluated as well. For example, transitioning costs associated with state-mandated public purpose programs from electric and gas bills to the state's budget should promote more equitable cost recovery and reduce unnecessary pressure on household electricity and gas costs.

   b. **Support low-income households so they can benefit from the clean energy transition.** To avoid disproportionately burdening low-income households, policymakers and regulators should learn how changes in energy usage across the economy will affect financially fragile households. Policy and regulatory support, such as appropriately designed incentive programs to assist consumers with the upfront costs of new electric appliances and vehicles, will help ensure lower-income households benefit from California's decarbonization efforts. The impact of decarbonization on social equity will depend on how strategies to achieve Net Zero are implemented.

   c. **Evaluate and prioritize cost-effective emission reductions programs.** California has enacted dozens of programs and policies to reduce GHG emissions. As we focus on the future, affordability is a key consideration

of customer acceptance and support of decarbonization. The state should continue to pursue cost effective energy efficiency and demand response programs, while also performing an immediate evaluation of all GHG reduction programs and policies to determine which deliver the greatest benefits relative to the cost. Following this review, the Legislature, California Public Utilities Commission (CPUC) and California Energy Commission (CEC) should take steps to sunset costly and ineffective programs to maximize limited ratepayer funds. The state should repeat this process on a regular basis.

d. **Support an equitable transition for affected workforces.** California's energy ecosystem employs highly skilled professionals, such as boilermakers, pipefitters, welders, and laborers whose jobs may be at risk from electrification. However, these skills will still be necessary in a decarbonized future. Policymakers and regulatory agencies should prioritize helping such workers evolve their skills on the journey to carbon neutrality.

2. **Prioritize electric system reliability.**

a. **Incorporate electric sector reliability into long-term state planning.** State agencies and load serving entities that are evaluating future electric generation should apply the industry reliability standard when assessing decarbonization options through 2045. A reliable energy system is essential for California, its residents and its economy. Achieving electric reliability will require fairly compensating providers of reliability services, developing new methods for assessing reliability in light of future uncertainties and reforming transmission planning processes. This includes using electricity demand forecasts aligned with state goals in planning processes and timely approval of long-lead transmission projects to accommodate increasing electrification.[28]

b. **Implement a regional transmission organization (RTO).** Recognizing that California is part of an electric system that extends beyond its borders, SDG&E continues to be supportive of the California Independent System Operator (CAISO) RTO market expansion efforts and broader long-term western regionalization based upon the belief that it will lead to market efficiency, optimization of renewable resources across the West and enhanced grid reliability.

c. **Adopt technology inclusive solutions.** Adopting a technology inclusive definition of clean energy should enhance reliability and affordability. Current policies, such as the Joint Agencies interpretation of SB 100, exclude certain technologies because they produce some emissions, even though they could support reliable decarbonization of the electric sector.[29] Technologies such as blending hydrogen into the fuel mix for natural gas generators or natural gas generation with CCS can enable California to meet its interim emissions goals and help ensure reliability. Policymakers and regulators should adopt a fuel-agnostic definition of clean energy that includes a diverse set of technologies.

3. **Enable deployment of decarbonization infrastructure.** As a growing number of California residents adopt electric vehicles and electric space and water heaters, the electric system must be ready to provide increasing amounts of clean and reliable electricity. Obstacles to approving, siting, permitting and interconnecting decarbonization technologies can prevent or slow the pace of decarbonization. Federal, state and local policymakers can:

[28] Electricity forecasts representative of state goals could be incorporated into the CPUC Integrated Resource Plan, CAISO's Transmission Planning Process and the CEC's Integrated Energy Policy Report (IEPR).
[29] The Joint Agencies include the CEC, CPUC and CARB.

a. Enable faster infrastructure development by updating planning efforts for clean electricity and fuels.

b. Simplify and accelerate regulatory reviews.

c. Authorize land use for decarbonization technologies.

d. Increase access to federal- and state-controlled rights-of-way.

e. Simplify the processes to use or cross federal lands.

f. Develop planning processes for new types of infrastructure, such as the production and distribution of clean hydrogen.

These actions will be critical to interconnect new electric generation capacity and to mobilize investments in transmission and distribution within California and across the Western U.S.

4. **Incentivize innovation and adaptability.** The state should encourage research, development and demonstration efforts to make sure necessary decarbonization technologies are available for deployment at an affordable cost. This will require incentivizing pilots, demonstration projects and large-scale deployments to meet an increasingly rapid pace of decarbonization. It also will require facilitating engagement with private and public sector partners across the U.S. and globally on decarbonization research and development.

   Since these initiatives may reveal more impactful or cost-effective approaches to decarbonization, the state should also foster an environment of experimentation, learning and adaptability on the way to carbon neutrality. Adopting a diversified approach will preserve optionality. The state should also continuously take a forward-looking view and be willing to permit investments for learning opportunities by creating supportive policy frameworks for promising technologies, such as CCS. Finally, an important component of adaptability involves recognizing when policies are not working as intended, are not cost effective or generally are no longer serving the public interest.

6. SDG&E is ready to partner

Achieving the objectives outlined in the *Roadmap* cannot be accomplished by SDG&E alone, as we are one player within a larger region. It will require time, investment and coordination from all stakeholders who share the goal of achieving carbon neutrality while maintaining a reliable electric system. To that end, SDG&E looks forward to sharing our findings with local and state agencies, community-based organizations, CCAs, other utilities and the public to explore opportunities with those who share our mission.

Economywide decarbonization will only be possible through the combined efforts of all stakeholders in the state. SDG&E is committed to doing its part and has established a sustainability target where we aim to have Net Zero emissions by 2045. SDG&E will continue to invest in decarbonization efforts to reduce the carbon content of energy used in key segments of the economy, including the transportation, electric and building sectors. These initiatives are described in SDG&E's sustainability reports published in 2020 and 2021.[30]

These reports demonstrate a partial list of what SDG&E has already accomplished:

Climate adaptation and wildfire safety
Over the past decade, SDG&E has invested more than $3 billion in establishing an industry-leading wildfire safety and climate adaptation program, which includes undergrounding power lines, strengthening regional emergency preparedness and improving situational awareness through advanced technologies such as live-streaming, fire-monitoring cameras and artificial intelligence (AI)-based fire forecast models. In the past 14 years, SDG&E equipment has not been the cause of any major wildfires, which are a major source of carbon and air pollution in California.

Reliability
For the last 16 consecutive years, SDG&E has been the most reliable electric utility in the West and in 2021, we were named by PA Consulting as the most reliable electric utility in the nation for the second time.[31]

[30] See *Building a Better Future: Our Commitment to Sustainability*, SDG&E, October 2020; *Building a Better Future: Sustainability Strategy Update*, SDG&E, October 2021, both available at https://www.sdge.com/more-information/environment/sustainability-approach.
[31] See *SDG&E Wins National Award For Best Electricity Reliability in America, Outstanding Reliability in the West & Grid Sustainability*, available at https://www.sdgenews.com/article/sdge-wins-national-award-best-electric-reliability-america-outstanding-reliability-west, November 2021.

Clean transportation
SDG&E has built more than 3,200 electric vehicle chargers and expects to build thousands more in the coming years to support not just passenger vehicles, but also medium- and heavy-duty vehicles, such as trucks and buses. SDG&E is also working to transition its fleet to 100% zero-emissions vehicles by 2035. In 2020, SDG&E, in partnership with regional stakeholders, established the Accelerate to Zero (A2Z) Emissions Collaboration to support transportation electrification in San Diego.

Battery storage
Over the past decade, SDG&E has built a diverse energy storage portfolio and is rapidly scaling up both its owned and contracted storage capacity. SDG&E is on track to double its owned storage capacity to 145 MW by the end of 2022. Additionally, we have another 284 MW of energy storage under contract.

Microgrids
SDG&E is pioneering zero-emission microgrids, like the Ramona Air Attack Base, as backup power to support vulnerable populations and critical facilities during emergencies. Since building America's first utility-scale microgrid in 2013, SDG&E has been working to add more throughout our service area. Currently, we have about a dozen microgrids that are either complete or under development.

Methane emissions reduction
2021 marks the fifth consecutive year SDG&E has achieved a zero leak repair backlog, supporting efforts to reduce methane emissions. Also contributing to the reduction of methane emissions are the SDG&E's 24-hour gas emergency response crews whose average response time to gas emergencies is under 30 minutes, enabling much quicker control of escaping gas.

Operational innovations
As part of a large-scale project to upgrade a natural gas transmission pipeline, SDG&E is deploying cutting-edge fiber optic sensing technology to monitor and locate digging vibrations near the pipe to protect against dig-ins and leaks. Enhanced analytics from fiber optics will help operators respond more quickly to issues and prevent natural gas from escaping into the atmosphere. Additionally, SDG&E is recapturing gas that needs to be purged from a pipeline during construction and re-injecting it back into the system for customer use.

Urban greening
Since launching its sustainability strategy in October 2020, SDG&E has planted more than 10,000 trees, leveraging a nature-based solution to capture carbon and clean the air.

To help ensure that decarbonization is equitable, SDG&E will continue investing in its "Outside In" community outreach program to meet the needs of diverse, underserved and disadvantaged communities through sustainability initiatives.

