Board Monitoring Report 2021
SD-9, Resource Planning

1. Background

It is a core value of SMUD to provide its customers and community with a sustainable power supply using an integrated resource planning process.

A sustainable power supply is one that reduces SMUD's greenhouse gas (GHG) emissions to serve retail customer load to Zero by 2030. Zero GHG emissions will be achieved through investments in energy efficiency, clean distributed energy resources, renewables portfolio standard (RPS) eligible renewables, energy storage, large hydroelectric generation, clean and emissions free fuels, and new technologies and business models. Additionally, SMUD will continue pursuing GHG savings through vehicle, building and equipment electrification. SMUD shall assure reliability of the system, minimize environmental impacts on land, habitat, water and air quality, and maintain competitive rates relative to other California electricity providers.

To guide SMUD in its resource evaluation and investment, the Board sets the following energy supply goal:

Year	Greenhouse Gas Emissions (metric tons)
2020	2,318,000
2030 - beyond	0

In keeping with this policy, SMUD shall also achieve the following:

a) Pursue energy efficiency and electrification to reduce carbon emissions by 365,000 metric tons from buildings and 1,000,000 metric tons from transportation in 2030 (the equivalent of 112,000 single family homes and 288,000 passenger vehicles electrified).
b) Procure renewable resources to meet or exceed the state's mandate of 33% of SMUD's retail sales by 2020, 44% by 2024, 52% by 2027, and 60% of its retail sales by 2030 and thereafter, excluding additional renewable energy acquired for certain customer programs.
c) In meeting GHG reduction goals, SMUD shall:
    1. Emphasize local and regional benefits.
    2. Improve equity for under-served communities.
d) Explore, develop, and demonstrate emerging GHG-free technologies and business models.
e) Promote cost effective, clean distributed generation through SMUD programs.

2. Executive Summary

SMUD's integrated resource planning process informs long-term strategic development by the various business units within SMUD, and efforts are made to balance reliability, sustainability, environmental, financial, and customer objectives while achieving SD-9 goals.

In 2020, SMUD's Board took two actions related to our SD-9 Goals. SMUD's Board (1) updated the SD-9 energy efficiency goal to a carbon-based metric and established building-electrification goals and (2) adopted a Climate Emergency Resolution that calls on the Board to work towards carbon neutrality by 2030. In 2021, the Board further revised our SD-9 targets and put us on a path to eliminate GHGs from our power supply by 2030.

In April 2021, SMUD's Board adopted our 2030 Zero Carbon Plan, our road map to eliminating carbon emissions from our electricity production by 2030. Under this plan, we're working to eliminate GHG

emissions from our power plants, develop new distributed energy resource business models, research emerging grid-scale carbon free technologies, and expand our investments in proven clean technologies. We have made progress implementing this plan including undertaking new studies, studying new zero carbon resources, and piloting new programs.

In 2020, our normalized GHG emissions were 1.624 million metric tons (MMt), which continues to be below our 2020 goal. We also met our 2020 RPS target of 33% renewables by 2020. As this report demonstrates**, in 2020, SMUD was in compliance with each of the goals for the year established in SD-9**.

3. Additional Supporting Information

A. Implementation of our 2030 Zero Carbon Plan

Our 2030 Zero Carbon Plan is our road map to eliminating carbon emissions from our electricity supply by 2030 while maintaining reliable and affordable service and partnering with our customers, communities, and a wide range of stakeholders on this journey. This plan calls for eliminating GHGs from our power plants and expanding our investments in proven clean technologies. Below, is a discussion of our current carbon footprint as well as an update on the near-term actions we're taking to implement our 2030 Zero Carbon Plan; for more detailed project information, see Appendix C.

As shown in Table 1, SMUD's adjusted GHG footprint in 2020 was 1.624 MMt, lower than our 2020 target of 2.318 MMt. SMUD's main sources of GHG emissions were from SMUD's thermal power plants and market purchases.

Table 1: 2020 SD-9 Carbon Footprint & Near-term Targets

Source	Net Power (GWh)	CO2e Emissions (1000 t) [1]
Net Generation and Power Purchases	12,331	2,252
Wholesale	(1,417)	(327)
SMUD Electric Sales, SMUD Usage and System Losses	***10,914***	***1,925***
Adjustment for Normal Load		(34)
Adjustment for Normal Wind and Hydro		(260)
REC Banking Adjustment		(7)
SMUD Normalized Total (estimate)		***1,624***
2020 Target		***2,318***

Expanding our Sustainable Power Supply; Local and Regional Benefits

We're focused on reimagining our generation portfolio through retirement or retooling of our natural gas assets, expanding our local investments in proven clean technologies and launching pilot projects and programs for new and emerging technologies all while continuing our work to improve equity for our under-resourced communities.

