Members of the public wishing to address the Board are requested to complete a sign-up slip at the lobby information center. Statements shall not exceed three minutes, unless the Board President grants special permission.

AGENDA

SACRAMENTO MUNICIPAL UTILITY DISTRICT
BOARD OF DIRECTORS' MEETING
SMUD CUSTOMER SERVICE CENTER
RUBICON ROOM - 6301 S STREET
SACRAMENTO, CALIFORNIA

September 17, 2015 – 6:00 p.m.

Call to Order.
a. Roll Call.

1. Approval of the Agenda.

2. Approval of the minutes of the meeting of September 3, 2015.

3. Board of Directors' reports.

   a. Committee Chair report of September 15, 2015, Policy Committee
   b. Other director reports
   c. President's report

4. CEO's Report.
   a. Board Video re Careers at SMUD

Items 6 and 7 were reviewed by the Policy Committee on September 15, 2015. Item 8 was reviewed by the Finance and Audit Committee on September 2, 2015.

Comments from the public are welcome when these agenda items are called.

<u>Consent Calendar</u>:

5. Approve Board member compensation for service rendered at the request of the Board (pursuant to Resolution 02-12-14) for the period of September 1, 2015, through September 15, 2015.

6. a. Accept the monitoring report for **Strategic Direction SD-9, Resource Planning**.

   b. Approve revisions to **Strategic Direction SD-9, Resource Planning**.

   Policy Committee 9/15. (Jim Tracy)

7. Authorize the Chief Executive Officer and General Manager to enter into one or more agreements with the State Office of Technology Services Statewide Telecommunications and Network Division and eligible service providers for as needed telecommunications and network services available under the State of California's competitively bid **CALNET 3** contract and any successive CALNET contracts in an amount not to exceed $12,000,000 through June 30, 2020, with the option for two additional one-year extensions. **Policy Committee 9/15. (Frankie McDermott)**

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Discussion Calendar:

8. Authorize the Chief Executive Officer and General Manager to execute the revised Gas Supply Agreement and the revised Operational Services Agreement, and approve the inclusion of SMUD's disclosure information (Appendix A) in the Preliminary Official Statement, all pursuant to a Natural Gas Prepay transaction with the **California Statewide Communities Development Authority** as the bond issuer and the **Royal Bank of Canada** as the gas supplier. **Finance and Audit Committee 9/2. (Jim Tracy)**

Public Comment:

9. Statements from visitors (non-agenda items).

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Board Committee Meetings are held at the SMUD Customer Service Center, 6301 S Street, Sacramento

September 15, 2015	Policy Committee	Rubicon Room*	5:30 p.m.
September 29, 2015	Finance and Audit Committee	Rubicon Room	5:30 p.m.
September 30, 2015	Energy Resources & Customer Services Committee	Rubicon Room	5:30 p.m.

* * * * * * *

The Rubicon Room is located on the first floor of the SMUD Customer Service Center, 6301 S Street, Sacramento, CA

Board of Directors' Meetings are held at the SMUD Customer Service Center, 6301 S Street, Sacramento

October 1, 2015	Rubicon Room*	9:00 a.m.
October 15, 2015	Rubicon Room	6:00 p.m.

The Rubicon Room is located on the first floor of the SMUD Customer Service Center, 6301 S Street, Sacramento, CA

Members of the public wishing to address the Board should complete a sign-up form available at the table outside of the meeting room. Members of the public shall have up to three (3) minutes to provide public comment on items on the agenda or items not on the agenda, but within the jurisdiction of SMUD. The total time allotted to any individual speaker shall not exceed nine (9) minutes.

Members of the public wishing to inspect public documents related to agenda items may call 916-732-6857 to arrange for inspection of the documents at the SMUD Customer Service Center, 6301 S Street, Sacramento, California.

NOTE: Accommodations are available for the disabled public. If you need a hearing assistance device or other aid, please call 916-732-6857 in advance of this Board Meeting.

SD-9 Board Strategic Direction on Resource Planning
Annual Report – September 2015

Purpose

It is a core value of SMUD to provide its customer-owners with a sustainable power supply through the use of an integrated resource planning process. A sustainable power supply is defined as one that reduces SMUD's net long-term greenhouse gas (GHG) emissions to serve retail customer load to 350,000 tonnes (10% of its 1990 carbon dioxide emission levels) by 2050, while assuring reliability of the system, minimizing environmental impacts on land, habitat, water quality, and air quality, and maintaining a competitive position relative to other California electricity providers. In reducing its net GHG emissions, SMUD will utilize energy efficiency, renewable and net carbon free resources, including large hydroelectric resources and biogas. SMUD may also use offsets to support these goals to the extent their use is cost effective and beneficial to SMUD customers and the region.

To guide SMUD in its resource evaluation and investment, the Board sets the following interim goals:[1]

Year	Net Greenhouse Gas Emissions (metric tonnes)
2012	2,608,000
2020	2,318,000

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

a) SMUD's goal is to achieve Energy Efficiency equal to 15% of retail load by 2023.

To do this, SMUD will acquire as much cost effective and reliable energy efficiency as feasible through programs that optimize value across all customers. SMUD shall support additional energy efficiency acquisition by targeting one percent (1%) of retail revenues for above market costs associated with education, market transformation, and programs for hard to reach or higher cost customer segments. The market value of energy efficiency will include environmental attributes, local capacity value and other customer costs reduced by an efficiency measure.

[1] Note: These goals do not take into account the potential impacts of the electrification of transportation.

Year	Gigawatt Hours	Megawatts
2014	172	24.6
2015	175	25.0
2016	178	25.4
2017	180	25.7
2018	182	26.0
2019	184	26.3
2020	186	26.6
2021	187	26.7
2022	189	27.0
2023	191	27.3
Total	1824	260.6

b) Provide dependable renewable resources to meet 20% of SMUD's load by 2010, and 33% of its load by 2020, excluding additional renewable energy acquired for certain customer programs. In acquiring renewable resources, SMUD shall emphasize local and regional environmental benefits.

c) Promote cost effective, clean distributed generation through SMUD programs.

Monitoring Summary

The Sacramento Municipal Utility District (SMUD) is currently in compliance with each of the goals established by SD-9, Resource Planning.

This annual monitoring report updates the progess made towards meeting the objectives established by Strategic Direction 9 (SD-9), as adopted by the Board of Directors in 2004 and updated in Oct 2013.

SD-9 includes a greenhouse gas (GHG) emissions reduction directive to reach by year 2050 and shorter term goals specified for years 2012 and 2020. In addition SD-9 directs electric energy and demand savings and renewable supply and clean distributed generation policy through year 2020 and an integrated resource planning (IRP) process to achieve these directives and balance them with other policies including financial, customer, local envirionmental impacts and reliability directives.

SMUD will continue its integrated resource planning process to focus on achieving the long run resource planning goals established by SD-9. This report details the many initiatives SMUD is pursuing to achieve SD-9 directives in the short and the long run. Pursuit of the goals established by SD-9 requires a balanced and integrated approach to ensure that all the strategic directives and policies affected by short and long run resource planning properly influence SMUD's resource and investment decisions. Staff's integrated resource planning (IRP) process seeks to balance Strategic Directives that establish policies for environment, reliability, carbon, renewable, and financial objectives to produce a plan that achieves all SMUD goals at a reasonable cost.

AB 2514 required that, on or before March 1, 2012, the governing board of each local publicly owned electric utility initiate a process to determine appropriate targets, if any, for the utility to procure viable and cost-effective energy storage systems to be achieved by December 31, 2016, and December 31, 2021. AB 2514 specifically provides that all procurement of energy storage systems must be cost effective.

In accordance with AB 2514, on March 1, 2012, the Board initiated a process under which Staff would consider energy storage options through the integrated resource planning process (IRP). Based on the IRP findings in 2014, staff determined that an energy storage systems target is not justified by energy storage costs at this time. Accordingly, on September 4th, 2014, the Board determined that adoption of energy storage targets is not appropriate at this time. In accordance with AB 2514, the Board must re-evaluate its determination of appropriate storage targets at least every three years. SMUD staff will likely reevaluate potential storage options within the next year.

SMUD is also monitoring and supporting plug-in vehicle market adoption given that these technologies also reduce green house gas emissions in our community and have other grid benefits.

Background

SD-9 provides guidance to SMUD staff in resource planning with goals for renewable power, energy efficiency and carbon mitigation. In December 2008, the Board added sustainable power supply as the overall objective of the integrated resource planning process. It stated the goal of reducing SMUD's long-term greenhouse gas emissions (GHG) from generation of electricity for serving our retail load to 10% of its 1990 GHG emission levels by 2050 (i.e. - <350,000 metric tons/year). The 2009 policy revision (Resolution 09-11-08) advanced the RPS target to procure 20% of SMUD's annual energy sales from renewables by 2010 (instead of 2011), and added a target of 33% annual energy sales met by renewables by 2020. Subsequently in May 2011, the Board added interim GHG targets for years 2012 and 2020, to establish a trend toward long-term GHG goals, and clarification for alternatives to achieve targets and goals.

Compliance with these interim GHG reduction goals, energy efficiency savings, demand reduction goals, renewable supply amounts and local environmental benefits objectives are summarized in this report. SD-9 also includes cost effective demand reduction resources (e.g. distributed storage, demand response, direct load management, and time-of-use pricing) as tools available to meet demand reduction goals. Accordingly, demand reduction goals will be updated after staff gains more insight into demand reduction program capabilities from pilot program studies currently under development through the various Smart Grid initiatives.

This report summarizes compliance with the SD-9 policy direction.

Primary Goal: Sustainable Power Supply (GHG targets and Goal)

Objectives to meet the goal

1. Meet near-term (through 2020) energy efficiency and RPS goals.

2. Develop offset projects if cost effective and beneficial to customers and the region.

3. Meet long-term goal (post 2020 targets and goal) with additional energy efficiency, renewables, offset projects, or other carbon neutral resources.