Acronyms & abbreviations

AI: Artificial Intelligence

BEV: Battery Electric Vehicle

CAISO: California Independent System Operator

CARB: California Air Resources Board

CCS: Carbon Capture and Sequestration

CEC: California Energy Commission

CPUC: California Public Utilities Commission

EO: Executive Order (in this instance, referring to an order issued by the Governor of California)

EV: Electric Vehicle

GDP: Gross Domestic Product

GHG: Greenhouse Gas

GW: Gigawatts

HDV: Heavy-Duty Vehicle

HFCV: Hydrogen Fuel Cell Vehicle

LDV: Light-Duty Vehicle

LOLE: Loss of Load Expectation

MDV: Medium-Duty Vehicle

MMT: Million Metric Tons

MW: Megawatts

NERC: North American Electric Reliability Corporation

PHEV: Plug-in Hybrid Electric Vehicle

RTO: Regional Transmission Organization

SB: Senate Bill (in this instance, referring to a bill passed by the California Senate)

TWh: Terawatt Hours

ZEV: Zero-Emission Vehicle

Glossary

Carbon Capture & Sequestration (CCS): The process of capturing carbon dioxide (CO_2) from a stationary source of emissions, typically an industrial facility or power plant. The CO_2 is then compressed, transported and permanently sequestered.

Carbon Neutrality: All greenhouse gas (GHG) emissions emitted into the atmosphere are balanced in equal measure by GHGs that are removed from the atmosphere. In this report, this is used interchangeably with Net Zero Emissions.

Carbon Removal Technologies: A term that encompasses many forms of GHG removal from the atmosphere, whether through carbon sequestration in natural and working lands, or through negative emissions technologies that actively pull carbon dioxide out of the atmosphere, such as direct air capture or biomass energy with CCS.

Clean Fuels: Low-carbon fuel substitutes, like clean hydrogen produced with renewable energy sources, or renewable natural gas, for fossil fuels such as natural gas. They are distinct from "clean electricity," which provides energy in the form of decarbonized electrical power.

Clean Hydrogen Generation: Dispatchable electric generators that produce clean electricity by combusting clean hydrogen fuel, typically in a combined cycle turbine.

Decarbonization: The reduction or elimination of CO_2 and other greenhouse gases.

Dispatchable Generation: Electric generation that can be controlled and is available when needed, in contrast to weather-dependent wind and solar generation.

Economywide: Including all economic sectors of the California economy (electric, transportation, residential, commercial, industrial and agriculture).

Electric Generation Capacity: The maximum output an electric power generator can produce; for large facilities, like at the scale generally contracted or owned by utilities, this is measured in megawatts (MW) or gigawatts (GW).

Electric Reliability: The degree to which the electric power system can deliver electricity to consumers in the amount desired, and within the accepted standards.

Electrification: The process of replacing technologies that use fossil fuels with technologies that use electricity as a source of energy.

Energy Transition: The energy sector's shift from fossil-based systems of energy production and consumption to renewable energy.

EO B-55-18: Establishes a statewide goal to achieve carbon neutrality by 2045.

EO N-79-20: Requires 100% of in-state sales of new passenger cars/trucks will be zero emissions by 2035. Requires 100% of in-state sales of medium/heavy-duty vehicles will be zero emissions by 2045. Requires 100% of off-road vehicles/equipment will be zero emissions by 2035.

EO S-3-05: Establishes the following GHG emission reduction targets:

By 2020, Reduce GHG Emissions to 1990 levels;

By 2050, Reduce GHG Emissions to 80% below 1990 levels.

Equity: Offers fair treatment, access, opportunity and advancement for everyone. Equitable practices identify and seek to eliminate barriers that prevent someone's full participation, recognizing that each person's needs are not the same. Climate equity means providing all customers equitable access to clean energy as well as climate resilience tools and technologies.

Gigawatts (GW): A unit of electric power equal to 1,000 megawatts (MW).

Greenhouse Gases (GHG): Gases that trap heat in the atmosphere. Greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases.

Heavy-Duty Vehicle (HDV): Any motor vehicle with a gross vehicle weight above 26,000 pounds.

Imported Generation: Generation capacity that is physically located outside of California (e.g., Arizona, Nevada), but is connected to the California electric system.

Interconnect: A multistep process that enables an electric generator to interconnect to the electric grid and supply power.

Intermittent (Variable) Generation: Wind and solar generation that is not continuously available due to external factors that cannot be controlled (i.e. weather).

Light-Duty Vehicle (LDV): Any motor vehicle with a gross vehicle weight of 10,000 pounds or less.

Load Serving Entity: Any company that sells or provides electricity to customers located in California.

Long-Term Battery Storage: Battery storage with a duration of 12+ hours.

Loss of Load Expectation (LOLE): A measure of electric reliability. The expected number of days per time period (usually a year) for which the available generation capacity is insufficient to serve electric demand at least once per day.

LOLE counts the days having loss of load events, based on a stochastic variation of historical supply data, regardless of the number of consecutive or nonconsecutive loss of load hours in the day. The study applies the industry standard of 0.1 days per year or 1 day in 10 years.

Make Ready Infrastructure: Electrical infrastructure required to install and operate charging stations, which usually includes utility pad-mounted transformers, underground conduit and meters.

Medium-Duty Vehicle (MDV): Any motor vehicle with a gross vehicle weight between 10,001 and 26,000 pounds.

MMTCO$_2$e: Million Metric Tons of Carbon Dioxide Equivalents. The climate impact of all GHG converted into a mass of carbon dioxide equivalent.

Net Peak Demand: The difference between base electric demand and generation from behind the meter resources.

Net Zero Emissions: All GHG emissions emitted into the atmosphere are balanced in equal measure by GHGs that are removed from the atmosphere. In this report, this is used interchangeably with Carbon Neutrality.

Pipeline Blending: Replacing natural gas with clean fuels, such as renewable natural gas and clean hydrogen, to reduce GHG emissions from using gaseous pipeline fuels.

Renewable Natural Gas: Gas derived from food waste, landfills, agriculture and other sources that release carbon emissions into the atmosphere.

Resiliency: The ability to withstand and reduce the magnitude of disruptive events, which includes the capability to anticipate, adapt to and/or rapidly recover from such an event.

SB 32: Requires that statewide GHG emissions are reduced to 40% below the 1990 level by 2030.

SB 100: Requires that 100% of retail sales of electricity in California be served by eligible renewable energy resources and zero-carbon resources by 2045.

State Mandated Public Purpose Programs: State-mandated programs funded through energy bills like financial assistance for income qualified customers and energy efficiency programs.

Transmission & Distribution: Transmission lines carry electricity at high voltages across the state. Distribution lines deliver lower voltage electricity to neighborhoods and communities over a shorter distance, and are the final stage of electricity delivery to homes and businesses.

Vehicle to Grid Integration: Any method that changes how grid-connected electric vehicles charge or discharge their batteries. This is done to optimize plug-in electric vehicle interaction with the electrical grid and provide net benefits to ratepayers.

Zero-Emission Vehicles (ZEV): Vehicles which produce no emissions from the on-board source of power (i.e., an electric vehicle or fuel cell vehicle).

Disclaimer

This report contains statements that constitute forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995. Forward-looking statements are based on assumptions with respect to the future, involve risks and uncertainties, and are not guarantees. Future results may differ materially from those expressed in any forward-looking statements. These forward-looking statements represent our estimates and assumptions only as of the date of this report. We assume no obligation to update or revise any forward-looking statement as a result of new information, future events or other factors.

In this report, forward-looking statements can be identified by words such as "believes," "expects," "intends," "anticipates," "plans," "estimates," "projects," "forecasts," "should," "could," "would," "will," "confident," "may," "can," "potential," "possible," "proposed," "in process," "under construction," "in development," "opportunity," "target," "outlook," "maintain," "continue," "goal," "aim," "commit," or similar expressions, or when we discuss our guidance, priorities, strategy, goals, vision, mission, opportunities, projections, intentions or expectations.

Factors, among others, that could cause actual results and events to differ materially from those described in any forward-looking statements include risks and uncertainties relating to: California wildfires, including the risks that we may be found liable for damages regardless of fault and that we may not be able to recover all or a substantial portion of costs from insurance, the wildfire fund established by California Assembly Bill 1054, in rates from customers or a combination thereof; decisions, investigations, regulations, issuances or revocations of permits and other authorizations, renewals of franchises, and other actions by (i) the California Public Utilities Commission (CPUC), U.S. Department of Energy, U.S. Federal Energy Regulatory Commission, and other regulatory and governmental bodies and (ii) states, counties, cities and other jurisdictions in the U.S. in which we do business; the success of business development efforts and construction projects, including risks in (i) completing construction projects or other transactions on schedule and budget, (ii) the ability to realize anticipated benefits from any of these efforts if completed, and (iii) obtaining the consent or approval of partners or other third parties, including governmental entities and regulatory bodies; the resolution of civil and criminal litigation, regulatory inquiries, investigations and proceedings, and arbitrations; changes to laws; actions by credit rating agencies to downgrade our credit ratings or to place those ratings on negative outlook and our ability to borrow on favorable terms and meet our debt service obligations; the impact of energy and climate policies, legislation and rulemaking, as well as related goals set, and actions taken, by companies in our industry, including actions to reduce or eliminate reliance on natural gas generally and any deterioration of or increased uncertainty in the political or regulatory environment for California natural gas distribution companies and the risk of nonrecovery for stranded assets; the pace of the development and adoption of new technologies in the energy sector, including those designed to support governmental and private party energy and climate goals, and our ability to timely and economically incorporate them into our business; weather, natural disasters, pandemics, accidents, equipment failures, explosions, acts of terrorism, information system outages or other events that disrupt our operations, damage our facilities and systems, cause the release of harmful materials, cause fires or subject us to liability for property damage or personal injuries, fines and penalties, some of which may not be covered by insurance, may be disputed by insurers or may otherwise not be recoverable through regulatory mechanisms or may impact our ability to obtain satisfactory levels of affordable insurance; the availability of electric power and natural gas and natural gas storage capacity, including disruptions caused by failures in the transmission grid or limitations on the withdrawal of natural gas from storage facilities; the impact of the COVID-19 pandemic, including potential vaccination mandates, on capital projects, regulatory approvals and the execution of our operations; cybersecurity threats to the energy grid, storage and pipeline infrastructure, information and systems used to operate our businesses, and confidentiality of our proprietary information and personal information of our customers and employees, including ransomware attacks on our systems and the systems of third-party vendors and other parties with which we conduct business, all of which may become more pronounced in the event of geopolitical events and other uncertainties, such as the conflict in Ukraine; the impact on competitive customer rates and reliability due to the growth in distributed and local power generation, including from departing retail load resulting from customers transferring to Community Choice Aggregation and Direct Access, and the risk of nonrecovery for stranded assets and contractual obligations; volatility in inflation and interest rates and commodity prices, including inflationary pressures in the U.S., and our ability to effectively hedge these risks and with respect to inflation and interest rates, the impact on our cost of capital and the affordability of customer rates; changes in tax and trade policies, laws and regulations, including tariffs and revisions to international trade agreements that may increase our costs, reduce our competitiveness, or impair our ability to resolve trade disputes; and other uncertainties, some of which may be difficult to predict and are beyond our control.