Natural Gas Generation

Currently, our natural gas-fired thermal power plants are economic and reliable sources of both energy and non-energy services to the system, but are our largest source of GHGs. Moving forward,

[1] Based on SMUD's internal accounting and represent best estimates available. The thermal power plant emissions, SMUD's largest source of emissions, have been independently verified. Biogenic emissions are excluded as they are part of the natural carbon cycle.

we're considering what role these units could play in our zero carbon future and we are on track with our year one implementation priorities.

- We are performing detailed studies of reliability and the impacts of retiring McClellan and Campbell; infrastructure planning and reliability studies are also underway. These studies are on schedule.
- We are conducting industry outreach, have begun preliminary research on the Allam-Fetvedt Cycle[2] and are expanding our understanding of clean fuels that could be viable alternatives as we transition away from natural gas. Additionally, we're probing long duration energy storage options and are further exploring hydrogen as part of the DOE's H2 Blend Collaborative Partnership Grant.

Proven Clean Technologies and Zero Emission Resource Development

Acquisition of additional proven clean technologies, such as renewables, batteries, and hydroelectric power will further help reduce and ultimately eliminate our GHG emissions. Staff continue to conduct procurement efforts, cultivate new resource development, and implement new ideas. In 2020, we added over 180 MW of renewables and have over 1,000 MW of new renewables and storage in the pipeline for development to serve our customers due online in the coming years.

Although our goals are more ambitious than already aggressive state mandates, we continue to implement a renewable energy strategy that fulfills state RPS requirements and gives our customers the choice to further reduce their emissions with renewable energy products. SMUD achieved our 2020 RPS target by providing 33% of retail sales with renewables and are on path to achieving the next RPS statutory requirement of 44% RPS in 2024.

We continue to be a leader in the nation by offering our customers renewable pricing choices. Last year SMUD delivered 1,271 GWhs,12.5% of retail sales, to customers participating in Greenergy and SolarShares. Our Greenergy program served more than 74,000 residential and commercial participants with 950 GWh and our Large Commercial SolarShares program met program expectations, delivering 321 GWhs to customers. Our Neighborhood SolarShares project, approved by the CEC in early 2020, will be served entirely from solar resources within SMUD's service territory. The first of those resources, Wildflower (13 MW), came online in December 2020.

We are on track with our year one 2030 Zero Carbon Plan implementation priorities in this area.

- Locational analysis, system impact studies, and economic valuation work are ongoing
- The team is exploring and evaluating delivery options for out-of-area renewables.
- The process to develop and issue competitive solicitation for new proven clean technology projects is ongoing; we are assessing need for new resources in the 2024-2027 timeframe.

New Technology and Business Models

Using proven clean technology, we expect to be able to reduce our carbon emissions by 90% without compromising reliability or our low rates. To eliminate the last 10%, we'll need to explore, develop, and demonstrate new technologies. As part of our 2030 Zero Carbon Plan, we are on track with our year one implementation priorities in this area.

- Perform information technology system upgrades to enable DERs and VPPs – this work is ongoing, anticipated completion in early 2022.

[2] A process that involves burning fossil fuel with oxygen instead of air to generate electricity without emitting any carbon dioxide

- Work integrating DERs in operations, distribution and the grid planning process is ongoing and will evolve based on our experience with our new load flexibility pilots.
- To support our load flexibility efforts, we're preparing to launch a portfolio of pilots, including behavioral, multi-DER, and storage virtual power plant, and are working to expand our EV managed charging and vehicle-to-grid demonstrations. Our residential Multi-DER Virtual Power Plant, which will launch in 2021 and a residential NextGen 2-way A/C load control switch program, is expected to be launched within the next couple years.

We continue to fund research and development efforts and to look for grants for clean energy and GHG reduction projects. Finally, recognizing the importance of equity, we will continue to prioritize under-resourced communities to help reduce the energy bill burdens of our low-income customers while ensuring equity in our program offerings.

Improving Equity through Workforce Development in Under-Resourced Communities

SMUD's carbon reduction actions help reduce climate change, but our work is about more than that. We are staying true to our roots—as a community-owned organization, implementation of our 2030 Zero Carbon Plan will deliver wide-reaching benefits to our community, including expanded workforce development program offerings, while focusing on equity and strengthening our communities—one SMUD, one Sacramento.

- SMUD has partnered with the California Mobility Center (CMC) and community-based organizations (La Familia Counseling Center, Inc., Asian Resources, Inc., and Greater Sacramento Urban League) to provide job readiness and technical training to over 300 community participants to prepare them for careers in the clean mobility sector.
- Additionally, SMUD and its Promise Zone partners graduated 25 students from the inaugural "Energy Career Pathways" solar training class. SMUD and its partners continue to work with graduates on job placement, with a total of 12 placements to date. After a short hiatus due to COVID-19 restrictions, SMUD restarted an expanded program in 2021 with a new partner, Grid Alternatives, which expects to graduate 100 participants in the program.