SMUD's adjusted GHG footprint in 2014 was approximately 2.48 million metric tons, which is below the year 2012 target of 2.61 million metric tons. Adjustments to the actual 2014 footprint include decreases to account for lower than expected hydro and wind production, increases to account for lower energy usage by SMUD customers and an increase for "banking" of renewable energy credits (RECs). The REC banking adjustment accounts for cases where renewable energy is procured in 2014 but the RECs are saved (or "banked") to comply with the Renewable Portfolio Standards (RPS) requirements in the future. The adjustments for hydro, wind, and REC banking assume that the renewable energy is replaced with market purchases and thermal generation. In the case of the load adjustment, the avoided emissions are also assumed to come from market purchases and thermal generation. Table 1 summarizes actual emissions, and adjustments to reflect normal weather conditions, expected energy usage and the REC banking adjustment. Note that the 2012 goal was set based on forecasts done in 2010, which included a 2% higher load forecast and a 1% lower RPS level than was actually achieved, further accounting for differences between our goal and our actual footprint.

Table 1 – Carbon Footprint & Targets

2014 SD-9 Carbon Footprint & Near-term Targets (Tonnes)[1]		
Source	**Power (MWh)**	**CO2 Emissions (MT)**
Generation and Power Purchases	12,860,191	3,475,437
Wholesale Adjustment	(2,362,231)	(885,338)
SMUD Electric Sales (Subtotal)	***10,497,960***	***2,590,100***
Adjustment for Normal Load		17,621
Adjustment for Normal Wind and Hydro		(371,328)
REC Banking Adjustment		248,496
SMUD Normalized Total (estimate)		***2,484,889***
2012 Target		***2,608,000***
2020 Target		***2,318,000***

Note 1: Some of the emissions have not been verified and are subject to change.

Goal A: Meet Energy Efficiency Goals and Reduce SMUD Peak

Objectives to meet the goal

Explore the potential for cost effective energy efficiency and peak reduction programs in SMUD's territory.

1. Encourage energy efficiency and peak reduction programs through marketing program options, offering rebates, and exploring new technologies that could be adopted in SMUD's service area.
2. Offer customers time-differentiated tariffs that encourage shifting power use to off-peak periods.
3. Provide energy efficiency incentives and load management programs that focus on power shifting or reduction during the summer peak.

2014 Energy and Demand Savings

The Energy Efficiency (EE) exceeded the SD-9 demand and energy savings goals established for 2014. The table below summarizes energy and demand savings from SMUD's residential and commercial energy efficiency programs.

Table 2 – Comparing 2014 Energy and Demand Savings with SD Goals

Program Type	Avg. Demand Savings MW (4-7PM)	Energy Savings Annual GWh
Information & Education Savings	0	3.56
Existing Residential	15.64	90.72
Existing Commercial	11.58	75.17
New Construction	1.33	9.95
Shade Trees	0.17	0.37
Total	***28.72***	***179.77***
SD-9 Goals for 2014	***24.6***	***172***

Through the various energy efficiency programs, SMUD assisted our customers with:

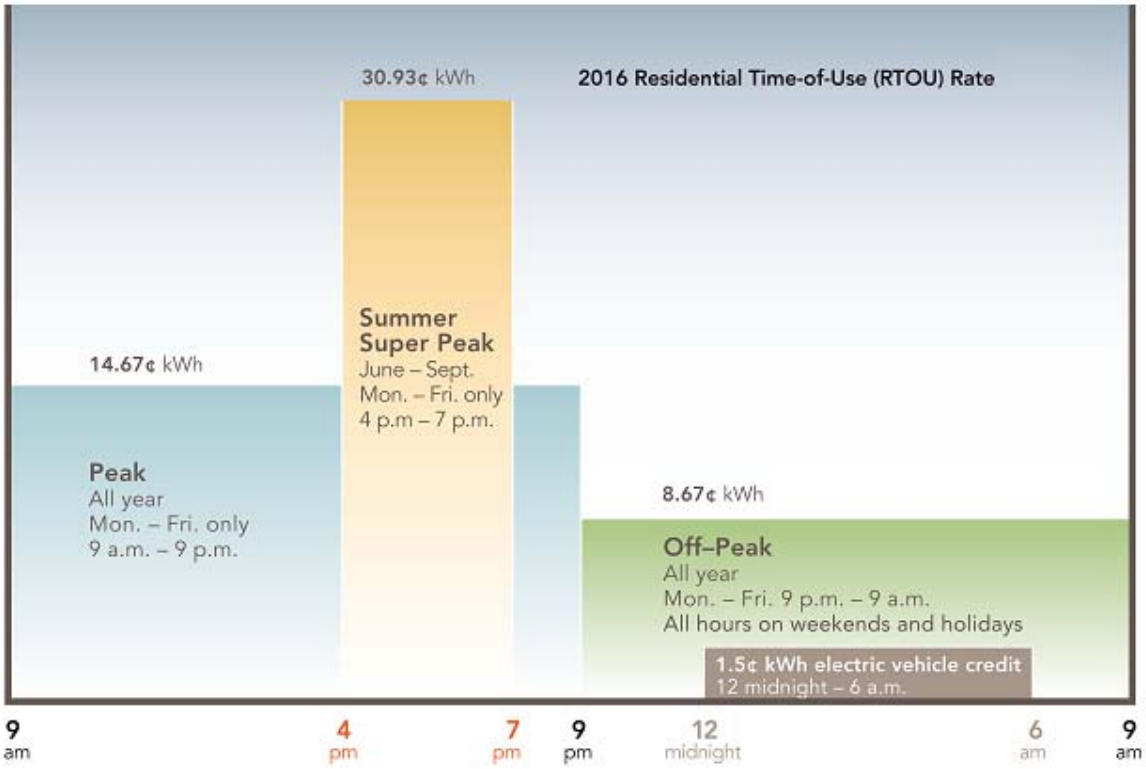
- The installation of 4,265 energy efficient residential central HVAC systems
- The procurement of 419 energy efficient room air conditioners
- The completion of 2,116 multi-family comprehensive energy efficiency jobs
- The purchase of 2,296 new energy efficient refrigerators
- The recycling of 9,239 old refrigerators
- The planting of 5,478 shade trees
- The acquisition of 100 residential heat pump water heaters
- The procurement of 981 whole house fans
- The installation of 283 energy efficient clothes washers

- The purchase of 418 energy efficient dishwashers
- The sale of 221,709 LED or CFL fixtures and 1,684,121 LED or CFL bulbs.
- The completion of 140 commercial custom energy efficiency projects.
- The construction of 18 new energy efficient commercial buildings.
- The training of 62 students in energy efficiency practices

New Residential Time-Of-Use Rates

In 2013, SMUD completed the two-year SmartPricing Options (SPO) pilot that included residential time-of-use (RTOU) that found significant peak reductions from pilot participants. On July 16, 2015 the Board approved a new optional RTOU rate for 2016 incorporating the findings of the SPO pilot. The new RTOU rate will replace SMUD's current optional residential TOU rates and move SMUD closer to the development of standard TOU rates for residential customers in 2018.

Figure 1 – New Residential Time-Of-Use Rates



Existing Demand Response Programs

SMUD maintained a number of operation-ready load management programs in 2014, as summarized in the table 3. These programs are available to Energy Trading & Contracts and Grid Planning & Operations for reliability purposes. SMUD currently activates its largest load management program targeting residential air conditioning, Peak Corps, only for emergency conditions. The last time this program was activiated was in 2001, during the California Energy Crisis. In 2014, SMUD used demand response resources three times for reliability purposes.

Table 3 - Available Demand Response Programs

Dispatchable Programs	Expected Load Shed Range
Residential Air Conditioning Load Management • At participants maximum elected level of cycling (full cycling) • At 100% full shed (emergency shed)	73 MW 106 MW
Industrial Curtailment (One customer)	6.5 MW
Total	**79.5 — 112.5 MW**
Non-Dispatchable Programs	**Expected Load Shed Range**
Temperature Dependent Rate • Air Products • Linde	0 MW - 8 MW 0 MW - 6.5 MW
Voluntary Emergency Curtailment Program	0 MW - 30 MW
Total	**0 MW - 44.5 MW**

One Long Running Demand Response Program Cancelled

The Volunatry Emergency Curtaiment Program was cancelled at the end of 2014 after being in existence since the late 1970's. The program was activated twice during the King Fire incident in September 2014. Customers' were notificed to reduce electricial load due to the reliability event. The results of the curtailment indicated on the first day, only 10.45 MW was shed. The second day, only 1.65 MW was shed. This was considerably less than the planned 30.59 MW for this time of the year. The previous time that this program was activated was during the 2001 California Energy Crisis.

New Demand Response Program Offerings Undergoing Further Evaluation

As part of the SmartGrid project, new demand response pilot programs leveraging the smart grid technology (i.e. smart meters, Internet, and DRMS) continued to be tested and evaluated in 2014. These programs could be used in emergencies, if needed (e.g. PowerDirect was used on Sept 15 and 16).

- In late 2014, the PowerDirect pilot program was redesigned to meet Energy Trading and Contracts operational needs so they could add it to their resource mix beginning June 1, 2015. Instead of 4 program offerings in the pilot, only one is being offered, the Minimum Dependable Load Reduction. There are now greater penalities for non-performance and capacity payments were restructured be align better with actual capacity replacement costs.

- The residential PowerStat pilot program continued into 2014 with the objective to continue to add more customers to the various price-based (TOU/CPP rate) and incentive-based ($ bill credit/event) program offerings to further assess the energy and demand impacts, customer satisfaction, technology and viability for future

program offerings that can be used for resource planning and scheduling. By year end, 1,569 customers were enrolled. The DRMS system was assessed to understand how as programs scale-up in participants, what constraints are placed on the underlying back-office systems and what upgrades and process improvements are needed. A key take-way was that a Silver Spring Networks HCM upgrade was needed, if PowerStat was ever going to be used by ET&C or Grid Operations and to support direct-to-grid two-way air conditioner switch technology.