These risks and uncertainties are further discussed in the reports that the company has filed with the U.S. Securities and Exchange Commission (SEC). These reports are available through the EDGAR system free-of-charge on the SEC's website, www.sec.gov, and on Sempra's website, www.sempra.com. Investors should not rely unduly on any forward-looking statements.

This report may include market, demographic and industry data and forecasts that are based on or derived from independent industry publications, publicly available information, government data and other similar information from third parties. We do not guarantee the accuracy or completeness of any of this information, and we have not independently verified any of the information provided by these third-party sources. In addition, market, demographic and industry data and forecasts involve estimates, assumptions and other uncertainties and are subject to change based on various factors, including those discussed above. Accordingly, you should not place undue reliance on any of this information. This report also contains links to third-party websites that are not hosted or managed by Sempra or its family of companies, including SDG&E. We are not responsible for, nor do we recommend, endorse or support, any information contained on any such third-party websites.

Sempra Infrastructure, Sempra LNG, Sempra Texas Utilities, Oncor Electric Delivery Company LLC (Oncor) and Infraestructura Energética Nova, S.A.P.I. de C.V. (IEnova) are not the same companies as the California utilities, San Diego Gas & Electric Company or Southern California Gas Company, and Sempra Infrastructure, Sempra LNG, Sempra Texas Utilities, Oncor and IEnova are not regulated by the CPUC.

The Path to Net Zero: A Decarbonization *Roadmap* for California was prepared based on information available at the date of publication. It is for general informational purposes only. SDG&E, Black & Veatch Management Consulting, LLC and David G. Victor, the preparers of The Path to Net Zero: A Decarbonization *Roadmap* for California, do not guarantee or make any representation or warranty as to the accuracy, reliability, completeness, or currency of the information. Readers should assess the relevance and accuracy of the content for themselves. The preparers of The Path to Net Zero: A Decarbonization *Roadmap* for California will not be liable for any loss, damage, cost, or expense incurred or arising by reason of any person using or relying on information in The Path to Net Zero: A Decarbonization *Roadmap* for California.

The Boston Consulting Group ("BCG") provided SDG&E with market research, data and review of the techno-economic analysis that SDG&E used in preparation of this report. The report's recommendations and specific recommendations and forward-looking statements in the report do not necessarily represent BCG's views. BCG used data from various sources and assumptions provided to BCG from other sources and modeling methodology from the preparers. BCG has not independently verified the data and assumptions from these sources or such modeling methodology. Changes in the underlying data, modeling methodology, or operating assumptions will clearly impact the analyses and conclusions. Neither BCG nor any of the preparers will be liable for any loss, damage, cost, or expense incurred or arising by reason of any person using or relying on information in this report.

P.O. Box 129831 | San Diego, CA 92112-9831 |
1-800-411-7343 | Connect at sdge.com

The Path to Net Zero: A Decarbonization Roadmap for California

Technical Appendix
April 2022

REV1

1 Modeling approach, methodology and assumptions

1.1 Overall modeling approach

The Path to Net Zero: A Decarbonization Roadmap for California (Roadmap) relies on multiple economic and electric power systems scenario modeling tools to evaluate a range of assumptions that could affect how California meets its economywide decarbonization and policy targets by 2045. The approach leverages past analyses of California decarbonization pathways, along with updated cost and technology assumptions. The methodology used in this study leverages a number of modeling tools to examine decarbonized futures on different geographical scales, including a Western Electricity Coordinating Council (WECC)-wide electricity capacity expansion model, a comprehensive reliability assessment of California's electric generation supply portfolio through 2045 and an evaluation of illustrative economic impacts both across the state and in San Diego Gas & Electric's (SDG&E) service area.

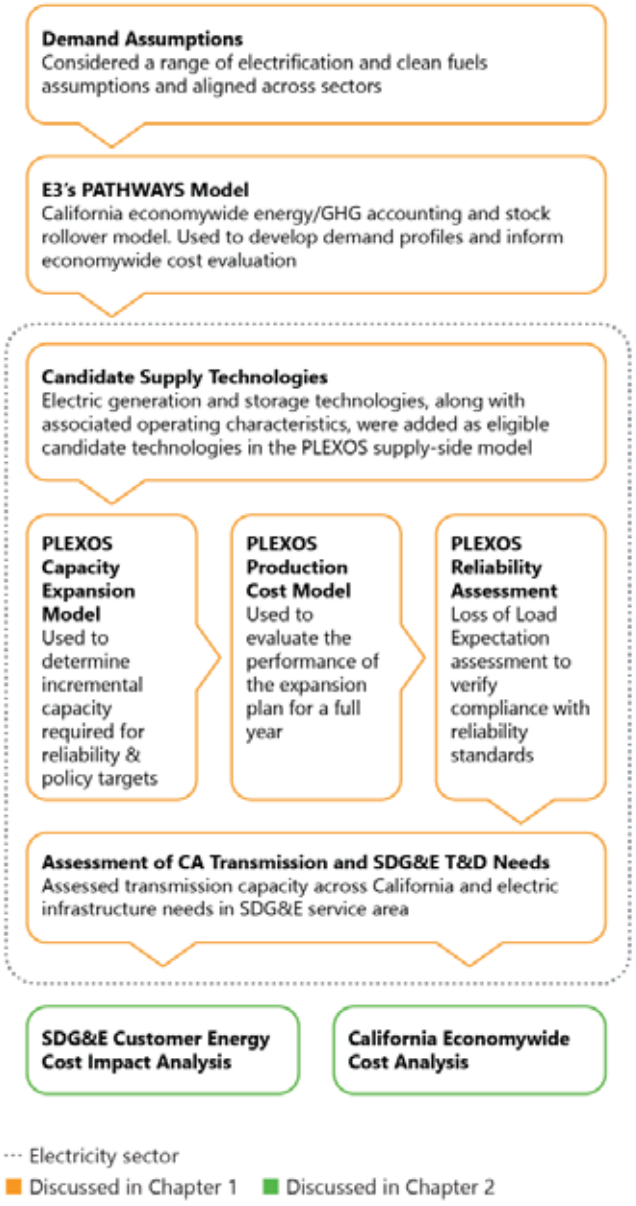
The Roadmap presented here is our evaluation of the combination of assumptions that should allow the state to meet its decarbonization goals, while helping to ensure feasibility, reliability and affordability. By 2030, the Roadmap yields a reduction in greenhouse gas (GHG) emissions of approximately 44% below 1990 levels, exceeding the state's 2030 requirement of 40% below 1990 levels.[1] By 2045, the Roadmap yields approximately an 84% reduction in GHG emissions, relative to 1990 levels, five years earlier than the current state goal.[2] Finally, to achieve the state's goal of net zero GHG emissions by 2045, carbon dioxide removal (CDR) technologies are used to remove the remaining 68 million metric tons (MMT) of emissions from the atmosphere.[3] Uncertainties related to the future costs and efficiency of CDR technologies like direct air capture (DAC), and other CDR technologies and strategies, made them difficult to model and were not evaluated as part of the analysis.

The methodology used in this study allowed SDG&E to evaluate a large number of assumptions, some of which involve substantial uncertainties. Furthermore, SDG&E was able to assess an array of possible strategies for decarbonization in terms of their cost to consumers, levels of investment needed and practicality. It also allowed assessment of the risks that could arise – for example, if there were complete electrification of the building and transportation sectors, as some have envisioned, that might require appliance and vehicle switching to degrees that could be highly disruptive. Though this study leveraged advanced modeling techniques with a large number of assumptions and considerations, the Roadmap acknowledges that technological, modeling, ecosystem and behavioral uncertainties exist that should be explored further.

[1] Senate Bill (SB) 32 requires statewide GHG emissions are reduced to 40% below the 1990 level by 2030.
[2] Executive Order (EO) S-03-05 establishes a statewide goal to reduce GHG emissions to below 80% below 1990 levels by 2050.
[3] EO B-55-18 establishes a statewide goal to achieve carbon neutrality as soon as possible, but no later than 2045.