B. Energy Efficiency and Electrification Goals

Energy Efficiency and Building and Vehicle Electrification

The Building Energy Efficiency portfolio includes offerings for residential retailer incentives, residential customer rebates, commercial builder incentives, and commercial customer rebates. The Building Electrification portfolio includes offerings for gas-to-electric conversions of water heating equipment, space heating equipment, and cooktops delivered through residential new construction, whole house retrofits, and prescriptive equipment rebates. In 2020, our energy efficiency and building electrification programs reduced emissions by 25,786 tCO2 [Civic Carbon].[3] By 2030, our goal is to have these programs reduce emissions by 365,000 MT in 2030, the equivalent of 112,000 single family homes. We are on track to meet this goal. We are on track to reduce carbon emissions by 365,000 metric tons from buildings in 2030.

[3] The DER Cost Effectiveness Tool evaluates and accounts for DER program effectiveness on achieving our prior 2040 Net Zero goal. This estimate is the 2020 gross annual emissions impact. It is a measure of the carbon reduced from measures, programs, and the DER portfolio. It is reported in each year the "measure" is installed on the grid and within its useful life. The tool will be updated to reflect our current 2030 Zero Carbon Vision so the 2020 carbon emission impact from this report should be considered draft and will be revised for the next monitoring report.

SMUD's Transportation Electrification portfolio includes offerings in residential vehicle incentives, dealership incentives, residential outreach, commercial charger incentives, and commercial vehicle incentives. At the end of 2020, we had 17,977 EVs registered within SMUD's service territory, an increase of 4,821 registered vehicles and an estimated CO2 reduction of 22,300 metric tons. 16,179 are residentially registered EVs. We are on track to pursue transportation electrification to reduce carbon emissions by 1,000,000 metric tons from transportation in 2030.

C. Promote Cost Effective Clean Distributed Generation and Storage

SD-9 requires that SMUD develop programs to promote cost effective, clean distributed generation. The following describes progress in 2020 and alignment with our 2030 Zero Carbon Plan.

Flexible Demand

Our flexible demand programs seek to optimize operation of our customer-partner's equipment and distributed energy resources while balancing customer-partner and grid needs as well as compensating customers for the energy they supply into SMUD's grid for use by other customers. In past, DERs have mainly focused on rooftop solar and heating/cooling technologies, but now include EVs, water heaters, solar panels with smart inverters, batteries, and more.

With our PowerDirect program, commercial customers were notified six times to curtail load; average load reduction of 2.06 MW to 9.56 MW across the duration of the events.[4] Under our temperature dependent rates, two commercial customers were notified three times during the summer, 13.55 to 15.46 MW of load reduction.[5] Finally, Peak Corps provides about 59 MW of resource adequacy capacity and remains an operational resource to be used in case of an emergency. Our dispatchable programs provide an expected load shed range of 53.5 to 79.5 MW; our non-dispatchable programs provide between 0 and 15.5 MW of expected load shed.

As part of our load flexibility programs, we offer time-of-day rates, which give the majority of our customers more time on the lower priced non-summer seasonal rate. In 2020, the TOD rate program exceeded our expectations, providing vital reductions in our peak load, carbon emissions and commodity costs. For more details, please see Appendix C.

As part of our 2030 Zero Carbon Plan, pilot programs aimed at flexible energy use will allow customers to reduce their energy usage and bills at times when grid stress is the highest.

Clean Distributed Generation and Storage

In 2020, we had over 34,000 customer-sited PV installations in SMUD's service territory. 35 MW of customer sited solar PV was installed and 3.17 MW of customer-sited energy storage projects were installed or in progress, 2.96 MW in residential and 0.206 MW in commercial. In addition, we procured a 4.4 MW SMUD owned utility-scale battery.

4. Challenges

There were no notable challenges to meeting the goals in SD-9.

5. Recommendation

It is recommended that the Board accept the Monitoring Report for SD-9.

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[4] NERC WebDADs report

[5] NERC WebDADs report

Appendix A – SD-9 History

SD-9 was established by SMUD's Board in 2004 and provides direction for SMUD's ongoing environmental leadership and the use of an IRP process to achieve these directives while balancing environmental goals with financial and customer rate impacts and reliability requirements. SMUD's strategic directions have evolved as markets, policies and laws have changed.

In December 2008, the Board added sustainable power supply as the overall objective of the integrated resource planning process and set a GHG emissions target. In 2018 the Board updated our greenhouse gas reduction goals to include a 2040 Net Zero GHG goal. In 2020, the Board amended SD-9 to adopt carbon-based targets for energy efficiency and building electrification. This change represents the first time a major utility has used carbon as its efficiency tracking metric, and was done to better align our energy efficiency and electrification programs as well as to align both of those programs with our evolving energy supply picture.