Peak Load per Customer

Load per customer is a metric used to monitor the effectiveness of SMUD efficiency and demand reduction programs. Table 4 shows the projected normal weather peak load for the District's customer base in 2015, 4.80 kW per customer.

Table 4 – Actual and Weather-Normal Peak per SMUD Customer (kW)

Year	Actual	Normal Weather
2000	5.24	5.26
2001	4.73	4.96
2002	5.20	4.94
2003	5.13	5.11
2004	4.75	5.14
2005	5.17	5.14
2006	5.62	5.14
2007	5.27	5.14
2008	5.23	5.14
2009	4.79	5.09
2010	5.01	4.99
2011	4.75	4.97
2012	4.90	4.95
2013	4.95	4.86
2014	4.90	4.86
2015*	4.80	4.86

* The *current system peak load of 2,956 MW was reached on Wednesday, July 29, 2015. The daily high and low temperatures were 108 and 67 degrees Fahrenheit, respectively, measured at the Sacramento City and Executive Airport weather stations. The actual peak was slightly below than the forecasted peak of 3,008 MW, a difference of 52 MWs.*

Goal B: Meet Renewable Goals and Emphasize Local and Regional Environmental Benefits

Objectives to meet key value:

1. Support local projects and initiatives that improve air quality in the Sacramento area.

2. Purchase or construct additional renewable generation sufficient to achieve 25% RPS by the end of 2016 and 33% RPS by the end of 2020.

3. Promote the adoption of plug-in electric vehicles to improve the air quality in our region, reduce green house gase emissions and provide for grid benefits.

Emphasize Local and Regional Environmental Benefits

SMUD Community Renewable Energy Deployment (CRED) Projects

SMUD received a $5,050,000 grant award in 2010 under the U.S. Department of Energy's (DOE) Community Renewables Energy Deployment (CRED) grant opportunity to develop local renewable energy projects SMUD also received a $500,000 award from the California Energy Commission's (CEC) Public Interest Energy Research (PIER) cost share for CRED.

The purpose of SMUD's CRED proposal is to develop renewable energy projects up to 5 MW in SMUD's service territory. The project developers will employ commercial technologies and make use of local renewable resources. The four CRED projects consisted of Simply Solar, Co-Digestion at Sacramento Regional County Sanitation District, the New Hope Dairy and the Van Warmerdam Dairy Anerobic Digesters. The Co-Digestion and Dairy Digester projects were completed in 2013.

Conergy was awarded and implemented the Simply Solar project. The project is located at the Sutter's Landing Regional Park with 1.5 MW of solar PV generating clean, renewable power utilizing existing public land assets. The project was completed in fall 2014.

Grant Funded Renewable Projects

- Demonstration of Biogas Clean-up and Solid Oxide Fuel Cell – SMUD in partnership with Fuel Cell Energy Inc and TDA Research Inc. (as Prime), and with grant funding from USDOE, continues to perform research and demonstration of a biogas clean-up system for solid oxide fuel cell (SOFC) application[2].

- South Area Transfer Station Biogas Energy Plant(SATS Digester) – in collaboration with SMUD, the County of Sacramento has completed the

[2] Note. For details please see Appedix: "2014 Renewable Energy Public Goods Report, Sacramento Municipal Utility District"

construction of the 25-ton-per-day (TPD) Phase-I Sacramento BioRefinery #1 (SBR1) at the County of Sacramento South Area Transfer Station (SATS)[3]. A larger scaled-up system capable of diverting 100TPD (36,500 tons per year) of source-seperated food waste is in progress. The entire project is expected to be completed in December 2015.

- Biomass Gasification – SMUD, through AB 32 Cap & Trade Allowances Value Investment Initiative, is providing funds to help develop and demonstrate a 3 MW biomass gasification project for DG and CHP application in the SMUD service territory[3].

- New Van Steyn Dairy Digester project in Elk Grove – SMUD through AB 32 Cap & Trade Allowances Value Investment Initiative is providing funds to help implement another dairy digester at Van Steyn dairy farm in Elk Grove. Commercial operation of this digester engine genset system is expected to begin in Q3 2015[3].

- Strategic Planning and Operational Tools for Integration of PV – SMUD is supporting DNV KEMA in conducting a research, demonstration and deployment project that targets the development of methodologies and software for evaluating high penetration PV on the distribution grids. This is expected to end in Q3 2015.

- Intra-hour Dispatch and Automatic Generator Control Demonstration with Solar Forecasting Project –The objective of this project is to integrate new short-term solar forecasting into automatic generator control algorithms; and improve operations room dispatch of regulation resources based on solar forecasting information[3].

- Distributed Resource Energy Analysis and Management System Development for Real-time Grid Operations – Hawaiian Electric Company will design new capabilities to enable visibility to thousands of uncontrolled distributed roof-top PV resources and factor advance short term wind and solar forecasting capability for the region into the EMS decision making process. SMUD is playing a monitoring and advisory role in the project, and also evaluating the project for applicability for our system[3].

- Improving the Accuracy of solar Forecasting – This is a multi-year project that is led by the University Corporation for Atmospheric Research (UCAR). The primary objective is to develop a solar power forecasting system that advances the state-of-the-science[3].

- Pre- and Post Combustion Nox Control with Microwave Energy – This project will develop and demonstrate an integrated microwave technology for pre-and post combustion NOx control of a biogas powered engine[3].

[3] Note. For details please see Appendix: "2014 Renewable Energy Public Goods Report, Sacramento Municipal Utility District"

- Demonstration of Low NOx Microwave Technology - SMUD has partnered with CHA Corporation and AFT for the biogas cleanup research projects (NOx and H2S removal systems using biogas) that are co-funded by the CEC and California Air Resource Board (CARB) to demonstrate more efficient and cost effective cleanup of biogas from waste water treatment plants and dairy anaerobic digesters.

- Biogas Enhancement Project - SMUD accepted a grant from the CEC for a biogas enhancement project to demonstrate the additive mineral treatment process, developed and patented by Argonne National Lab, and also explore options for overcoming local obstacles to expanded biogas generation. Bench scale and pilot tests are being conducted at Argonne National lab and if the results of the bench scale and pilot tests are satisfactory, field demonstration of this additive process is planned at CleanWorld's digester in Sacramento. A resource assessment and procurement plan for a potential food waste collection program has also started to support this project. This project had won a prestigious R&D 100 Award from R&D Magazine. The project is expected to be completed Q4, 2015.

Additional Renewable Energy Studies

- Wind Resource Site Monitoring and Analysis - This project conducts preliminary analysis for potential future wind plant development sites at North Lassen and Abert Rim. Since as early as 2007, SMUD has located meteological equipment at four sites to record data, and further SMUD's interest in these wind sites. The analysis is expected to be completed at the end of 2015.

- Investigation of the Lassen South wind resource - This project aims to identify and conduct preliminary analysis for potential future wind plant development sites at South Lassen. The analysis is expected to be completed at the end of 2015.

- Quantifying the Externailities of Renewable Generation - This analysis focuses on quantifying the typically unquantifiable benefits of renewable generation in an objective fashion using existing methodologies to determine/calculate the indirect costs and benefits of renewable generation. These externalities include impacts to water usage, reduction in greenhouse gases (GHG), etc.

- Bulk System Variable Generation Integration Study - SMUD staff, with Energy Exemplary and NREL, is conducting a study to examine the impacts on system reliability with increasing penetrations of variable generation on the system. It examined higher penetration of renewables scenarios in the. 2020 and 2030 time frames to estimate breaking points for system reliability caused by significant variable generation. The results of this work will be used for SMUD grid planners to improve understanding about flexibile resources SMUD will need in the future in order to maintain system reliability.

Water & Energy Assessment and Demonstration Projects

AB32 Allowance Auction revenue was utilized to conduct an assessment of the energy intensity of the regional water supply. Managed jointly with staff from the Regional Water Authority, this project resulted in the first formal assessment of the energy embedded in

local water, providing data necessary to inform future policy and customer programs to promote water conservation. In addition to the assessment, we funded four demonstration projects in partnership with local water agencies, which resulted in energy savings and greenhouse gas emissions reductions. The City of Sacramento leveraged the SMUD-funded pilot study to win a $2.5 million dollar Department of Water Resources grant to expand their leak detection and repair program.

Carbon Offset Demonstration and Protocol Development Projects

We are investigating ways to sequester carbon that restore natural systems and provide cleaner air, cleaner water, flood protection and expanded wildlife habitat in and around our service territory. Here is a summary of our current research agenda:

- Delta Carbon Capture & Wetlands Farming - We partnered with the Sacramento San Joaquin Delta Conservancy, The Nature Conservancy, Metropolitan Water District, the California Coastal Conservancy and the American Carbon Registry to develop a GHG methodology for wetlands and rice farming in California. The draft protocol has been developed and will be circulated for public comment in late summer 2015.

- Placer Forest Sustainability Initiative - We are partnering with the Placer County Air Quality Management District to conduct research and develop GHG offset protocols for forest fuel management activities that preserve forests by reducing the impacts of catastrophic wildfire and black carbon emissions.

Other Carbon Reduction Research Projects completed in 2014

Carbon Sequestration Potential Evaluation – This project determined the potential for Carbon Capture in various depleted natural gas wells in region within 100 miles of SMUD service territory; Screened for faults and ability to maintain supercritical CO2 state based on depth and pressure; Screened for more than 20 years storage of SMUD carbon emissions; estimate cost for transportation and sequestration of CO2 by new pipeline from CPP in suitable depleted gas region; and Evaluated a method to quantify sequestration potential in transfaulted depleted gas region and use method to identify 20yr+ sequestration opportunity for CPP.