The modeling approach, summarized in Figure A1, included the following components:

FIGURE A1
SDG&E net zero modeling approach

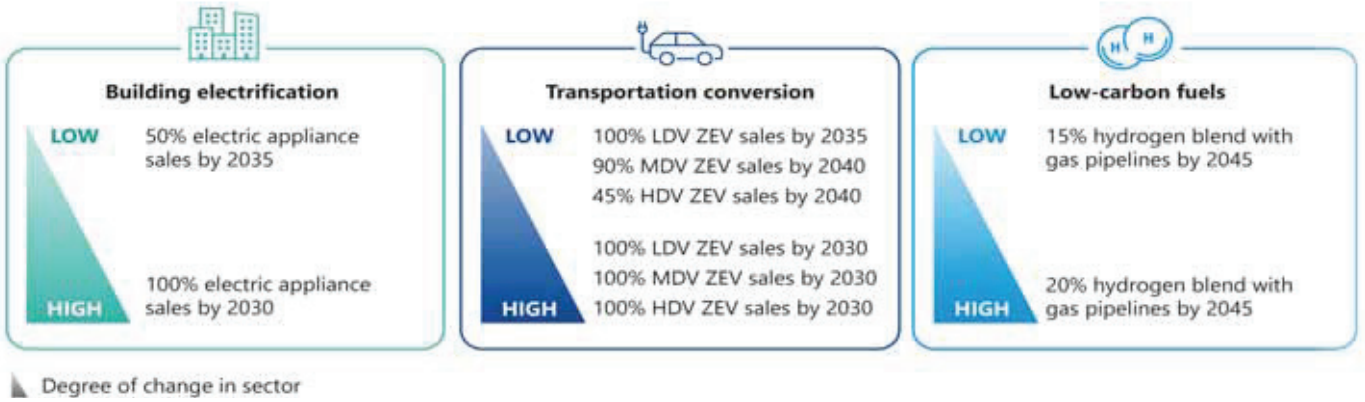


1) **Demand Assumptions:** This study leveraged modeling efforts outlined in the October 2020 Energy and Environmental Economics, Inc. (E3) report, *Achieving Carbon Neutrality in California*, to inform assumptions about the factors that affect how sectors of the economy demand and consume energy.

   Most assumptions used to inform the Roadmap derive from the three decarbonization pathways outlined in the E3 report.[4] This study also considered distinct assumptions consistent with a comparatively slower pace of electrification and a greater dependence on clean fuels.[5]

   All assumptions, and clusters of such assumptions, include a number of common elements: high levels of energy efficiency, behind-the-meter solar growth, renewable electricity generation and electrification of the transportation and buildings sector along with deep reductions in non-energy and non-combustion GHG emissions like methane and hydrofluorocarbons. The figure below outlines the range of assumptions considered across building electrification, transportation conversion and low carbon fuels:

FIGURE A2
Analyzing uncertain futures: ranges of assumptions modeled



Building Electrification: The Roadmap assumes 100% electric appliance sales by 2035. As the attributes of new appliances are altered these new appliances then diffuse into more widespread application as new replaces old. No forced retirements were assumed (natural replacement).

Transportation Conversion: The Roadmap assumes 100% light-duty vehicle (LDV) sales, 90% medium-duty vehicle (MDV) and 93% heavy-duty vehicle (HDV) zero-emission vehicle (ZEV) sales by 2035.[6] No forced retirements were assumed (natural replacement).

[4] These pathways are the "High Carbon Dioxide Removal," "Balanced," and "Zero-Carbon Energy" pathways, as described in E3's October 2020 "Achieving Carbon Neutrality in California" report.
[5] In this cluster of assumptions, the existing gas distribution system is leveraged with an objective of improving affordability, maintaining dispatchable low-carbon energy reliability and reducing emissions.
[6] The presented Roadmap assumes 10% compressed natural gas (CNG) MDVs by 2035. CNG used as fuel for transportation follows the same blend as that specified in the pipeline gas blend, therefore it's a split between conventional natural gas, renewable natural gas and hydrogen.

Low-Carbon Fuels: The study evaluated several decarbonization strategies for clean fuel pipeline blending over the study horizon, replacing natural gas with clean fuels, i.e., clean hydrogen and renewable natural gas.[7] The Roadmap projects the composition of the fuel in the pipeline to be comprise of 58% natural gas, 28% renewable natural gas and 14% clean hydrogen in 2045.

Additionally, the electricity required to produce hydrogen for use in industry, electric generation and gas pipeline blending is assumed to be off-grid and is not included in the electricity consumption and net peak demand values. The electricity used to produce hydrogen for use in the transportation sector is assumed to be on-grid is included in the electricity consumption and net peak demand values.

2) **PATHWAYS Demand Model:** This study used the E3 PATHWAYS economywide energy and GHG accounting model to test different "what-if" approaches to decarbonization and project – through 2045 – energy demand, cost and GHG emissions across California's economy.[8] The PATHWAYS model takes into consideration the timing of investments to replace appliances, vehicles, buildings and other infrastructure along with growth and sectoral changes across the economy. It captures the dynamics between incremental new loads from transportation and buildings and examines the role of low-carbon fuels such as biofuels and hydrogen.

   The main outputs used in this study of the PATHWAYS modeling are annual electric demand, net electricity peak, non-electric fossil and low-carbon fuel demand, non-electric economywide costs (represented as equipment stock costs) and non-electric emissions in California. These outputs are combined with PLEXOS supply-side modeling to yield implications for economywide costs and GHG emissions.

[7] Clean hydrogen refers to either "green" or "blue" hydrogen. See, for example, the World Economic Forum for definitions of these sources of hydrogen, in particular *Grey, blue, green – why are there so many colors of hydrogen?*, available here: https://www.weforum.org/agenda/2021/07/clean-energy-green-hydrogen.
[8] Modeling efforts leverage version 2.3.2 of the E3 PATHWAYS model. Additional details about the PATHWAYS model can be found on E3's website at https://www.ethree.com/tools/pathways-model/.

3) **Energy Exemplar's PLEXOS®:** This study used Energy Exemplar's PLEXOS software, an advanced power system modeling tool used for electricity market modeling, to complete an iterative process to determine a capacity expansion solution for California's power market that met stringent requirements for reliability and emissions.

   This analysis used PLEXOS for three functions: (1) a deterministic WECC-wide capacity expansion simulation; (2) a deterministic production cost model; (3) a stochastic simulation to confirm power system reliability.

   Candidate Supply Technologies: As a first step in electric generation supply modeling, the study identified a variety of mature and emerging electric generation technologies to meet the projected electricity demand from PATHWAYS and to help enable the state to achieve its decarbonization goals over the study horizon. Eligible candidate technologies were input into the PLEXOS model (see next section), along with their financial, technical and operational parameters and characteristics. Subject-matter experts evaluated candidate technologies, prioritizing those with proven commercial viability, practicality and achievability within California, and taking account of the state's existing regulations.

   The following eligible candidate technologies were considered and included in the PLEXOS capacity expansion model. The same set of eligible candidate technologies and assumptions were used across all modeled assumption clusters. All technologies are in-state unless otherwise specified.

   - Renewable and Clean Generation Technologies
     - Land-based solar photovoltaic and solar thermal generation
     - Land-based wind generation
     - Off-shore floating wind generation
     - Geothermal
     - Out-of-state solar and wind
   - Energy Storage Technologies
     - Short Duration (Li-ion/zinc)
     - Long Duration (Flow)
     - Pumped Storage (Hydro)
   - Near Zero and Zero Emissions Dispatchable Technologies
     - Biomass
     - Natural Gas with carbon capture and sequestration (CCS), both new build and retrofits of existing natural gas facilities
     - 100% clean hydrogen generation - new build
     - Hydrogen retrofits of existing natural gas facilities

   Expansion candidate technology and fuel price assumptions were largely consistent with those used in the RESOLVE model developed for the California Public Utilities Commission (CPUC) 2019 Integrated Resource Plan (IRP) proceeding. This study leveraged the "mid-case" in the RESOLVE 2019 Resource Cost and Build dataset, the most recent publicly available version at the onset of this study.

Technologies unique to this analysis include Natural Gas and CCS and hydrogen-based generation. Costs for these resources were derived from Black & Veatch practical technology and engineering expertise. The CCS costs and characteristics assumptions modeled are consistent with those found in the National Energy Technology Laboratory's (NETL) 2019 Cost and Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity Report.

Hydrogen cost assumptions were developed using California-specific market intelligence by Black & Veatch subject-matter experts. A fully delivered (storage, fuel and transportation) all-in cost projection was developed and utilized, as reflected in Table 1 below.

Table 1. Hydrogen Fuel Pricing Assumptions ($/MMBtu)[9]

Fuel Type	Min (USD), 2021-2030	Max (USD), 2021-2030	Min (USD), 2030+	Max (USD), 2030+
Clean Hydrogen Production	$18.00	$70.00	$10.00	$26.00
Hydrogen Storage + Transportation	$2.00	$40.00	$2.00	$40.00

a. **PLEXOS Capacity Expansion Model:** A deterministic long-term capacity expansion simulation was completed to forecast how the power system may evolve over the study horizon. The capacity expansion model was used to determine the cost-optimal mix of incremental power generation capacity needed through 2045 to meet the California electricity demand generated by PATHWAYS. To determine the optimal resource mix, only technologies included as eligible candidate supply technologies, as noted above, could be selected by the model as new generation resource builds.

As a first step in electric power system modeling, key inputs and assumptions were entered into the zonal WECC-wide model to optimize least-cost resources and satisfy the modeled demand profiles, while still meeting the study's emissions and renewables goals. The study developed a deterministic WECC modeling in PLEXOS, utilizing SDG&E specific information and California electric generation baseline resources, and implemented the following assumptions and constraints:

- *Model horizon:* A zonal model horizon of 2021–2045 with electricity demand in all 8760 hours of each year as modeled in the PATHWAYS output.

- *Electric Generation Emissions*: This study implemented emissions constraints leveraging two methods: (1) A California GHG emissions constraint of 38 MMT in 2030 and 0 MMT in 2045, and (2) hourly import emissions constraints. Both targets were embedded to serve retail sales with 100% clean energy by 2045 to ensure compliance with SB 100.