In April 2021, the Board adopted Resolution No. 21-04-04 which updated the SD-9 direction to align with our 2030 goal of 0 MT GHG emissions in our energy supply by 2030, as put forth in our *2030 Zero Carbon Plan*. SMUD has embarked on a path to zero carbon by 2030, focusing on zero carbon resource acquisition and new renewable energy contracts, expanding on customer programs for energy efficiency and building and transportation electrification, developing new voluntary customer programs, and researching emerging clean energy technology. Under SD-9, SMUD's goal is the reduction of long-term GHG emissions for serving retail load from its current state to zero carbon by 2030, more aggressive than California's goal of 20% of 1990 emissions by 2050.

Appendix B – Methodology Discussion

Normalization Adjustments

Emissions adjustments to the actual footprint include a *decrease* to account for higher than expected energy usage by SMUD customers, a *decrease* to account for lower than expected hydro production, an *decrease* to account for lower than expected wind production and a *decrease* for using banked renewable energy credits (RECs). In 2020, SMUD strategically utilized banked RECs to achieve RPS mandates as additional large renewable projects are developed. In previous years, SMUD procured more renewable energy than required and received credits for future use. These credits were saved or banked in accordance with RPS rules. Using these banked RECs lowers SMUD's normalized emissions because any emissions impacts were realized at an earlier date.

Renewable Portfolio Standard (RPS)

State law requires SMUD procure renewable generation of at least 33% of retail sales by December 31, 2020 and 60% by 2030 as well as interim targets be achieved over compliance periods[6]. In 2020, we achieved our and the State's RPS target with 3,200 GWh of eligible RECs.

Appendix C – Detailed Project Descriptions

Sustainable Communities

Implementation of our 2030 Zero Carbon Plan will deliver wide-reaching benefits to our community while focusing on equity and strengthening our communities.

[6] Senate Bill 100 (De León, Chapter 312, Statutes of 2018) increased RPS targets to 44% by the end of 2024, 52% by the end of 2027, 60% by the end of 2030 and sets a statewide retail sales goal of 100% RPS eligible and zero-carbon resources by 2045.

- Transportation Electrification. SMUD is dedicated to partnering with the community to expand eMobility Hubs throughout our region, which will be strategically located at sites in under-resourced communities. These Hubs will include various modes of transportation such as public transit, micro mobility, shared mobility, ride hail, taxi services, community electric vehicles, public EV charging stations, etc. Additionally, EV programs will be expanded to assist customers that own or lease an electric vehicle to charge at home by providing low cost or free EV charging infrastructure for income eligible customers and expertise on home charging solutions. We also have incentive funds available to expand EV charging infrastructure at public locations, multifamily properties and affordable housing sites.
- Load Flexibility. SMUD will work to ensure that all customers can participate in the portfolio of load flexibility pilots launching in 2021 and 2022. These pilots are necessary to meet our 2030 zero carbon goal, yet they can sometimes require costly technology like a smart thermostat, electric vehicle, or battery storage system to participate. SMUD will continue to explore ways in which our load flexibility pilots can be more inclusive despite this barrier. Examples surfaced to date include integrating load flexibility program enrollment into our existing low-income weatherization program, which already provides a no-cost smart thermostat in most cases. Another example would be creating a no-cost technology installation pathway for low-income homeowners or renters to participate in our virtual power plant with their heating/cooling system.
- Building Electrification and Energy Efficiency. To support SMUD's equity efforts as part of the 2030 Zero Carbon Plan, SMUD will continue expansion of its existing efforts to provide no-cost energy retrofit installations to income eligible residential customers for both gas-to-electric conversions and electric-to-electric upgrades. Available project measures include electric heat pump water heaters, electric heat pump HVAC units, seal and insulate projects, and panel upgrades. In addition, SMUD will continue to provide a low-income incentive premium for projects within SMUD's Multifamily retrofit program that meet affordable housing criteria

Our Sustainable Communities Workforce Development efforts partner with organizations to reach into our community to understand the challenges that residents face in pursuing good-paying careers.

- SMUD and its Promise Zone partners graduated 25 students from the inaugural "Energy Career Pathways" solar training class. The class recruited participants from underserved communities and helped them access high-paying solar jobs by demonstrating proficiency in the areas of energy industry knowledge, solar installation and the social, teamwork, and safety skills needed to be successful in the workforce. Despite the challenges presented by the onset of the COVID-19 pandemic, several students were hired-on by solar companies immediately upon graduating. SMUD and its partners continue to work with graduates on job placement, with a total of 12 placements to date. As part of the program, trainees installed two solar trees each at The Greater Sacramento Urban League and the Simmons Community Center. The installation of these solar trees not only serves to beautify our community and help to promote renewable energy, but they also provide class participants with hands-on experience building solar structures. After a short hiatus due to COVID-19 restrictions, SMUD restarted an expanded program in 2021 with a new partner, Grid Alternatives, which expects to graduate 100 participants in the program.
- SMUD is partnering with the California Mobility Center and community-based organizations (La Familia Counseling Center, Inc., Asian Resources, Inc., and Greater Sacramento Urban League) to provide job readiness and technical training to over 300 community participants to prepare them for careers in the clean mobility sector. The CMC provides an atmosphere where clean mobility start-ups can grow and drive new business opportunities and this partnership will ensure that these new business opportunities will have an already trained, local workforce to draw upon. The infrastructure that is used to design and manufacture clean mobility vehicles will also be used to train priority populations.