Marginal Abatement Cost Curve Analysis – This project Identified the cost effectiveness and potential for reducing carbon from a SMUD utility perspective of various options including energy efficiency measures, renewable energy (SMUD or customer owned) and electrification measures.

Plug In Hybrids and Battery Electric Vehicles

Plug-in Electric Vehicle (PEV) reduce criteria pollutant emissions by 90% and green house gas emissions by approximately 70% as recognized by the California Air Resources Board. PEV market activities were reactivated in late 2010 with the commercial launch of both the Chevrolet Volt and Nissan Leaf in our service territory. Today, there are over 20 models to choose from automakers such as Toyota, Honda, Ford, BMW, and Tesla. Overall PEV sales picked up significantly in the Sacramento area

starting in October of 2012. As of the spring of 2015 approximately 2500 PEV's are registered in SMUD service territory.

- FOA 28 PHEV Demonstration – Under stimulus grant activity with General Motors and Chrysler, SMUD acquired 10 Chevrolet Volts and 14 plug-in hybrid Ram Pickup trucks. In addition to the actual vehicle testing, the grant funding regional PEV readiness activities such as grid impact evaluation, multi-family dwelling charging infrastructure surveys and basic vehicle-based smart charging. The General Motors grant was completed during Q2 of 2014 and the Chrysler grant was completed during the Q3 of 2014.

- AB32 Allowance Auction Revenue – Also initiated in 2013 were two projects being funded by AB32 Allowance Auction Revenue. Those two projects included the Truck Electrification Project and EV DC Fast Charger deployment in our community. Under the Truck Electrification Project, additional electrified truck parking stalls were built at the 49er Travel Plaza and the project was completed in August of 2013. A second effort electrified the trucking docks of refrigerated warehouses for Penske Trucking in late 2014. The electrified trucking docs at Penske Trucking allowed the trucks to shutdown their normal diesel truck refrigeration units while loading groceries, which reduced emissions and lowered truck operational costs. The EV DC Fast Charger program includes the install of 3 DC Fast Chargers which allows of recharging most typical EV's in as little as 30 minutes. SMUD installed its first DC Fast Charger at the SMUD headquarters campus in March of 2014 and its second DC Fast Charger in Citrus Heights in March 2015. The remaining DC Fast Charger in this effort will be installed at the Sacramento Valley Amtrack station in late 2015.

- SACOG CEC DC Fast Charging – SMUD teamed with SACOG in late 2014 and won a California Energy Commission Grant to install another 3 DC Fast Chargers in our community. Property negotiations and siting activities have begun. The 3 sites include: Sac-Food Coop in mid-town Sacramento, the Nugget Market in Elk Grove and the Nugget Market in the Pocket Area.

- AB 32 Workplace and Mulifamily Charging Infrastructure Pilot – Starting in 2015 funding for an internal AB32 project came through for a small pilot incentive program to evaluate market desire for workplace and multi-family dwelling unit charging was launched. The program will provide incentives to 24 customers per year. As of July 2015, 12 chargers have been installed and additional customers are being sought for the remaining icentives. This is a two year program.

Additional Grant Opportunities

- New Slab Creek Powerhouse and Boating Flow Valve Project - Staff is moving forward with a DOE-funded project to add a new, small hydroelectric powerhouse at Slab Creek Dam. The new Slab Creek Powerhouse would produce on average approximately 11 GWH annually, generated from new and higher minimum releases that are required at Slab Creek Dam under the new UARP license. Staff filed a Final Non-Capacity License Amendment Application with FERC for the new powerhouse in September 2014. Recently, SMUD's Owner's Engineer contractor

and have developed preliminary function designs and prepared a construction cost estimate. Staff have also submitted permit applications to several permitting agencies in preparation for constructing the project.

Meet Renewable Goals (25% and 33% RPS Goals)

Senate Bill 2 in 2011 (SBX1-2) established a Renewables Portfolio Standard (RPS) goal of 33% by 2020 for local publicly-owned electric utilities (POUs) as well as retail sellers. SBX1-2 gave the California Energy Commission (CEC) new oversight responsibilities with respect to the enacted RPS requirements for POUs, and included new interim goals between the initial 20% by 2010 target and the end 33% by 2020 target. As implemented by the CEC POUs are required to procure an average of 20% renewable in 2011-2013; an slightly higher average in the period 2014-2016, aimed at reaching a level of 25% by the end of 2016; and then about a 30% average in 2017-2020, aimed at achieving 33% renewables by the end of 2020. In each year after 2020, a 33% renewable procurement level is required.

SMUD met its 20% Renewable Portfolio Standard (RPS) targets in 2010 and the State goal of 20% average for the period of 2011 through 2013. SMUD filed its first compliance period report with the CEC in June 2014, and has retired 6,257,282 Renewable Energy Certificates (RECs) for RPS compliance in Compliance Period 1. SMUD also has excess procurement of over one million RECs from the compliance period that we expect to apply toward future compliance.

SMUD is well under way to meet the next RPS requirements for compliance periods 2 and 3, as well as continue to achieve 33% renewables after 2020. 21.7% of total retail sales for Compliance Period 2), and 33% by 2020 (30% of total retail sales for Compliance Period 3). As illustrated in Table 5, any renewable power in excess of an annual or compliance period target will be banked as credit (surplus procurement) to apply in future years.

Table 5 - SMUD's Renewables Goals and Accomplishments

Program	2014 Target	2014 Procurement	2014 Banked Surplus	2016 Goal	2020 Goal
RPS (%)	20.0%	26.5%	6.5%	25.0%	33.0%
RPS GWh	2,115	2,798	683	2,657	3,498

Meeting Future Goals

With the renewable power secured to date, and with successful achievement of the energy efficiency goals and maintaining the savings rate thereafter, SMUD will most likely have sufficient procurement to meet its 2020 RPS goal.

To continue progress in achieving future RPS goals, staff has conducted a number of procurement efforts including the following:

- SMUD has expanded eligible renewable procurement with Conergy's new 1.5 MW PV system at the Sutter Landing Regional Park. This project received grant

funding from the DOE Community Renewable Energy Deployment program and the CEC.

- SMUD also executed contract amendments for extended procurement of renewable resources from the Kiefer landfill (County of Sacramento) and Iberdrola PPM Highwinds.
- SMUD staff released a Solar Request for Offers (RFO) in 2013 seeking bids for solar projects. SMUD is currently negotiating with an entity on the short list for a solar PV project (up to 20MW) in SMUD's territory.
- Two biomethane projects outside of California (from various sources, under contracts signed and reported to the CEC prior to 3/29/2012) went on-line in early 2014, providing additional biomethane for combustion in SMUD's Cosumnes Power Plant.
- In March 2014, SMUD staff secured real property in California that has the potential to support up to 30 MW for future wind development.
- SMUD executed a contract with CalEnergy, LLC in August 2014 for geothermal energy from the Salton Sea Geothermal Area.
- SMUD staff is examining the potential for receiving RPS procurement credit from incremental hydro efficiency improvements to power plants in the Upper American River Project.
- SMUD is supporting the development of an anaerobic digester at the Van Steyn Dairy, the fifth dairy digester in the Sacramento County, with an expected on-line date of fall 2015.
- SMUD staff is considering a new small hydro facility near the current Slab Creek reservoir in the Upper American River Project.
- SMUD is considering additional renewable power offers from a variety of renewable resources in 2015.
- SMUD has added 10.3 MW of behind the meter renewable systems through interconnection and incentive payment agreements with our customer-owners, 7.6MW of these systems have been certified by the CEC and registered in WREGIS.

Goal C: Promote Cost Effective Clean Distributed Generation and Storage

Objectives to meet the goal:

1. Support the installation of photovoltaic (PV) units on customer sites and small solar generation projects connected to SMUD's distribution system.

2. Support the installation of clean distributed generation and storage.

3. To create an established and quality solar industry infrastructure that sustains itself in a subsidy-free marketplace.

SB1 Solar Status

Customers installed 10.25 MW of solar PV through SMUD's SB1 Solar PV Incentive Program during the 2014 calendar year. The total PV installations through 2014 were 66.68 MW.

The SB1 PV installation forecast for 2015 is 19.41 MW. Most of the program activity is in the residential sector, where the installed capacity in 2015 is expected to double what was installed in 2013. The 2014 installed capacity in the commercial sector drecreased by 50% compared to 2013. For the most part this is due to SMUD low rates.

Table 6 - PV Installed and Expected under SMUD's SB1 Program

	Residential Retrofit		SolarSmart Homes		Solar Shares and Multifamily Affordable VNM		Commercial Retrofit		Totals	
	# Systems	MW	# Systems	MW	# Systems	MW	# Systems	MW	**# Systems**	**MW**
2007	55	0.191	105	0.187	0	0.000	5	0.309	**165**	**0.687**
2008	73	0.236	255	0.450	1	1.100	10	1.466	**339**	**3.252**
2009	215	0.768	188	0.417	0	0.000	12	4.225	**415**	**5.410**
2010	368	1.458	222	0.512	1	0.475	20	8.908	**611**	**11.353**
2011	611	2.263	154	0.373	0	0.000	39	8.018	**804**	**10.654**
2012	752	3.395	298	0.778	3	0.130	29	7.617	**1082**	**11.920**
2013	1,310	6.223	656	1.395	0	0.000	33	5.491	**1999**	**13.109**
2014	1,406	7.017	476	0.950	0	0.000	43	2.285	**1925**	**10.252**
2015*	3,000	15.09	0	0.000	0	0.000	31	4.320	**3031**	**19.410**
TOTALS	**7,790**	**36.97**	**2,354**	**5.062**	**5**	**1.705**	**222**	**42.639**	**10,371**	**86.088**
Total MW Installed through the end of 2014										**66.68**

* 2015 values are forecasted values based on the July 2015 CSBU Performance Scorecard – Solar Programs 2015

NOTE: values have changed for some programs in previous years.To align with other SMUD departments reporting activity, we changed the completion date to PV meter set date rather than incentive funding date.