[9] Hydrogen fuel pricing is based on Black & Veatch's analysis and confidential market data specifically for this study, which assumes large quantities of hydrogen transported via pipeline. Values should not be assumed to be replicated outside of this study, nor be assumed to be applicable to smaller quantities of hydrogen production and transport.

- *Existing Generation Technologies and Units:* Existing generation resource technologies were included based off of the California Independent System Operator (CAISO) CAISO PLEXOS Model. Generation characteristics including retirement, availability capacity, emissions and price curves were included, consistent with 2019 IRP assumptions from the CPUC.

- *Expansion Candidate Technologies:* Expansion candidate technology characteristics and pricing as described above in section 3 "Candidate Technologies".

After a long-term capacity expansion model for the given assumptions was modeled and reviewed, production cost modeling and reliability modeling was performed.

b. **PLEXOS Production Cost Model:** This study utilized PLEXOS for production cost modeling. Using a deterministic linear programming technique, it identifies the most economic dispatch of resources across various weather conditions to meet operational needs on an hourly basis in CAISO (e.g., demand, ancillary service) for a bulk power system and ensure that load is reliably met in every hour of every day at every location. If infeasibilities such as unserved energy or emissions violations occurred, adjustments were made to the capacity expansion and the production cost model was rerun until infeasibilities were resolved.

   Unlike a capacity expansion model, production cost models evaluate the power system over a shorter timeframe but at a higher temporal resolution. The mixed-integer simulation was run over the full 25-year horizon (2021–2045) to determine the optimal dispatch and total system cost of the available generation resources.[10]

c. **PLEXOS® Reliability Assessment:** This study leveraged PLEXOS to model power system reliability based on the resource selections made in the capacity expansion model. A Monte Carlo-based stochastic simulation calculated the loss of load expectation (LOLE) for each capacity expansion build during key benchmark years (primarily 2045), leveraging 30 years of weather, renewable generation, random outage data and load variables. The stochastic model runs a number of samples against the forced outage probabilities to determine the number of loss-of-load events. In doing so, the simulation includes unserved energy estimates for every hour within the simulation horizon where demand exceeds generation. Capacity expansion builds were deemed reliable if they met the criteria of 1 loss-of-load event in 10 years, the industry standard for reliability found in the North American Reliability Corporation (NERC) guidelines.[11]

[10] Production cost modeling utilized the optimized build as a result from the long-term capacity expansion. Production cost simulations were run for each year in the 25-year planning horizon to determine annual emissions, energy generation by technology and total energy system costs of the power system necessary to inform the full economywide costs of the presented Roadmap. This simulation also included emissions targets consistent with those in the long-term capacity expansion plan. Additionally, annual production simulation identified where potential infeasibilities and unserved hours occurred, informing the years in which reliability assessments should be considered and revisions to capacity build should be made.

[11] NERC: Reliability Standards for the Bulk Electric Systems of North America: LOLE is defined as the expected number of days per time period (usually a year) for which the available generation capacity is insufficient to serve

As described in the narrative of this study, this approach to studying reliability identified the critical need for clean dispatchable generation resources. The study observed that as renewable generation increased and emissions targets forced much lower utilization of conventional natural gas plants, new or retrofitted clean firm resources were required to fill the need previously served by the gas generators. This study tested numerous variations of builds including the addition of even more renewable resources and battery energy storage. We found, however, that those resources alone were unable to meet the LOLE requirement more cost-effectively than a clean-firm dispatchable resource, such as 100% clean hydrogen generation. This result is consistent with other findings in the published academic literature and is a crucial insight that comes from full reliability analysis.

If capacity expansion model builds did not meet the 1-in-10 criteria, more zero emission firm generation resources were evaluated and added to the capacity resource mix to increase reliability; the LOLE analysis was repeated until the minimum LOLE criteria was met. Once a final, reliable build was determined, total build and system costs were modeled in the PLEXOS capacity expansion and production cost model.

While previous studies of California decarbonization relied on a planning reserve margin to guarantee reliability, SDG&E believes that this is insufficient to model the variability of a predominantly renewable generation portfolio. As such, the Roadmap was developed using the LOLE approach, which models the impact of weather variability on both demand and renewable generation and measures the instances that the electricity system is not able to serve all of the required load (a loss of load event). For power customers, what ultimately matters is the actual reliability of the grid and that is what this approach assesses.

4) **Transmission Investment:** Based on the PATHWAYS and PLEXOS expansion plans (i.e., expected system peaks, electricity consumption) an assessment was conducted to estimate the transmission investment needed to bring new generation resources to serve load.

   To determine in-state, greater CAISO and WECC incremental transmission, the study used the PLEXOS long-term capacity expansion plan, with the generation capacity informing the zonal transmission needs from renewable generation to in-state load centers. The study utilized transmission costs developed by CAISO and WECC to estimate incremental transmission costs associated with incremental generation resources.[12]

bulk power demand at least once per day (actual local reliability depends on many additional factors, such as redundancy of local power lines and transformers). LOLE counts the days with loss-of-load events, regardless of the number of consecutive or nonconsecutive loss-of-load hours in the day. The study applies the industry standard of 0.1 days per year or 1 day in 10 years.

[12] In-state capital transmission investment utilized the 2019 CAISO Whitepaper: Transmission Capability Estimates as an input to the CPUC Integrated Resource Plan Portfolio Development. Out-of-state transmissions capital investment was based on the CPUC SB380 Phase 3 Analysis by FTI on Out of State Transmissions projects to California.

2 Analysis of household impacts and economywide costs

2.1 SDG&E average residential customer energy cost impacts analysis

The following approach was used to estimate SDG&E-specific residential bundled customer (delivery and commodity) economic impacts:

- Estimated investments needed to support the Roadmap: SDG&E calculated Roadmap-related electric infrastructure investments and related costs by utilizing outputs from the PATHWAYS tool (specifically LDV, MDV, HDV electric vehicle (EV) stock figures, as well as changes in net peak demand). Investments related to the development of clean fuels infrastructure was not included in the scope of the analysis.

- Developing illustrative financial and rates models: Utilizing the Roadmap-related cost estimates described above, along with SDG&E capital plan figures and projected generation costs (outputs from the PLEXOS production cost model), illustrative electric and gas financial and rates models were run to estimate potential residential bundled customer rate impacts within the SDG&E service area.[13] Additional details are provided below – these assumptions were leveraged as starting points and were further refined given outputs from the emissions modeling efforts.

    - Key Revenue Requirement Assumptions:
        - Electric basis: used allocations embedded in approved 1/1/22 rates
        - Gas basis: used allocations embedded in approved 1/1/22 rates
        - 2022-2026 SDG&E 5-year capital plan data (electric and gas) and estimated decarbonization-related capital investments (electric only)
        - CPUC and Federal Energy Regulatory Commission (FERC) Filings
            - CPUC 2019 General Rate Case
            - 2020 CPUC Cost of Capital
            - FERC Transmission Owner Formula Rate 5, Cycle 4 Filing
            - FERC Form 1 and 2 data

    - Key Sales/Determinants Assumptions:
        - Electric basis: 2020 California Energy Demand Update (CEDU) through 2032
        - Gas basis: 2020 California Gas Report

- Estimating Annual Household Energy Spend: The study estimated the ongoing energy costs for a representative residential household in SDG&E's service area by leveraging these financial and rates modeling results, assumptions and outputs directly from PATHWAYS, external data sources and proprietary SDG&E data.[14] This illustrative analysis helped frame how decarbonization efforts could potentially impact an SDG&E residential household's overall ongoing energy expenses in 2045 (specifically, expenses related to electric and gas utility bills and gasoline for transportation).

[13] Generation capital investment cost estimates were levelized throughout the study horizon. Levelization utilized the National Renewable Energy Laboratories (NREL) Capital Cost Recovery Factor from the 2021 Annual Technology Baseline (ATB).
[14] Including the Energy Information Administration's (EIA) 2021 Annual Energy Outlook (AEO), U.S. Bureau of Labor Statistics, California Department of Industrial Relations, U.S. Department of Energy Fuel Conversion Factors and EIA Conversion Factors.

- General Financial Assumptions:
    - All SDG&E-specific cost estimates, rate projections and annual household energy spend figures are shown in real $2021, so exclude potential future inflation effects.
    - Projected electric and gas rates do not assume future changes in rate design.
    - Illustrative annual household energy spend analysis was focused on ongoing energy costs only.

Annual household energy spend analysis:

The annual household energy spend analysis utilized outputs from the financial and rate models to forecast illustrative energy cost impacts of the Roadmap for average residential bundled customers in SDG&E's service area. The analysis only estimates ongoing energy costs for residential customers and does not include upfront investment costs associated with electrifying appliances or vehicles, or the use of behind-the-meter solar generation.

Over the decarbonization timeline, the analysis assumes average adoption rates of certain low-emission technologies (electrified appliances and transportation) consistent with the PATHWAYS modeling assumptions and results. Utility-related costs leveraged estimated residential class average rates and forecasted residential consumption from the financial and rates modeling process. Moreover, the analysis attempted to estimate annual energy expenses for two different customer types (see residential customer types below).

Residential customer types:

To illustrate how decarbonization of the energy grid will impact customers differently, SDG&E modeled the annual household energy expenses of two different types of residential customers.

- The Adopter customer type represents a residential customer who electrifies their appliances and vehicles at the average pace of the Roadmap. Electric and natural gas consumption in the baseline year is based on SDG&E's estimated average residential customer consumption in 2022. For an Adopter, forecasted energy consumption in 2045 was derived from the change in average residential consumption estimated in the financial and rate modeling efforts, relative to the 2022 starting point. The drivers of these consumption changes include increasing adoption rate of low-emission appliances and vehicles, as well as efficiency increases in appliances and vehicles.