Additionally, to deploy comprehensive resources for our communities most in need, we must align our region's investments toward the goal of creating and supporting healthy, vibrant, and economically sustainable neighborhoods. We have several data collection and visualization initiatives aimed at matching areas of inequity within the Sacramento region with future investment; we're working to address potential inequities in the way we do business.

- Our Sustainable Communities Resource Priorities Map is a result of SMUD's data-driven approach to geographically identify areas of inequity within the Sacramento region that highlight where future resources may be optimally utilized. This interactive map helps analyze current data to identify under-resourced and distressed areas in our region, driven by lack of community development, income, housing, employment opportunities, transportation, medical treatment, environmental sustainability mitigation, nutrition, education and clean environment. Recently, we used this map to analyze thermal power plants in high/moderately high sensitivity areas that should be targeted for emissions reductions.
- Also, part of our data-driven approach to equity, our internal Sustainable Communities Dashboard tracks funding and links partners and projects across six key focus areas – Institutional Support and Outreach, Education, Health Equity, Environmental Leadership, Economic Development, and Transportation and Access. These metrics coupled with expanded access to equitable workforce pipeline and business creation, will serve to validate investments across focus areas.
- SMUD will establish a structure for institutionalizing and operationalizing DEI strategies by creating an equity index to provide evaluation of new & existing SMUD programs & incentives.

Proven Clean Technology Projects

Table C-1 details new proven clean technology procurement activities.

Table C-1: New Procurement and Project Development Status

Project Name	Type	MW	Status	Projected Online Date
Sacramento Valley Energy Center	PV	250	Planning	2024
	Battery	100		
King's Country	PV	50	Planning	2024
Sacramento Solar	PV	340+	Planning	2024
	Battery	170+		
Solano 4	Wind	91	Pre-Construction	2024
Hedge Battery	Battery	4MW/ 8MWh	Under Construction	2021
NTUA Drew Solar	PV	100	Under Construction	2022
South Fork Powerhouse	Small Hydro	3	Online	2020
Wildflower	PV	13	Online	2020
Chili Bar	Small Hydro	7	Online	2021
Rancho Seco 2	PV	160	Online	2021
Total		**1,000+**		

Additionally, in the near-term, we are exploring options to procure or develop new zero emission resources, including local solar and storage, to help achieve our 2030 Zero Carbon Vision.

Energy Efficiency Programs

In 2020, SMUD's residential new construction program completed 230 newly built all-electric homes, and installed 928 gas-to-electric heat pump water heaters in existing homes, 1,265 gas-to-electric heat pump HVAC systems in existing homes, and 78 gas-to-electric induction cooktops in existing homes.

Below is a summary of some of our 2020 energy efficiency and building electrification accomplishments including our energy efficiency improvement and building electrification initiatives for our income eligible customers.

Table C-2: 2020 Energy Efficiency and Building Electrification Accomplishments

Measures & Projects	**Results**
Commercial Projects Completed Complete Energy Solutions	47
Commercial Projects Through Express Energy Solutions	3,681
Custom Commercial Projects Completed	41
New Efficient Commercial Buildings Constructed	25
Multifamily Apartments Retrofitted (Electric To Electric)	622
Multifamily Apartments Retrofitted (Gas To Electric)	45
Efficient Induction Cooktops (Electric To Electric)	86
Efficient Induction Cooktops (Gas To Electric)	78
Energy Star Products Purchased through RPP Retailers	23,059
Advanced Power Strips Installed	4,320
Old Refrigerators Recycled	9,949
Pool Pumps Purchased	879
Residential Heat Pump Water Heaters Installed (Electric To Electric)	77
Residential Heat Pump Water Heaters Installed (Gas To Electric)	928
Residential HVAC Installations (Electric To Electric)	2,540
Residential HVAC Installations (Gas To Electric)	1,265
Residential Seal and Insulate Installations	346
All Electric New Homes Constructed	230
Income Eligible Energy Efficiency Bundles and Electrification	**Results**
Solar + Weatherization	743
Energy Saver Deep Home Retrofits	743
Energy Saver House Bundles	421
Energy Saver Apartment Bundles	1,194
Virtual Energy Education	1,014
Weatherization	808
Energy Saver bundle for Mobile Homes	277
Heat Pump Space Heating (Gas to Electric)	226
Heat Pump Water Heaters (Gas to Electric)	97
Induction Stoves (Gas to Electric)	23