By the end of 2015, it is expected that SMUD customers will have installed 86.09 MW of PV systems since the SB1 program began in 2007. The table 6 summarizes SMUD's progress by year and by the four market sectors covered by the program including the Multifamily Affordable Housing Virtual Net Metering Pilot Program and Solar Shares.

Commercial Retrofit

The Commercial Retrofit Program installed 2.29 MW in 2014. The drop off in expected Commercial Retrofit installations for 2014 when compared to 2013 installation is a reflection of the reduction in the incentive level to Step 10 in early 2014 ($ 0.20 per watt). As of June 2015, all of the SB1 Program budgeted funds for commercial are committed.

Residential Retrofit

Residential retrofit installs were brisk in 2014 with 1,406 installs. The market activity in 2015 is on pace to double that of 2014. The program began 2014 with a different incentive structure. Rather than calculating the incentive based on kW size, we've introduced a flat incentive of $500 per installation address. This captures more capacity per dollar than the previous step 10 $0.20/watt level. Despite this dramatic drop in incentives the PV market continues at a brisk pace. Part of the reason for the increased activity is due to the increased PV sales force in Sacramento with vigorous activity promoting and selling the 20 year lease option for PV installations.

SolarSmart

In 2014, the SolarSmart program incentivized the installation of 476 new solar homes, which is 27% fewer than 2013 installations. The SolarSmart Home Program has transitioned in the new SMUD Smart Home program, which provides for a more comprehensive new home approach.

SolarShares

Participation in the SolarShares program remained strong in 2014, increasing from 93% to 94% subscribed by year end. Customers received 15,000 MWhs of solar energy through the program. Plans are underway to begin offering up to 11 MW of commercial SolarShares in 2016.

Sacramento Solar Canal

SMUD partnered with a private developer to develop a pilot proposal for a PV system that would be suspended over the US Bureau of Reclamation (USBR) owned Folsom South Canal, providing renewable generation and reducing evaporation from the canal. The project was unsuccessful in securing WaterSMART grant funding, but USBR staff have continued working with SMUD to further refine the project approach and identify key success measures. The Folsom South Canal offers the potential for up to 75MW of distributed generation within SMUD service territory, and such a project would be the first of its kind in the United States.

FIAMM Energy Storage Project

This project will evaluate the ability of 50 kW/130 kWh NaNiCl battery technologies to enable higher penetrations of renewables, reduce peak load on the system, and improve system reliability. Use cases include PV firming, renewable time shift, EV charging peak load reduction. The project is expected to be completed in the end of 2015.

California Solar Initiative: PV Integrated Storage

This project leverages 34 units of solar with integrated storage already in place in the innovative 2500 R Street Zero Net-Energy development in Sacramento. We will design and implement control strategies to both reduce customer energy bills and provide distribution system benefits for PV integration. These strategies will include time-of-use pricing and peak load reduction, firming PV generation, DR, shaping net loads, scheduling and dispatch of spinning reserves, and voltage support. Our experience and findings will culminate with Energy Solutions leading the design of a utility-managed customer program to enroll new and existing customers in providing PV integration and distribution system support with behind-the-meter assets.

Conclusion

SMUD's continued progress toward meeting future goals and fully complies with the standards and goals articulated within SD-9. SMUD is on track to meet its 2020 carbon goal and renewable energy goals through 2020, and has met the energy efficiency goal for 2014. With SMUD's existing and expected renewable surplus, SMUD should be able to achieve the State's and SMUD's renewable and carbon goals through 2020. SMUD continues to invest in development and implementation of new programs and projects to ensure the goals established by SD-9 are met. The integrated resource planning process balances reliability, environmental, financial, and customer objectives to produce a balanced portfolio of resources that achieves SMUD goals in an reasonable and affordable way.

Appendix:

2014 Renewable Energy Public Goods Report

Sacramento Municipal Utility District (SMUD)

SMUD Public Goods Programs 2014

The Sacramento Municipal Utility District's Public Good programs benefit our customers and the Sacramento community every day. Long before a legislative mandate required Public Good programs, SMUD built a national reputation as a leader in many of these areas, including clean energy projects and renewable energy research and development.

In 2014 for Renewable Energy, SMUD collected $15,887,209 in SB-1 revenues and received $1,783,992 in new grant funding for research and development (R&D). SMUD has expensed $ 15,565,553 (SB-1) and $5,757,752(R&D) to Renewable Energy related Public Goods programs and projects. This report describes these programs, expenditures, and expected or actual results for 2014.

About the Renewable Energy Public Good programs

California law requires utilities to maintain specific programs that contribute social and environmental benefits to the state. The Renewable Energy related Public Good programs may include:

- SB1 legislation requires utilities to offer incentives for customer sited PV installations that offset the customer's electricity use. SMUD's portion of the $3.4 billion in funding allocated for SB1 programs amounts to $130 million, and SMUD hopes to provide incentives sufficient to interconnect 125MW of customer-sited PV systems with that funding. SMUD's PV incentive program began in 2007 and will continue for 10-years or until the funds run out, whichever comes sooner.
- Research, development and demonstration programs for the public interest, to advance renewable energy science or technology that is not adequately provided by competitive and regulated markets.
- New investment in renewable energy resources and technologies consistent with existing statutes and regulations that promote those resources and technologies.

SB1 Photovoltaic

Total SB1 2014 Incentive Expenditures: $15,565,553

SMUD's SB1 related Public Goods programs continue to focus on the development and deployment of solar photovoltaic (PV) systems. Continued success in residential, commercial, and utility-scale deployment of grid-connected PV systems has kept SMUD at the forefront of being a national leader in solar-electric generation. SMUD's established programs serve as models for other public and public-private PV programs throughout the state. In all, SMUD interconnected nearly 10.3 MW of SB1 customer sited PV in Sacramento in 2014.

SB1 Summary of Program Activities and Challenges:

• Declining incentive levels did very little to slow down project activity in the residential retrofit sector. Activity has noticeably decreased in the commercial market since the incentives dropped to Step 10 ($0.20 per watt) in 2013.

• The new housing market demonstrated a downward momentum in 2014. New residential construction with solar installations participating through the SMUD program saw a 27% decrease over the previous year. Declining incentive levels requiring developers to pay a larger portion of the installation cost contributed to the decline. Increased efficiency requirements due to Title 24 also contributed to the decline.
• The solar PV leasing business model continues to capture a prominent share of the market for financing residential rooftop solar PV systems. While the majority of the observed growth in solar leasing is in the residential retrofit market it is also available in the new home market. The concern is the tendency to distort the true cost of installation due to solar leasing service providers "optimizing" the federal investment tax credits. The perceived customer benefit is a set monthly payment that on an annual basis provides net utility bill savings. It is anticipated that solar leasing and power purchase agreements will continue to capture a large share of the residential solar PV market. The solar PV leasing business model is also increasing penetration into the New Solar Homes market as home builders look for ways to remain competitive. Solar leasing allows the home builders to keep the cost of the solar PV system out of the total cost of the new home. When the new home is purchased, the solar lease is assigned to the new home owner and becomes their obligation.
• Solar PV system installation costs continue to decline. Solar PV is getting closer to becoming a subsidy free market, especially for high energy use residential customers. On the commercial side, SMUD's low rates coupled with risk adverse financing options hold back widespread PV market penetration.
• Strategies for reducing time and costs for PV project approval, grid interconnection and coordination with building department agency approvals continue to be explored.
• Customer education will continue to play a large part in SMUD's role in the solar electric marketplace. We will continue the development of our SolarMap and other web based products to build customer awareness and understanding to support customer interest in solar.
• SMUD held a 3-day training session in September 2014 to prepare participants for the North American Board of Certified Energy Practitioners (NABCEP) certification test. The class was taught by Bill Brooks from Brooks Engineering. This is an advanced solar PV training class for code compliance design and installation of solar PV systems.
• SMUD held an all-day Energy Expo in April 2014 to educate customers about efficiency and renewable generation options. We also participate in many local home shows and the state fair to inform customers of of EE and PV opportunities.
• SMUD solar PV system inspectors provide continuous guidance, advice and instructions to solar vendors operating within the SMUD service territory as part of the solar PV system installation inspections, as well as solar system plan reviews.
• The SMUD website provides customer access to PV information and financing to help customers during the decision process to invest in solar. Contractors also use the site for program documents and updates.
• SMUD spent $2,113,000 to manage the SB1 incentive program. Costs include labor, software license fees, and consultant fees to administer applications and payments, perform inspections, support customer inquiries, and marketing.

SB1 Customer Program and Activity Descriptions

SB-1 Residential Retrofit PV: In order to help increase market development and drive down the initial cost of PV, SMUD provides rebates to customers who install rooftop solar PV. SMUD staff performs intake, verification, inspection and payment processing for residential installations. In addition, staff handles contractor and customer questions, inquiries and status updates.

SB-1 Commercial Retrofit PV Rebates: SMUD authorizes and pays PV incentives to customers for the installation of solar PV on commercial buildings and property. SMUD staff performs intake, verification, inspection, interconnection and payment processing for eligible solar PV systems installed on commercial

buildings and property. In addition, staff handles contractor and customer questions, inquiries and status updates.

SB-1 SolarSmart PV: In order to encourage the installation of PV on new homes, SMUD secures and maintains solar PV and EE agreements with new home developers. Builders agree to install PV on all of the homes that they build in SMUD's service territory. In return, SMUD pays PV incentives based on kW installed per home. SMUD staff processes and authorizes incentives for homes built in accordance with the solar PV and EE agreements. During 2013 and 2014, SMUD renegotiated all of the longstanding agreements with participating builders to adjust PV incentives downward in response to the declining PV costs. Further program adjustments were defined in 2014 as the new Title-24 Energy Code is expected to take effect in July 2014. SMUD SolarSmart home program will move to SMUD SmartHome program January 2015. All the solar PV activity will be managed through the residential PV program in 2015.