- The Non-Adopter customer type represents a residential home that makes no changes to its electric and gas consumption patterns from 2022–2045 and drives gasoline vehicles – in other words, a residential customer who does not embark on the decarbonization Roadmap.

Transportation Assumptions

Transportation costs were broken down into two categories: the gasoline costs of internal combustion engine (ICE) vehicles and EV-related charging costs. The Adopter customer type assumes a residential household will adopt EVs at the average rate that EVs penetrate the total vehicle stock (increasing over time). The Non-Adopter customer type assumes that the household will not adopt EVs at all, but rather continue to operate ICE vehicles through 2045.

Certain transportation-related assumptions were similar for both customer types, such as the number of vehicles per household and vehicle miles traveled. Transportation costs differ between the customer types due to their choice of vehicle technology, vehicle efficiencies, and the cost of each vehicle fuel type through 2045. While EV penetration rates reflected both plug-in hybrid vehicles (PHEVs) and battery electric vehicle (BEV), a simplifying assumption was made to leverage BEV efficiencies as a proxy for EVs in general.

Retail gasoline prices through 2045 were projected by taking the annual 2021 average price of a gallon of gasoline by component from the California Energy Commission's (CEC) weekly gasoline price breakdown.[15] Next, the average 2021 price of the crude oil component was aligned with the Energy Information Administration's (EIA) 2021 Annual Energy Outlook (AEO) crude oil $/barrel forecast, while other gasoline components were held constant at a real $2021 level.[16]

Forecasted Electric Cost Assumptions:

In addition to transportation, electric costs differ between customer types based on the rate at which each sample customer switches from natural gas appliances to electric. The Adopter customer type assumes that a household would adopt electric appliances in place of natural gas appliances at the average rate at which the total appliance stock electrifies within the Roadmap, incrementally increasing electric usage over time.

The Non-Adopter customer type assumes that a household's electric and natural gas consumption will stay constant at the baseline 2022 levels. In other words, the Non-Adopter household will not substitute any of its current natural gas appliances with electric appliances through 2045, and the existing appliance efficiencies will remain constant. Forecasted electric rates are applied to the specific electric consumption of each customer type through 2045.

Forecasted Natural Gas Cost Assumptions:

Natural gas costs for each customer type reflect the estimated household consumption in the future combined with forecasted $/therm price increases.[17] Natural gas commodity prices were leveraged from the CA RESOLVE model. Forecasted natural gas rates are applied to the specific natural gas consumption of each customer type through 2045. As overall system throughput declines, the per unit cost to deliver gas to SDG&E gas customers is projected to increase.

The Adopter customer type assumes a household decreases its natural gas usage over time, in alignment with projected gas throughput decreases and forecasted electrification of appliances and vehicles. The Non-Adopter customer type once again assumes that a customer's energy consumption will not change over time and the household natural gas usage will remain constant at the 2022 baseline level.

[15] CEC Estimated Gasoline Price Breakdown and Margins – 2021 data.
[16] Carbon costs were not included in the scope of this analysis. If those factors were included then the savings for adopter households would be much larger.
[17] The commodity portion of the gas rate reflects different amounts of blending, aligned with the methodology used for economywide costs which leveraged outputs from PLEXOS, RESOLVE and PATHWAYS.

Table 2. Annual Household Energy Spend by customer type

	Non-Adopter		Adopter	
	2022	2045	2022	2045
Electricity	$1,614	$1,563	$1,657	$3,146
Natural Gas	$569	$2,106	$569	$835
Gasoline	$2,064	$1,574	$2,012	$255
Total	**$4,248**	**$5,243**	**$4,238**	**$4,236**

Table 3. Annual Household Energy Spend Key Assumptions

Key Assumptions – Adopter (Real $2021)	Source[18]	2022	2045
Electric Rate ($/kWh)	Calculated	$0.345	$0.334
Gas Rate ($/therm)	Calculated	$2.06	$7.63
Gasoline Price ($/gallon)	CEC and EIA[19]	$4.18	$5.69
Electric Consumption (kWh/mo)	Calculated	400	784
Nat Gas Consumption (therm/mo)	Calculated	23.0	9.1
Vehicles per Household (LDVs)	PATHWAYS	1.77	1.95
Vehicle Miles Travelled (miles/yr)	PATHWAYS	11,233	9,492
EV Penetration (%)	PATHWAYS	2.6%	84%

2.2 Economywide costs analysis

A California economywide cost estimate was generated across anticipated supply- and demand-side investments. Economywide costs were calculated from modeling output, publicly available sources and stock cost assumptions embedded in E3's PATHWAYS tool, with minimal adjustments focused on updates to key costs that had shifted since their input into the PATHWAYS tool (i.e., costs of electric/hydrogen fuel-cell vehicles, space heaters and water heaters). Similarly, liquid and pipeline fuel costs were measured utilizing demand output data, with updated costs assumptions primarily from 2021 EIA AEO data, embedded PATHWAYS cost assumptions and Black & Veatch assumptions.

The economywide cost calculation provides a high-level estimate of cumulative expenditure between 2021 and 2045 associated with the decarbonization Roadmap represent full costs (not incremental).[20] As referenced in the white paper, percentage of California GDP figures were calculated to help frame the overall size of the economywide investments. To do this, annual estimated economywide costs were compared with annual projected California GDP estimates. GDP was forecasted by using 2021

[18] Residential rates and consumption (for both electric and gas) were calculated using a high-level, illustrative rates model utilizing internal data as well as outputs and assumptions derived from demand-side and supply-side modeling.
[19] Average 2021 oil crude oil price taken from CEC Estimated Gasoline Price Breakdown and Margins and aligned with EIA 2021 Annual Energy Outlook crude oil forecast. Other gasoline components are held constant at a 2021 level.
[20] This study did not include the cost of emissions removal required in 2045 and beyond, nor did it include a "business as usual" economywide cost estimate.

California GDP and applying a real growth rate of 2.7% annually through 2045.[21] On a discounted basis, estimated economywide costs through 2045 were projected to be approximately $2.7T in real 2021 dollars.[22] Of this total, approximately 75% is related to equipment stock costs, approximately 17% is fuel and approximately 8% is electric generation and production. Within equipment stock costs, the majority (approximately 67%) is comprised of transportation-related investments.

This calculation reflects both supply- and demand-side cost estimates, leveraging cost assumptions that are provided subsequently in this appendix.[23]

- The demand-side cost estimates were captured as follows:
  - PATHWAYS model output, reflecting updated assumptions for key cost elements including decarbonization of the transportation, buildings, and industrial sectors including transportation and building stock costs, conventional fuels, pipeline fuels and biofuels
  - PATHWAYS fuel demand output with out-of-model calculations for conventional fuels, hydrogen fuels and biofuels.
    - PATHWAYS outputs incorporate fuel savings and lifecycle costs for decarbonization, and the out-of-model calculations supplement the PATHWAYS model by incorporating upfront capital expenditures not included in PATHWAYS.

- The supply-side cost estimates were captured as follows:
  - PLEXOS model outputs for capacity additions (new generation, storage) and their associated capital and operations (such as fuel) and maintenance costs.
  - Electrical transmission infrastructure costs via out-of-model calculations for additional transmission infrastructure as previously described.

Supply cost methodology

On the supply side, generation costs are calculated as the product of new generation and storage capacity, output by the PLEXOS capacity expansion model, and the associated capital cost for each resource type based on CPUC's RESOLVE IRP. Cost assumptions from Black & Veatch were utilized for CCS technologies and hydrogen fuel assumptions. Total new build and capital costs estimates were pulled directly from the long-term capacity expansion model. Annual system costs of power system operation derived from simulation results of the production cost model for each year in the study horizon. Modeled new build capacity expansion costs in California were levelized each year over the study period.

Transmission infrastructure costs were broken into the following categories, each with a unique calculation method:

[21] Represents 10-year historical real CAGR, U.S. BEA GDP by State SQGDP2.
[22] Utilizing a real discount factor of 10%, consistent with the factor used in E3 PATHWAYS to levelize (annuitize) costs.
[23] All economywide cost figures are presented in 2021 dollars.

a. **Transmission Infrastructure for the rest of California:** Calculated based on the in-state renewable generation capacity expansion plan developed in PLEXOS. The study used various published transmission outlooks developed by CAISO to determine the costs and incremental transmission capacity to move the renewable generation to various load centers.

b. **Transmission Infrastructure beyond California, needed for imports:** Calculated as the product of transmission costs for delivery of imports for each resource type and their proximity to California, based on the PLEXOS expansion plan. With each model completed, the PLEXOS expansion plan determines the generation needs in each zone. New transmission investment was determined as required when incremental generation exceeded aggregated zonal transmission line capacities. Transmission capacity costs are based on public reports and studies developed by CAISO, as well as studies submitted to CPUC as part of various long-term planning analysis.

End-use Stock cost methodology

On the demand side, the PATHWAYS model calculates capital cost estimates on an annualized, full-cost basis for a wide range of end-use technologies (or stocks), from zero-emissions vehicles to electric appliances.[24] These stock costs were largely left unchanged, with the exception of the items described below. Original cost inputs for the PATHWAYS model can be found in the input files in the "California PATHWAYS Scenarios Data (4/6/2015 ZIP file)" at https://www.ethree.com/tools/pathways-model/.