Vehicle Electrification

In 2020, the California Mobility Center (CMC) prepared to move from its pre-launch phase to commercial operations, which began March 2021. This transition helped us achieve a major milestone towards our transportation electrification objectives, 288,000 passenger vehicles electrified by 2030, and defined Sacramento as a hub for innovation. In 2020, SMUD continued its leadership and support of the CMC, leveraging relationships with our Sustainable Communities partners who conduct outreach and job readiness training to prepare residents in underserved communities for jobs in stable, upwardly mobile careers. With SMUD's support, the CMC obtained grants worth over $2M and is expanding their workforce development efforts to reach even more community members, opening doors to emerging zero carbon careers.

SMUD team members also collaborate broadly through the Sacramento PEV Collaborative, which includes the County of Sacramento, the City of Sacramento, Sacramento Metropolitan Air Quality Management District (SMAQMD), Sacramento Area Council of Governments (SACOG), State of California agencies, UC Davis Institute of Transportation Studies, Electrify America, Sac EV and many others.

In 2020, SMUD's Drive Electric program continued to promote adoption of plug-in electric vehicles (PEV) through a special EV rate offering, our "Charge Free for 2 years" rebate, and participation in educational events, educational offerings through our website http://www.SMUD.org/DriveElectric and in collaboration with local auto dealers and Sac EV. In 2020, SMUD's Charge Free for Two Years EV incentive ended in Q4 and was replaced by the statewide California Clean Fuel Reward program. In 2020, SMUD approved 1,846 EV incentives for the purchase or lease of a new EV.

Due to COVID restrictions, in lieu of in-person events, staff produced a virtual ride & drive video to expand capabilities and reach. The video, designed for customers, is "experiential" and to the extent possible educates viewers on many "EV lifestyle" elements.

Other 2020 activities included:

- Transitioned to live online dealer EV sales training webinars in response to COVID and implemented on-demand online training as an additional resource to enhance dealer certification as PlugStar certified dealers. Twenty-two dealers are participating in the program.
- Implemented an "EV Concierge" service for SMUD customers through Plug in America's Electric Vehicle Support Program offering live one-on-one support answering questions on all things EV.
- Implemented our first EV auto dealership competition to encourage and incentivize EV sales and reward dealerships and their staff for increased EV promotion.
- Developed and launched the Clean Cars for All program in conjunction with SMAQMD. This program provides up to $9,500 toward a new or used PEV for income-qualified residents living in areas impacted by higher levels of pollution (disadvantaged communities).
- Facilitated the second *Charge Up Change!* EV video competition in which middle school students produce a video on why "EVs are cool" and compete for monetary awards and other recognition.
- SMUD partnered with the California Energy Commission and the Center for Sustainable Energy to launch the California Electric Vehicle Infrastructure Project (CALeVIP) in Sacramento County to promote the installation of public level II and DC fast charging stations. The partnership was the first of its kind in the state, and is being used as a model for projects in other areas of California. In 2020, SMUD staff hosted a contractor training to 70 attendees to provide overview of the State CALeVIP and Commercial EV programs.

Additionally, SMUD conducted and supported research to increase EV adoption:

- Awarded $85,000 incentive to a Shell gas station for the installation of a 50kW DC Fast Charger (DCFC) located in a high traffic area, miles from any other DCFC.
- Analyzed the extent to which SMUD's electric transportation programs impacted EV adoption.
- Researched and verified technical solutions to reduce total installed cost of EV charging for commercial customers.
- Identified fleet vehicles suitable for EV replacements for five commercial customers and provided them with a total cost of ownership compared to gas or diesel vehicles.
- Contributed $200K for the Del Paso Mobility Hub, which started grid interconnection and site construction in 2020. The Del Paso Mobility Hub will provide sensible, clean, affordable transportation and other social benefits to an underserved community, helping advance equitable electric transportation adoption in Sacramento, the state, and the country. The project is expected to be operational August 2021.

Time-of-Date Rates

Our residential customers reduced overall load in the range of 110-130 MW, similar to 2019 levels, despite the increase in residential load due to COVID. In addition to avoiding peak energy prices, customers, on average, saved money using more energy in the middle of the day when retail energy prices are cheaper, and renewables are abundant. Participation in the program has remained strong with 98% of customers on TOD rates.

Table C-3: 2020 Results of TOD Implementation

Benefits	Assumed based on pilot	2019 Normal Weather	2020 Normal Weather
Carbon reduction (tonnes)	3K-5K	12.8K	12.8K
Residential peak load reduction	75MW, or 5.8%	~130MW, or 8%	~110MW – 130MW, or 7-8%
Financial benefit	$4M annually	$5M estimated	$6M - $8M** estimated
Selection of TOD	96%	98%	98%

Zero Emission Resources

We are continuing to fund research and development efforts as well as pursue grants for clean energy and GHG reduction projects in 2020 and beyond as part of our 2030 Zero Carbon Plan. Below are some of those projects.