SolarShares: SMUD staff maintains a customer enrollment level of 94% of capacity, about 750 customers, for a 1 MW virtually net metered solar PV installation. SMUD bought the generation from a third party provider through a purchase power agreement. Participating customers voluntarily pay a monthly charge to SMUD for a portion of the system's generation. In return, they receive generation benefits that are applied against their electric usage throughout the year. SMUD markets to customers, pays for the generation through a purchase power agreement, and tracks customers' usage. The proceeds offset part of the purchased power costs.

Community Solar: SMUD customers voluntarily contribute to this program with the proceeds going toward installing PV on community buildings, Habit for Humanity developments, and to build and/or offer solar education projects for local schools. SMUD solicits participants for the program, tracks the contributions, selects a community site and oversees the installation of the PV, with the generation benefit going to the customer. The Community Solar program is also a sponsor of the annual Solar Regatta solar PV powered boat race. SMUD also is a contributor/sponsor for the CSUS Solar Decathlon entry which will be held in September/October 2015 in Irvine, CA. SMUD also initiated a Tiny House competition for college participation and will be held in Sacramento in 2016.

Customer Virtual Net-metered Solar PV: SMUD developed a pilot NEM customer aggregation rate. This allows a customer with multiple commercial accounts in a development, to aggregate the total use and offset that use with a PV system installed on the same premise.

Summary table of Solar PV installation activity in 2014

Customer Sited Systems Installed and Capacity per Sector

Sector	No. of Installations	MW	Annual GWh	SB1 Incentives paid or Reserved for 2014 installations
Residential	1,966	8.01	11.30	$ 2,616,254
Commercial	43	2.29	3.33	$ 547,661
	2,009	10.30	14.63	$ 3,163,915

Renewable Energy Research, Development and Demonstration

Total 2014 expenditures: $ 5,757,752

Research and Development (R&D) is the responsibility of the Energy Research & Development (ER&D) department at SMUD, reporting to the Chief Grid Strategy and Operations Officer. The department is comprised of the following programs: Climate Change, Electric Transportation, Smart Grid, Energy Efficiency, Demand Response, Renewable Energy, Distributed Generation, and Energy Storage.

An important strategy of the ER&D department is to take advantage of funding opportunities for R&D that fit the needs and direction of SMUD. Funding opportunities vary from year to year. The following describes the Renewable Energy Program including grant projects and activities.

Renewable Energy Program

The objective of the Renewable Energy program is to support SMUD's renewable supply and sustainability goals while maintaining system reliability and security. The program consists of several elements:

- Research, development and demonstration of technologies and resources for renewable energy sources including biomass, geothermal, solar, wind, and water (hydro) for electricity production and other value-added products (e.g. heat) and addressing barriers to market adoption, such as siting and permitting issues.
- As needed, solicit and evaluate new renewable energy projects and develop plans for renewable energy growth at SMUD.
- Identify, analyze and mitigate barriers to the reliable integration of variable renewable energy technologies to SMUD's grid.
- Implement compliance activities (i.e. generating and tracking of Renewable Energy Certificates) mandated by the SMUD Board and other regulatory entities.
- Evaluation of regulatory and environmental initiatives that will affect renewable energy mandates and impact utility operations.

SMUD Community Renewable Energy Deployment (CRED) Program

SMUD received a $5,050,000 grant award in 2010 under the U.S. Department of Energy's (DOE) Community Renewable Energy Deployment (CRED) grant opportunity to develop local renewable energy projects. The DOE grant is part of the stimulus funding program initiated by the U.S. American Recovery and Reinvestment Act, under the Funding Opportunity Announcement (FOA) 122. SMUD also received a $500,000 award from the California Energy Commission's (CEC) Public Interest Energy Research (PIER) cost share for CRED. This grant was initiated in 2010 and is expected to be completed June 2015.

The purpose of SMUD's CRED program is to develop renewable energy projects up to 5 MW in SMUD's service territory. The project developers employ commercial technologies and make use of local renewable resources (3 biomass projects and one solar PV project). These projects help meet SMUD's 2020 renewable energy target and DOE's Energy Efficiency and Renewable Energy (EERE) goals to accelerate market adoption of renewable energy technologies. In November 2014, SMUD's CRED program was awarded a 2014 *State Leadership in Clean Energy Award* (SLICE) from the Clean Energy States Alliance (CESA), a national, nonprofit coalition of public agencies working together to advance clean energy. SMUD is now conducting closeout activities for the CRED grant.

The following is a summary and status of each of the CRED projects:

- Simply Solar –Conergy was awarded the Simply Solar project. The project is located at the Sutter's Landing Regional Park. The goal of the Simply Solar is to install about 1.5 MW of solar PV that will generate clean, renewable power utilizing existing public land assets. The sub-recipient agreement with Conergy was executed in November 2013. The project was completed in fall 2014.

Figure 1. The Simply Solar project consists of solar trees, parking structure and a ground-mounted system.

- Co-Digestion at Sacramento Regional County Sanitation District (SRCSD) – In partnership with the SRCSD, SMUD implemented a full-scale co-digestion facility for fats, oil and grease (FOG) and liquid food waste. The biogas generated in this activity is being fed to the SMUD-owned Cosumnes combined cycle power plant with estimated power recovery of 1 MW to 3 MW. Construction of the project was completed in December 2012. Commission of the project occurred in early 2013. The system is operational and generating renewable energy for our RPS.

  New Hope Dairy Digester – The New Hope dairy farm has 1200 milking cows. SMUD has partnered with, ABEC New Hope, LLC as the developer to implement a dairy digester project at New Hope Dairy farm. This digester was completed in June 2013. The New Hope project developer changed the manure collection system from a flush to a scrape system to collect a higher amount of solid in the manure, which is more compatible with the high-solids, above-ground heated tank digester they installed. ABEC New Hope also installed a 450 kW genset equiped with a Selective Catalyst Reduction system (SCR) for NOx emissions reduction. The genset is operated during peaking hours. This prime mover system complies with the latest, strict NOx and SOx emissions limits. The New Hope Dairy digester engine-genset system has been performing well and has delivered over 1,135 MWh of electricity to the SMUD grid since the beginning of its commercial operation.

- Van Warmerdam Dairy Digester – The Van Warmerdam Dairy has 1200 milking cows and uses a flush system for dairy manure management. SMUD has partnered with Maas Energy Works, Inc. and implemented a covered lagoon and heated digester. The Warmerdam project utilizes a 600 kW genset, also with SCR treatment for NOx emission reduction and also being operated during

peaking hours. The Van Warmerdam Dairy digester engine-genset system has been performing well and has delivered over 1,098 MWh of electricity to the SMUD grid since the beginning of its commercial operation in May 2013.

Biomass Projects

SMUD's Biomass Program combines research, development and demonstration (RD&D) and deployment projects to convert local problem wastes and residues into renewable energy and co-produce value-added products such as transportation fuels and fertilizer.

SMUD's Biomass Program continues to envision having an affordable, reliable, and sustainable biomass industry that empowers our customers, captures environmental benefits, e.g. reduces greenhouse gas emissions, reduces odor, produces renewable biopower, lowers costs, co-produces value-added products, and creates economic opportunities across the SMUD's region. The Biomass Program includes RD&D and deployment of biomass energy technologies that addresses and helps resolve the technical, economic, environmental and institutional barriers facing the biomass industry in the SMUD Region, throughout the state of California and elsewhere.

Homogeneous Charge Compression Ignition (HCCI) Engine Demo

SMUD has partnered with Makel Engineering, funded by the CEC, to demonstrate a novel engine technology that can potentially reduce nitrogen oxide (NOx) emissions from small (< 500 kW) internal combustion engines both for electricity only and CHP applications. The technology, Homogeneous Charge Compression Ignition (HCCI), uses diesel engine blocks as a base engine. HCCI technology controls explosion temperatures and fuel/air mixtures in each cylinder, lowering explosion temperatures, which reduces NOx emissions, and optimizes fuel combustion. Makel's goal is to reduce NOx emissions to meet air districts' emissions limits (e.g. 9 ppm NOx) while maintaining relatively high engine efficiency. Further, Makel aims at building engines that are robust and rugged enough to withstand the demands of biogas combustion at technically and economically sustainable levels. Two HCCI systems were tested at Tollenaar and CalDenier Dairy farms for electricity only and CHP applications, respectively. Demonstrations at the dairy farms was completed in Q1 2014, with about 300 hours run at Tollenaar using 100 kW HCCI unit (see Figure 7) and about 400 hours operation at Cal Denier for CHP application using 30 kW HCCI unit.

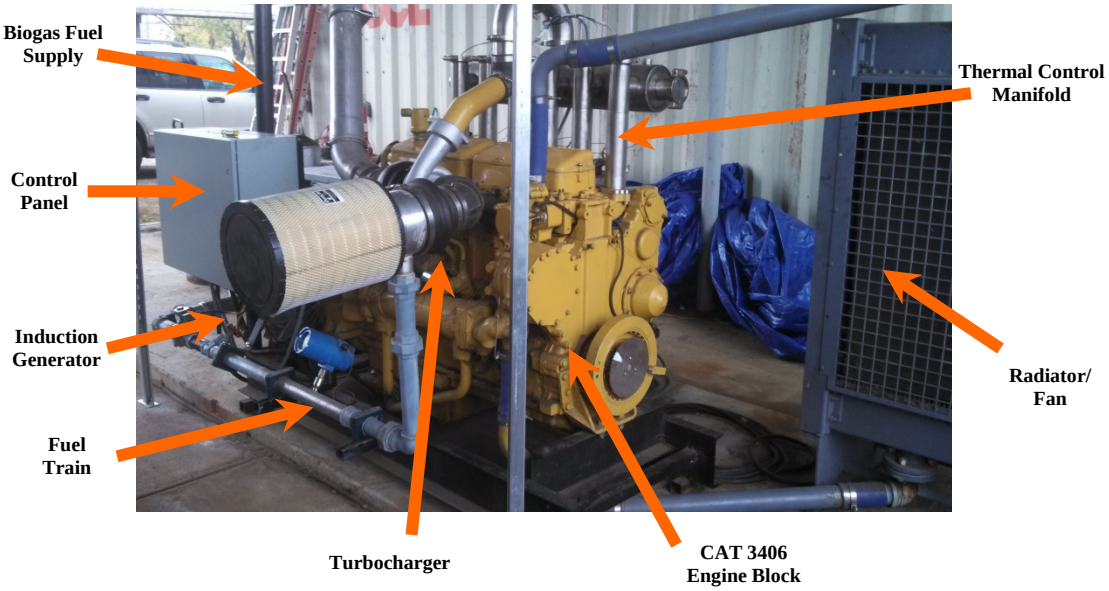


Figure 2. 100 kW HCCI System at Tollenaar Dairy Farm

Performance tests showed satisfactory results and allowed for the development of an automated control system for HCCI that maintains optimal operating conditions. The HCCI genset has an overall efficiency of ~33% while producing less than 0.07 lb/MWh NOx emissions. The demos have indicated that scaled up biogas fueled HCCI engine technology is a technically viable pathway for distributed power generation with low BTU value fuels. This project was completed in early 2014.