The following resources were utilized to update certain costs:

Transportation

- National Renewable Energy Laboratories (NREL) Transportation Annual Technology Baseline (ATB) Data
  - Light-duty automobiles – BEV, PHEV and HFCV
- National Renewable Energy Laboratories (NREL) Electrification Futures Study: End-Use Electric Technology Cost and Performance Projections through 2050
  - Light-duty trucks – BEV and PHEV
  - Medium-duty vehicles – BEV
- California Air Resources Board (CARB) Advanced Clean Trucks Total Cost of Ownership Discussion Document - Preliminary Draft for Comment
  - Heavy-duty vehicles – HFCV

Buildings

- U.S. Energy Information Administration (EIA) Updated Buildings Sector Appliance and Equipment Costs and Efficiencies
  - Residential
    - Space heaters – High Efficiency Electric Heat Pump
    - Water heaters – High Efficiency Electric and Heat Pump Electric
  - Commercial
    - Space heaters – High Efficiency Electric Heat Pump and Reference Electric Boiler
    - Water heaters – High Efficiency Electric Heat Pump

[24] PATHWAYS assumes a real discount rate of 10% to perform the cost annualization over the life of the technology.

Levelized stock costs for each year were exported from the PATHWAYS model and added to the levelized electric generation costs to determine the annual levelized cost. Annual fuel costs and electric generation system costs were included as a levelized cost assumption. All costs were updated and adjusted to reflect 2021 USD.

Fuel cost methodology

Fuel demand forecasts by PATHWAYS were exported from the model to calculate study-specific cost assumptions. Data from the 2021 EIA AEO was leveraged for conventional fuels, with the exception of refinery and process gas and wood, each of which were calculated directly in the PATHWAYS model.[25] Pipeline natural gas and hydrogen fuel pricing were consistent with the pricing used in capacity expansion modeling.

[25] 2021 EIA AEO data was utilized to be consistent with the cost methodology of earlier PATHWAYS models, but to use more recent and updated cost values since the version of the PATHWAYS utilized in this study used EIA 2013 AEO data.

3 Supporting data tables for whitepaper figures

3.1 Supporting data tables

Table 4. Emissions by State Economic Sector (MMT) (Whitepaper Figure 4)

State Economic Sector	CARB 2019* Actuals	2030 GHG Emissions	2045 GHG Emissions
Electric Power	59.0	31	~0
Transportation	170.3	87	11
Buildings	57.2	43	13
Industrial	99.9	51	25
Agriculture	31.8	24	19
Total CA GHG Emissions	***418.2***	***236***	***68***

- *CARB 2000-2019 GHG Inventory (2021 edition, by economic sector).

Electricity sector versus economywide emissions removal

While our Roadmap is able to achieve near zero-emissions from the electricity sector, the assumptions on technology conversion that underpin the economywide sector model still show that there will be some emissions in the broader economy outside of the electric sector. Following the approach taken by all other major studies, we quantify the emissions that remain, ~68 MMT in 2045 as provided by sector in Table 4 above, but do not estimate the cost of removing remaining emissions in 2045 and beyond—as those technologies are still at an early stage of evolution.

Table 5. Growth in Energy Consumptions (all values in TWh)* (Whitepaper Figure 6)

End Use	SDG&E		California	
	2030	2045	2030	2045
Total Energy Usage	***31***	***50***	***352***	***549***
MD/HD Charging	2	5	19	51
LDV Charging	2	6	26	70
Hydrogen Fuel Production	1	5	6	54
Buildings	17	23	200	257
Industry, Agriculture, and Other	9	11	101	117

- *Values represent 1-in-2 weather year.

Table 6. Growth in Net Peak Demand (all values in GW)* (Whitepaper Figure 6)

Net Peak Demand and Breakdown	SDG&E		California	
	2030	2045	2030	2045
Net Peak Demand	***5.7***	***8.5***	***65.7***	***93.4***
Date/Time	8/24 @ 7pm	9/27 @ 7pm	8/24 @ 7pm	9/27 @ 7pm

- *Net Peak Demand = Base Load – BTM PV – CHP.

Table 7. Generation Capacity (all values GW) (Whitepaper Figure 7)

Resource Type	SDG&E		California	
	2030	2045	2030	2045
Installed Capacity	***8.6***	***15.8***	***135.8***	***355.8***
Natural Gas	3.8	2.8	44.0	37.2
Imports	0.9	1.0	22.1	33.7
Storage*	1.6	2.5	14.0	44.0
Solar	1.6	3.9	38.2	183.6
Wind	0.7	0.7	6.8	21.9
CCS**	0.0	1.0	0.0	4.0
Hydrogen	0.0	3.9	0.0	20.0
Other***	0.0	0.0	10.7	11.4

- *Includes both short- and long-duration battery energy storage and pumped hydroelectric storage.
- **Natural gas generation with CCS. Includes new builds and retrofits.
- ***Other includes oil, coal, geothermal, biomass, hydroelectric, and nuclear.

Table 8. Electric Generation Production (Annual Electricity Breakdown) (Whitepaper Figure 7)

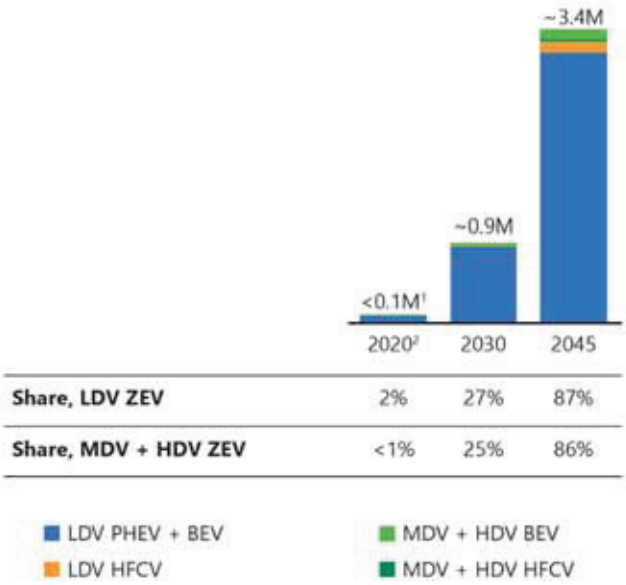
Resource Type	California	
	2030	2045
Natural Gas	27%	0%
Imports	23%	17%
Solar	27%	44%
Wind	7%	16%
CCS	0%	1%
Hydrogen	0%	14%
Other*	15%	9%

- *Other includes oil, coal, geothermal, biomass, hydroelectric, and nuclear.

Table 9. ZEV Adoption (Thousands of Vehicles) (Whitepaper Figure 9)

Vehicle Type (thousands)	SDG&E		California	
	2030	2045	2030	2045
ZEV Total	***914***	***3,366***	***8,676***	***32,061***
LD PHEV and BEV	866	3,101	8,178	29,405
LD HFCV	10	115	97	1,086
MD/HD BEV	37	131	388	1,375
MD/HD HFCV	1	19	13	195

FIGURE A3
Projected zero-emission vehicle adoption in SDG&E service area



[1] Estimated as ~69.6K vehicles.
[2] 2020 represents actuals based on CEC (2021) Zero-Emission Vehicle and Infrastructure Statistics (for light-duty vehicles only). Note: 2030 + 2045 shown are projected ZEVs (for light-duty, medium-duty, and heavy-duty vehicles).

Figure A3 presents projected vehicle adoption for the SDG&E service area.

Table 10. EV Charging Infrastructure Needed in San Diego (Whitepaper Figure 10)

Projected # of EV Chargers* (thousands)	SDG&E	
	2030	2045
Total EV Chargers	**180**	**640**

- *Includes projected public, workplace and multi-unit dwelling chargers to support light, medium and heavy-duty vehicles.

Table 11. Building Electrification (% Electrified) (Whitepaper Figure 11)

Appliance Type	SDG&E/CA 2030	SDG&E/CA 2045
Residential Space Heating	20%	70%
Residential Water Heating	34%	96%
Commercial Space Heating	23%	69%
Commercial Water Heating	45%	98%

Table 12. Hydrogen End Use Breakdown (Whitepaper Figure 12)

Hydrogen End Use	California 2045
Clean Hydrogen Demand	***6.5 MMT***
Electric Generation (Hydrogen Combustion)	5.2 MMT (80%)
Transportation, Buildings and Industry	1.3 MMT (20%)

Table 13. Pipeline Gaseous Fuel Mix (percentages calculated by volume) (Whitepaper Figure 12)

Gaseous Fuel Type*	California 2045
Natural Gas	58%
Renewable Natural Gas	28%
Hydrogen	14%

- *Pipeline mix serves residential and commercial buildings, the industrial sector and natural gas electric generation.

ATTACHMENT E

CALIFORNIA AIR RESOURCES BOARD

California moves to accelerate to 100% new zero-emission vehicle sales by 2035

CARB approves first-in-nation ZEV regulation that will clean the air, slash climate pollution, and save consumers money

DATE August 25, 2022

RELEASE NUMBER 22-30

CONTACTS

Dave Clegern

Office of Communications

dave.clegern@arb.ca.gov

(916) 717-9652

Stanley Young

Office of Communications

stanley.young@arb.ca.gov

(916) 956-9409

SACRAMENTO – The California Air Resources Board today approved the trailblazing Advanced Clean Cars II rule that sets California on a path to rapidly growing the zero-emission car, pickup truck and SUV market and deliver cleaner air and massive reductions in climate-warming pollution.

The rule establishes a year-by-year roadmap so that by 2035 100% of new cars and light trucks sold in California will be zero-emission vehicles, including plug-in hybrid electric vehicles. The regulation realizes and codifies the light-duty vehicle goals set out in Governor Newsom's Executive Order N-79-20.