- Carbon Projects for Zero Carbon Planning. Completed high level techno-economic assessments of proven clean technology expansion opportunities (wind, on-shore and off-shore; solar; geothermal; biomass/biogas for RNG), long duration storage technologies, carbon capture, renewable hydrogen and gas pipeline analysis. Results of these assessments were utilized as inputs into the modeling and planning efforts for the Zero Carbon Plan.
- Assessment of Alternative Clean Fuels. The 2030 Zero Carbon Plan calls for a shift in the role of natural gas electricity generation towards decarbonization using carbon negative or carbon free fuel sources. This shift represents much of the flexibility built into the Plan. With the 2030 Zero Carbon Plan in mind, a study was initiated for deep understanding of the resource

sustainability, existence of supply/suppliers, price forecasts, market trends, and the economic/technical feasibility of these alternative biofuels that will facilitate decision making across many business units. The clean fuels to be researched in this project include ethanol, biodiesel, renewable diesel, RNG, hydrogen, and others.

- Wind Resources in Northern CA. In order to meet SMUD's 2030 zero carbon goals, SMUD may need to procure wind resources outside of the service territory. This project was initiated to perform a study of all the available wind generation resource in Northern California with the potential to be delivered to the SMUD Balancing Authority. This study will concentrate on turbine blade tip heights under 500', 600' and 700'. AECOM was tasked to complete this study by the end of 2021.
- Zero CI Electricity Pathway for Wind. Completed the first annual report submitted to CARB for Zero CI electricity pathway from wind energy systems. Monetized value garnered from LCFS credits from this Zero CI pathway is about $1.0 Million with GHG reduction of about 5,202 MT (Q2 to Q4 2020 only).
- Long Duration Energy Storage Market (LDES) & Technology. This project addresses intermittency of higher penetration of renewable sources and lower costs in replacing thermal generation assets beyond the economics of Lithium-ion batteries. Comparative market and economic analysis of all long duration energy storage technologies (Chemical, Mechanical, Electrochemical, Thermal & Hybrids) to serve as an initial screening for future LDES in-depth studies. Analysis will identify pros and cons and will compare LCOEs, technology maturity, markets, benefits and challenges
- Long Duration Flow Battery Study. Initiated an assessment of the feasibility of using long duration flow batteries at the BESS/HEDGE site after PV3 is removed. LDES may serve as a viable alternative to traditional thermal plant operations.
- Geothermal resource opportunities. A follow-up study was initiated to identify geothermal project opportunities that would include identifying projects, engaging with developers, and providing resource technical due diligence to support SMUD with assessing possible opportunities for power purchase agreement.
- Allam Fetvedt Cycle. Direct-fired, supercritical CO2 power cycle with in-situ oxy-combustion designed to capture CO2 is being investigated to understand its status and commercial opportunities, assess any technical issues, and potential applicability to help achieve SMUD's Zero Carbon Plan.
- LCFS Electricity Pathway for New Hope Dairy Digester. Completed the certification of New Hope Dairy Digester Electricity Pathway to charge EVs with CI score of -750.81 gCO2/MJ (CI Deemed Complete: 1/1/2021, CI Certified on 6/28/2021, CI Start Date: 1/1/2021)
- Dairy Digesters e-RIN Applications. This project entails the development and submission of the biogas-to-electricity pathway applications for Van Steyn, Van Warmerdam and New Hope dairy digesters under the USEPA-Renewable Fuel Standard (RFS) otherwise known as electricity Renewable Identification Number (eRIN). This is Federal credits akin to LCFS credits that can be generated when electricity produced from dairy digester biogas is used to charge electric vehicles in SMUD Service Area or in California. If monetized, eRIN may amount to 12-33 cents/kWh, a financially fit proposition and supports the growth of electric transportation.
- Concentrating Solar with Thermal Energy Storage. Assessment of current CSP+TES technologies, levelized cost of energy and consideration of commercial viability of local or regional development prior to 2030.
- Long duration thermal energy storage. Feasibility analysis and cost assessment of long-duration, utility-scale, solid state energy storage solution.

Grant Funded Clean Energy Projects

- Hydrogen Blend Collaborative Research. Received $12.45 M grant award from USDOE H2@Scale Initiative with NREL as the Prime Applicant for hydrogen blending research with participation from six National Laboratories and more than 20 industry and academia participants with combined cost share of over $4 Million. This project will address the barriers on pipeline materials compatibility & degradation related to the blending of hydrogen into natural gas pipelines, a concept referred to as HyBlend. Blending hydrogen into the natural gas infrastructure has national and regional benefits by storing green hydrogen for energy storage, resiliency and emissions reduction. SMUD will provide data and will serve as one of the sites or use cases for injection point of H2. Data that will be provided will be used for techno-economic analysis to quantify costs and opportunities of H2 production and blending with natural gas. Completed the execution and kickoff of collaborative research agreement for this project.