Biogas Enhancement Project

The grant agreement with CEC was approved in May 2013. SMUD's sub-agreements with Argonne National Lab, CleanWorld and TSS Consultants as members of the research team were prepared and executed in Q3 2013. A kickoff meeting was held on Dec 6, 2013. The aim of this project is to enhance biogas production by using Argonne's additive process that increases biogenic methane production rates up to five times and decreases CO_2 contamination in the biogas by three times. At Argonne National Labs, the Argonne team have completed the initial characterization of walnut biochar samples and sent the samples for further analysis to third party analytical laboratories. They have also started the third set of experiments at thermophilic temperatures to determine the impact of operating temperature on methane yield. The fermenters are running with walnut biochar. The team are monitoring and recording daily gas production rates in the digesters. They are also collecting and analyzing gas and liquid samples and continuing to conduct data analysis of fermenter runs under semi-continuous mode. Meanwhile in Sacramento County, TSS Consultants are continuing to evaluate potential feedstock suppliers, adding to an existing list for the project with the help of Clean World Partners. The walnut biochar additive is being used at the Clean World Partners' high-solid organic waste conversion facility at American River Packaging's (ARP) Sacramento headquarters to demonstrate increased production of biogas. This project won a prestigious "R&D 100 Award" from *R&D Magazine*. The project is expected to be completed by the third quarter of 2015.

Dairy Biogas Monitoring

SMUD partnered with Summers Consulting and Williams Engineering with funding from the CEC for the completion of data collection and monitoring of detailed data over a 12-month period from 6 manure

digester facilities in California, including Cal Denier and Tollenaar dairy digesters. The project included the installation of real-time data collection equipment and monthly sample collection to characterize energy and mass flows in these systems. SMUD provided data collected from both Tollenaar dairy and Cal Denier digester projects and SMUD staff provided technical advice and actively participated in the Technical Advisory Committee for this project. Results of this project provided data to the dairy digester industry. The data included technical, economic and environmental performance data for dairy biogas systems including manure and effluent handling, anaerobic digestion, and biogas-to-electricity processes. This project was completed in early 2014.

SATS Digester

This project has completed the construction of a 25-ton-per-day (TPD) Phase-I Sacramento BioRefinery #1 (SBR1) at the County of Sacramento South Area Transfer Station (SATS) (see Figure 10). CleanWorld is the prime contractor, in collaboration with SMUD, Atlas Disposal Industries (ATLAS), LLC Carson Development (CARSON), Otto Construction Company (OTTO), and the County of Sacramento, and with funding from CEC's Alternative and Renewable Fuel and Vehicle Technology Program.. The current phase is to scale-up to a larger system capable of diverting 100 TPD (36,500 tons per year) for co-digestion of source-separated food waste and other organic wastes (AD) into 566,000 diesel gallon equivalents (DGE) of renewable natural gas (RNG) per year; 3.17 million kWh of electricity per year to power the SBR1 facility (with a net metering agreement with SMUD); 190,000 therms of heat per year for use at the SBR1 facility; 8,000 tons per year of nitrogen-loaded zeolite for granular fertilizer; 7,500 tons per year of compost; and 5,450,000 gallons per year of reclaimed water. The digester tanks and the gas compression skid have been installed and started to generate biogas. The project is expected to be completed in December 2015.

Figure 3. AD of organic wastes at Sacramento South Area Transfer Station

Pre-and Post-Combustion NOx Control with Microwave Energy

The CHA Corporation in collaboration with SMUD garnered funding from the CEC for research and demonstration of integrated pre- and post- combustion NOx emission control processes, consisting of two systems: a hydrogen (H_2) production system for pre-combustion NOx control and a NOx and other pollutants removal system on the engine exhaust. For this demonstration, a microwave steam-reforming prototype previously developed by CHA Corporation (CHA) will be modified to reduce NOx formation during combustion. The H_2 production system consists of microwave hydrogen sulfide (H_2S) removal and steam reforming units. A two-stage biogas treatment system consisting of air injection into the digester and microwave desulfurization will be used for H_2S removal. This system allows for H_2S removal from the very high concentrations in dairy digesters to the levels necessary for steam reforming to produce H_2 from biogas. The post-combustion NOx removal system is a pair of alternating carbon adsorption vessels in

series installed on the engine exhaust pipe to capture NOx, sulfur dioxide (SO_2) and volatile organic compounds (VOCs). The efficient capture of NOx with carbon has been successfully demonstrated by CHA under a previous project.

The CEC approved this project at the May 14, 2014 Business meeting. A kickoff meeting was held and the project was initiated in Q4 2014. Design drawings and schematics for the integrated system were completed. A lab test plan for H_2S removal system and steam reforming was prepared and submitted to CEC. Lab testing for the H_2S removal system has shown satisfactory results. The initial H_2S lab test program was completed with simulated biogas using the CTC-70 and CTC-80 GAC and copper oxide (CuO) and zinc oxide (ZnO) catalysts. Microwave energy completely destroyed H_2S in simulated biogas in both GAC and catalyst beds. Since the CuO/ZnO catalyst is consumed by reacting with H_2S, but GAC acts as a catalyst, CHA recommends the use of GAC for field-testing. The project is in progress. Completion is expected in early 2017.

Demonstration of Biogas Clean-Up and Solid Oxide Fuel Cell

SMUD in partnership with Fuel Cell Energy Inc and TDA Research Inc. (as Prime), and with grant funding from USDOE, continues to perform research and demonstration of a biogas clean-up system for solid oxide fuel cell (SOFC) application. TDA Research Inc. has completed the construction of a new, high capacity, low cost sorbent to remove all the hydrogen sulfide and other contaminants from biogas to meet the cleanliness requirements of the SOFC being constructed by Fuel Cell Energy Inc. This will be a key technology that enables the use of biogas in distributed fuel cell CHP systems. The team will demonstrate the capacity of TDA's cleanup system on a 2 kW SOFC being constructed by Fuel Cell Energy Inc. using biogas at Cal Denier Dairy Farm (See Figure 11). TDA has completed the construction of the cleanup system and delivered the unit to the Cal Denier dairy farm in the summer of 2014. Fuel Cell Energy Inc. performed factory testing of the fully constructed 2 kW SOFC and delivered the unit to the Cal Denier dairy farm in August 2014. Completion of the integrated system occurred at the end of 2014. A 3-month testing of TDA's desulfurization skid and FuelCell Energy's 2-3 kW Solid Oxide Fuel Cell fueled by biogas at CalDenier dairy digester was completed in December 2014. The TDA skid treated a total of 192,080 cubic ft of biogas while removing the sulfur down to less than 50 ppb from an average sulfur level of 646 ppm.. Expected completion date for the project is Q2 2015.

Figure 4. TDA's Biogas Clean Up Skid and 2 kW SOFC skid from FuelCell Energy Inc.

Van Steyn Dairy digester

Usingrevenue from the sale of surplus Cap and Trade allowances, SMUD is helping to implement another dairy digester to energy project at the Van Steyn dairy farm. Through a competitive solicitation process, the developer Maas Energy Works/John Galt LLC won the bid to build, own, finance and operate the

digester project. The Van Steyn Dairy has 600 milking cows. Dairy manure management is a flush system. Maas Energy Works plans to install a covered lagoon & a heated digester with an engine-genset of 225 kW. SMUD's Board approved the ten-year PPA and the grant agreement on December 4, 2013. An interconnection study was completed in May 2014. The foundation for the solid separator is being completed and the covered lagoon digester is expected to be completed by the end of June 2015. Commercial operation and grid interconnection is expected to be done by mid July 2015.

Biomass Gasification
SMUD, using funding from the sale of surplus Cap and Trade allowances, is helping to develop and demonstrate a 3 MW biomass gasification project for DG and CHP application in the SMUD service territory. This project is aimed to evaluate the technological and economic aspects and market penetration of thermal gasification using clean wood and other agricultural residues and assess how to improve the technology and reduce capital and O&M costs. A preliminary technical and economic feasibility study and feedstock resource assessment were completed by B&V. The project site is tentatively planned at the HP Hood LLC facility in Sacramento Release of a solicitation and selection of a project developer was completed in Q4 2014. The project is in progress.

Pellandini Dairy digester
SMUD, using funding from the sale of surplus Cap and Trade allowances, is helping to implement another dairy digester at the Pellandini dairy farm. Through a competitive solicitation process, the developer Maas Energy Works/John Galt LLC will also build, own, finance and operate this digester project. This project was initiated in late 2014.