"Once again California is leading the nation and the world with a regulation that sets ambitious but achievable targets for ZEV sales. Rapidly accelerating the number of ZEVs on our roads and highways will deliver substantial emission and pollution reductions to all Californians, especially for those who live near roadways and suffer

from persistent air pollution," said CARB Chair Liane Randolph. "The regulation includes ground-breaking strategies to bring ZEVs to more communities and is supported by the Governor's ZEV budget which provides incentives to make ZEVs available to the widest number of economic groups in California, including low- and moderate-income consumers."

Many states and nations have set targets and goals to phase out the sale of internal combustion cars. California's is the most aggressive regulation to establish a definitive mechanism to meet required zero-emission vehicle (ZEV) sales that ramp up year over year, culminating in 100% ZEV sales in 2035. The timeline is ambitious but achievable: by the time a child born this year is ready to enter middle school, only zero-emission vehicles or a limited number of plug-in hybrids (PHEVs) will be offered for sale new in California. The regulation also includes provisions that enhance equity in the transition to zero-emission vehicles and provides consumers certainty about the long-term emission benefits, quality, and durability of these clean cars and trucks and the batteries they run on.

Clean Air and Climate Benefits

Transportation is the single largest source of global warming emissions and air pollution in the state. This nation-leading regulation slashes emissions from cars and light trucks.

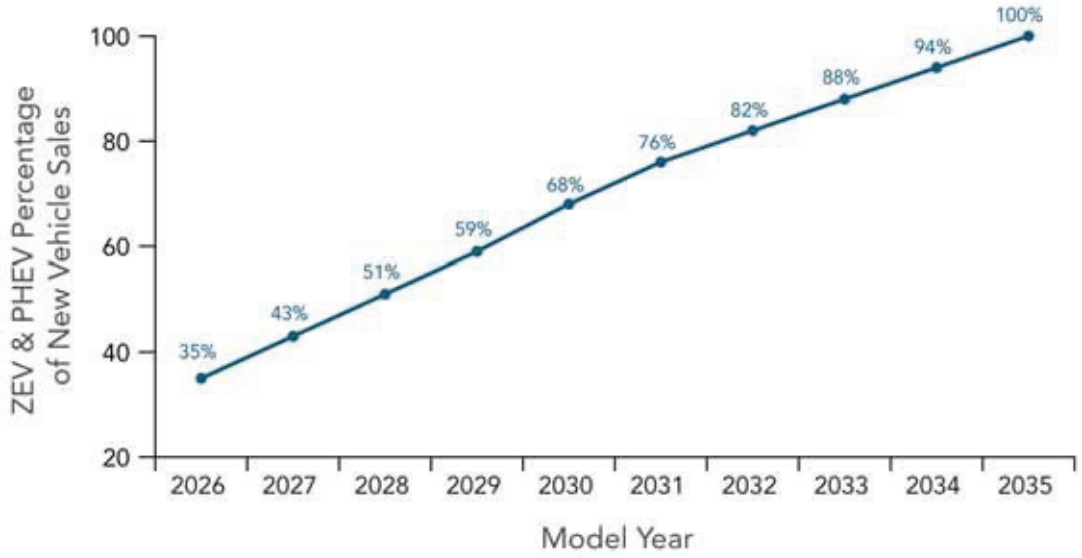
By 2037, the regulation delivers a 25% reduction in smog-causing pollution from light-duty vehicles to meet federal air quality standards. This benefits all Californians but especially the state's most environmentally and economically burdened communities along freeways and other heavily traveled thoroughfares. From 2026 through 2040 the regulation will result in cumulative avoided health impacts worth nearly $13 billion including 1,290 fewer cardiopulmonary deaths, 460 fewer hospital admissions for cardiovascular or respiratory illness, and 650 fewer emergency room visits for asthma.

The regulation delivers multiple benefits that grow year by year. By 2030, there will be 2.9 million fewer new gas-powered vehicles sold, rising to 9.5 million fewer conventional vehicles by 2035. In 2040, greenhouse gas emissions from cars, pickups, and SUVs are cut in half, and from 2026 through 2040 the regulation cuts

climate warming pollution from those vehicles a cumulative total of 395 million metric tons. That is equivalent to avoiding the greenhouse gases produced from the combustion of 915 million barrels of petroleum.

General requirements

The new regulation accelerates requirements that automakers deliver an increasing number of zero-emission light-duty vehicles each year beginning in model year 2026. Sales of new ZEVs and PHEVs will start with 35% that year, build to 68% in 2030, and reach 100% in 2035.



Eligibility and Credits

The regulation applies to automakers (not dealers) and covers only new vehicle sales. Itdoes not impact existing vehicles on the road today, which will still be legal to own and drive.

Plug-in hybrid, full battery-electric and hydrogen fuel cell vehicles count toward an automaker's requirement. PHEVs must have an all-electric range of at least 50 miles under real-world driving conditions. In addition, automakers will be allowed to meet no more than 20% of their overall ZEV requirement with PHEVs.

Battery-electric and fuel cell vehicles will need a minimum range of 150 miles to qualify under the program, include fast-charging ability and come equipped with a charging cord to facilitate charging, and meet new warranty and durability requirements.

Enhanced Durability and Warranty Requirements

The new regulation also takes regulatory steps to assure that ZEVs can be full replacements to gasoline vehicles, hold their market value for owners, and that used car buyers are getting a quality vehicle that will not pollute.

By model year 2030, the rules require the vehicle to maintain at least 80% of electric range for 10 years or 150,000 miles. (Phased in from 70% for 2026 through 2029 model year vehicles.) By model year 2031, individual vehicle battery packs are warranted to maintain 75% of their energy for eight years or 100,000 miles. (Phased in from 70% for 2026 through 2030 model years.) ZEV powertrain components are warranted for at least three years or 50,000 miles.

Environmental Justice

As noted, the regulation delivers substantial emission reductions to all Californians, with particular benefits to those who live near roadways and suffer from persistent air pollution. The durability and warranty requirements in the regulation will help establish a viable and dependable used ZEV market to ensure the emission benefits are permanent, and the regulation includes an approach that provides credits to automakers for certain actions that increase access to ZEVs by low-income households and people living in disadvantaged communities.

Increasing Access to Zero-Emission Vehicles for all Californians

Governor Newsom proposed, and the Legislature has approved, $2.7 billion in fiscal year 2022-23, and $3.9 billion over three years, for investment in ZEV adoption, as well as clean mobility options for California's most environmentally and economically burdened communities. These programs support the new regulation by increasing access to ZEVs for all Californians, including moderate- and low-income consumers. They include:

- Clean Cars 4 All provides up to $9,500 to low-income drivers who scrap their older vehicles and want to purchase something that runs cleaner.
- The Clean Vehicle Rebate Project (CVRP) provides up to $7,000 for income-qualified drivers to buy or lease a ZEV.
- The Clean Vehicle Assistance Program provides low-income car buyers with special financing and up to $5,000 in down-payment assistance.

The Governor's ZEV budget includes $400 million over three years for the statewide expansion of Clean Cars 4 All and for a suite of clean transportation equity projects. The budget also includes $525 million for the Clean Vehicles Rebate Project (CVRP). In addition, there is $300 million for more charging infrastructure, especially for those consumers who may not have a garage where they can charge their EV.

Consumer Savings

Drivers of full battery-electric vehicles already save money on operation and maintenance compared to cars with internal combustion engines. That's the result of cheaper fuel — charging at home costs about half as much as gasoline for the same number of miles driven — and battery-electric vehicles can save drivers 40% in maintenance costs.

CARB analysis indicates that battery-electric vehicles are likely to reach cost parity with conventional vehicles by 2030. By 2035, consumers are likely to realize as much as $7,900 in maintenance and operational savings over the first 10 years of ownership. Owners will also see 10-year savings from 2026 model year battery-electric vehicles, though not quite as much.

Stringent Standards for Conventional Cars

As with the original Advanced Clean Cars rules, ACC II includes updated regulations for light- and medium-duty internal combustion engine vehicles as well, to mitigate the air quality impacts from conventional vehicles. These low-emission vehicle standards help deliver real-world emission benefits that complement more significant emission reductions gained by wider ZEV deployment. This will prevent potential emission backsliding by removing ZEVs from the emissions baseline used to calculate new vehicle fleet-average emissions. The regulation also reduces the allowable exhaust emissions under more real-world driving conditions and emissions caused by evaporation.

Background

Transportation is responsible for approximately 50% of greenhouse gas emissions (when accounting for fuel production emissions) and 80% of air pollutants in California.

The ACC II regulation is phase two of the Advanced Clean Cars Program, originally adopted by CARB in 2012. The regulation was designed to bring together CARB's passenger vehicle requirements to meet federal air quality standards and also support California's AB 32 statute to develop and implement programs to reduce greenhouse gas emissions back down to 1990 levels by 2020, a goal achieved in 2016 as a result of numerous greenhouse gas emissions mitigation programs.

The ACC II regulation is a major tool in the effort to reach the SB 32 target of reducing greenhouse gases an additional 40% below 1990 levels by 2030, while also achieving Governor Newsom's 2035 target for ending sales of new internal-combustion engine passenger vehicles. Ending sales of vehicles powered by fossil fuels is a critical element in the state's efforts to achieve carbon neutrality by 2045 or sooner.

Other States

States that currently follow California's vehicle rules are expected to adopt these regulations through their own rulemakings, gaining the clean air and climate benefits the regulation delivers. These states constitute about 40% of the nation's new car sales.

CARB's mission is to promote and protect public health, welfare, and ecological resources through effective reduction of air pollutants while recognizing and considering effects on the economy. CARB is the lead agency for climate change programs and oversees all air pollution control efforts in California to attain and maintain health-based air quality standards.

ATTACHMENT E

Source URL: *https://ww2.arb.ca.gov/news/california-moves-accelerate-100-new-zero-emission-vehicle-sales-2035*