Distributed Generation Studies

- PRECISE Project – Completed requirements and the QA environment integration. Unit tests were completed with oracle driver installation. Additionally, produced training material for SMUD Engineers on how to use PRECISE for evaluating PV interconnection applications and to identify advanced inverter settings that each PV system with a smart inverter is to be set to. Worked with NREL to further refine the development of this advanced interconnection assessment tool that won the 2019 R&D 100 award for deployment at SMUD.
- LCFS Electricity Pathway for Van Warmerdam and Van Steyn Dairy Digesters. Completed the first annual re-calculation of carbon intensities (CIs) and annual report with recent performance data that were submitted to CARB. Monetized value of LCFS credits from certified CIs for both Van Warmerdam and Van Steyn dairy digesters with over $1.2 Million gross for both facilities and with total credits of 7,856 MT or GHG reduction (Q4 2019 to Q4 2020).
- DER Carbon Tool. Completed the development and expansion of DER planning and modeling tool that assess carbon reduction/savings, budgeting, portfolio optimization, cost effectiveness and load forecasting for EE and building electrification, electric vehicles (EV), solar PV, battery storage and flexible load measures.
- EPRI DRIVE. Completed the operational transfer of EPRI DRIVE evaluation software tool to Distribution Planning Engineers enabling them to more efficiently and effectively evaluate the technical impacts of DERs on distribution systems.
- Allume PV Disaggregation. Partner with Allume, developer of SolShare, which enables interconnection and management of electron flowing from a single PV array to co-located meters at a multifamily dwelling property, overcoming one of the main barriers to rooftop PV for multifamily properties not eligible for net-energy metering. Still in ideation, plan to work with owner/manager of multiple fourplexes serving predominantly low-income residents to test the functionality, billing accuracy, and feasibility of Allume's PV disaggregation software as an alternative to virtual net-energy metering for multifamily dwellings that are not designated affordable housing.

Climate Change and Carbon Reduction Research Projects undertaken in 2020

This program provides technical, economic, and policy expertise on climate change and impacts to SMUD territory supporting SMUD's IRP goals, assisting operations in addressing climate vulnerabilities, and creating opportunities for customers and community partners who support climate neutrality and regenerative projects with a net positive impact.

- Natural Refrigerant Incentive Program, which targets commercial and industrial systems, continued executing grant-funded field assessment and reporting on two new grocery store

installations, expected to deliver over 10,000 tons CO2e reduction relative to conventional systems.

- Began planning for ecosystem service integration research at SMUD's Rancho Seco II Solar project, including soil carbon monitoring, native seeding and hedgerows, grazing and pollinator field studies (Delayed due to COVID-19)
- Completed research on physical climate impacts and summarized key findings relevant to SMUD's service territory, generation, transmission and sourcing locations.

Renewable Energy Programs

Greenery is a voluntary green pricing program that gives customers the option to support carbon free energy generation by paying a fixed monthly rate ($4 or $8) to match either 50% or 100% of their usage with renewable energy credits. When a customer enrolls in Greenergy their usage is tracked according to their enrollment level. SMUD uses the proceeds from this program to purchase renewable or carbon free power or renewable energy credits to supply participants from generators located within the western US. These purchases are in addition to our RPS requirements.

In 2018, the CEC adopted new Title 24 Building Energy Efficiency Standards that, beginning in 2020, now requires solar on new homes, with some exceptions. These standards are expected to drive additional solar installations within SMUD's service territory. In 2020, the CEC approved SMUD's application for our Neighborhood SolarShares program to act as an alternative compliance method for California's rooftop solar mandate in the 2019 Title 24 Building Code.

Customer-side Solar Status

In 2016, SMUD achieved our SB1 Program funding goals for residential and commercial installations. Currently, there are remaining SB1 funded projects still under development. Additionally, residential and commercial solar systems are being installed under our net-energy metering tariff. In 2020, nearly 36 MW of customer solar was installed in SMUD service territory under net-energy metering agreements. Table C-4 summarizes solar installation data through 2020.

Table C-4: Installed Customer PV[7]

	SB-1		Residential		Commercial		Totals	
	Installed Systems	MW	Installed Systems	MW	Installed Systems	MW	Installed Systems	MW
2020	38	0.193	4,924	22.2	149	13.38	5,111	35.78
Totals	14,673	129.76	19,138	85.12	472	151.94	34,283	366.82

[7] This table includes NEM, Solar Smart, VNEM installations, and projects funded with SB-1 dollars.