<u>Other Grant Funded Renewable Projects</u>

Concentrating Solar Power (CSP) Steam Augmentation with Thermal Storage at the Cosumnes Power Plant
This is a multi-year project initiated at the end of 2013. In early 2013, SMUD submitted a proposal in response to a DOE Funding Opportunity Notice (FOA), "CSP Heat Integration for Baseload Renewable Energy Development (CSP HIBRED)" (DE-FOA-0000772). SMUD was awarded $10 million to implement the proposal. The objective of this project was to design, develop and demonstrate through commercial operation an advanced hybrid CSP technology (with thermal storage) that will be integrated at an existing natural gas-fueled combined cycle power plant. SMUD hired IEC to initiate feasibility studies for the project, andthe project was found not to be feasible. In late fall of 2014, DOE and SMUD agreed not to pursue the project. SMUD is currently conducting grant close out activities.

Tools Development for High PV Penetration
Together with other utilities, SMUD is studying potential impacts to the individual feeders, substations, utility regions and utility grid from high DG PV penetrations. The several utilities will select different feeder configurations to demonstrate, evaluate and validate high PV penetrations under steady-state, contingency and dynamic scenarios. The utilities include Sacramento Municipal Utility District (SMUD), the Hawaii Electric Companies (HECO/MECO/HELCO), Pacific Gas & Electric (PG&E) and the city of Roseville. This is a multi-year project initiated in 2012 with anticipated completion in Q2 2015.

Intra-Hour Dispatch and Automatic Generator Control Demonstration with Solar Forecasting
This project is being led by UC San Diego with SMUD providing technical input and data. This multi-year project was initiated in 2013. The objective of this project is to integrate new short-term solar-load forecasting into automatic generator control algorithms; improve the integration of higher penetrations of

PV resource; and improve operations room dispatch of regulation resources based on solar forecasting information.

Distributed Resource Energy Analysis and Management System Development for Real-time Grid Operations (DREAMS)

The Hawaiian Electric Company (HECO) has solar penetrations ranging from 15% to over 100% on its distribution feeders. HECO proposes to design, with two major EMS vendors, new capabilities which will enable visibility to thousands of uncontrolled distributed roof-top PV resources aggregated at hundreds of controllable 12kV distribution substations and factor in advanced 15-min short term wind and solar forecasting capability for the region into the EMS decision making process. The proposed approach enables jumpstarting this DG and forecasting integrated solution to "see and manage" distributed solar PV and builds utility workforce confidence by engaging them in creating solutions, testing and sharing new EMS capabilities to account for DG and provides "look ahead" forecasts to support utility functional and business processes. This is a multi-year project initiated in 2013 and expected to conclude in Q3 2015.

Improving the Accuracy of Solar Forecasting

This is a multi-year project that is led by the University Corporation for Atmospheric Research (UCAR). The primary objective is to develop a solar power forecasting system that advances the state-of-the-science through cutting edge research, test it in several high penetration solar utilities and ISOs, and disseminate the research results widely to raise the bar on solar forecasting technology. In support of UCAR's efforts to improve the state of the art in Solar forecasting, SMUD is leveraging our existing high density irradiance monitoring network and data from 8 utility scale PV systems in our service territory totaling nearly 100 MW of capacity to inform the performance and evaluation of solar forecasts. SMUD is evaluating the economic benefit of forecast accuracy improvement as part of determining the level and timeframes that forecast improvement will provide maximum benefit to the utility.

Other Variable Renewable and Integration Research & Development Activities

SMUD is continuing to collect wind resource data and conduct analysis of energy potential at four sites. Two sites are located in Lassen County north of Susanville with a met tower and a SODAR unit. Two sites are located in southern Oregon, north of Lakeview, one met tower at each site. SMUD holds temporary project evaluation rights with the U.S. Bureau of Land Management at these locations, and will be determining their wind energy and development potential. The analytical results will assist in determining whether to pursue future resource development at the sites. Development of these sites could complement SMUD's Solano County wind projects because the wind resource at the new sites are most energetic during the winter months, as opposed to the Solano sites , which produce best during the summer months. However, transmission constraints and wildlife habitat may prove to be a barrier to development of these sites.

SMUD is also studying bulk system variable generation integration impacts on the grid. The objective of the project is to determine impacts of variable renewable generation on SMUD's system and SMUD's ability to meet NERC reliability requirements. Flexible resource needs will be characterized in a way that helps grid planners identify the correct size and type of future flexible resources. The first phase of the project examined impacts of dynamically scheduling SMUD's current wind resources into system operations. Results suggest that SMUD has enough flexibility to do so even during extremely dry water years when the UARP is limited as a flexibility resource. SMUD also worked to identify a system breaking point with increasing penetrations of solar and wind resources on SMUD's system. The key result showed over-generation issues during the spring month of April, where SMUD has low load coincident with high wind and solar generation. The work did not include assessment of mitigation measures.

SMUD's Solano Wind Facility is an important asset. Staff is having UC Davis evaluate the forecasting of this resource. The objective of this project is compare actual Solano generation with DA and HA wind forecasts received by SMUD as part of the CAISO PIRP, and inform SMUD of forecasting needs based SMUD resources characteristics. Results have informed SMUD the need to maintain quality wind resource data, which is used by industry forecasters to generate power forecasters. The wind power forecasts that SMUD has received from the CAISO have been shown to be accurate to within industry benchmarks.

SMUD is also investigating the interaction of local water resources and energy usage. In conjunction with Aerojet, staff initiated a feasibility study to identify the renewable energy potential of in-conduit generation technology at Aerojet's groundwater treatment facility in Carmichael. The study included an assessment of current hydrokinetic technologies that may suit this particular site as well as other promising technologies to consider for other sites in the region. The initial study launched in early August 2014 and concluded by the end of 2014. The project included an assessment of the market for viable hydrokinetic technologies that may be appropriate at this location and for other potential sites in the region. A follow-on effort is planned which will conduct a broader in-stream and in-conduit resource assessment, utilizing the market assessment developed for the Aerojet work and the AB 32 Regional Water and Energy project as starting points. This effort was initiated in December 2014 but the bulk of the work would occur in 2015.

Staff is also in the very early stages of scoping a demonstration project which would install PV panels over exposed surface water conveyance canals. This approach could utilize existing infrastructure resources to expand solar generation and reduce evaporative water loss from the canals. Initial project discussions are expected to continue.

Finally, SMUD is continuing to evaluate the possibility of utility-scale solar on or near SMUD territory. The objective of this project is to locate a suitable site on disturbed or marginal land and determine feasibility of a utility scale CSP or PV power plant.

Attachment ___

SMUD BOARD POLICY		
Category: **Strategic Direction**		Title: **Resource Planning**
		Policy Number: **SD-9**
Adoption Date:	**May 6, 2004**	Resolution No. **04-05-11**
Revision:	**May 6, 2004**	Resolution No. **04-05-12**
Revision:	**September 15, 2004**	Resolution No. **04-09-11**
Revision:	**May 17, 2007**	Resolution No. **07-05-10**
Revision:	**December 18, 2008**	Resolution No. **08-12-15**
Revision:	**November 19, 2009**	Resolution No. **09-11-08**
Revision:	**May 6, 2010**	Resolution No. **10-05-03**
Revision:	**May 19, 2011**	Resolution No. **11-05-05**
Revision:	**December 20, 2012**	Resolution No. **12-12-12**
Revision	**October 3, 2013**	Resolution No. **13-10-09**
Revision:	**September 17, 2015**	Resolution No. **15-09-___**

It is a core value of SMUD to provide its customer-owners with a sustainable power supply through the use of an integrated resource planning process. A sustainable power supply is defined as one that reduces SMUD's net long-term greenhouse gas (GHG) emissions to serve retail customer load to 350,000 tonnes (10% of its 1990 carbon dioxide emission levels) by 2050, while assuring reliability of the system, minimizing environmental impacts on land, habitat, water quality, and air quality, and maintaining a competitive position relative to other California electricity providers. In reducing its net GHG emissions, SMUD will utilize energy efficiency, renewable and net carbon free resources, including large hydroelectric resources and biogas. SMUD may also use offsets to support these goals to the extent their use is cost effective and beneficial to SMUD customers and the region.

To guide SMUD in its resource evaluation and investment, the Board sets the following interim goals:[1]

Year	Net Greenhouse Gas Emissions (metric tonnes)
2012	2,608,000
2020	2,318,000

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

a) SMUD's goal is to achieve Energy Efficiency equal to 15% of retail load ~~by 2023~~ over the next 10-year period. On an annual basis, SMUD will achieve energy efficiency savings of 1.5% of the average annual retail energy sales over the three-year period ending with the current year.

To do this, SMUD will acquire as much cost effective and reliable energy efficiency as feasible through programs that optimize value across all customers. SMUD shall support additional energy efficiency acquisition by targeting one percent (1%) of retail revenues for above market costs associated with education, market transformation, and programs for hard to reach or higher cost customer segments. The market value of energy efficiency will include environmental attributes, local capacity value and other customer costs reduced by an efficiency measure.

~~Year~~	~~Gigawatt Hours~~	~~Megawatts~~
~~2014~~	~~172~~	~~24.6~~
~~2015~~	~~175~~	~~25.0~~
~~2016~~	~~178~~	~~25.4~~
~~2017~~	~~180~~	~~25.7~~
~~2018~~	~~182~~	~~26.0~~
~~2019~~	~~184~~	~~26.3~~
~~2020~~	~~186~~	~~26.6~~
~~2021~~	~~187~~	~~26.7~~
~~2022~~	~~189~~	~~27.0~~
~~2023~~	~~191~~	~~27.3~~
~~Total~~	~~1824~~	~~260.6~~

b) Provide dependable renewable resources to meet 20% of SMUD's load by 2010, and 33% of its load by 2020, excluding additional renewable energy acquired for certain customer programs. In acquiring renewable resources, SMUD shall emphasize local and regional environmental benefits.

c) Promote cost effective, clean distributed generation through SMUD programs.

Monitoring Method: GM Report
Frequency: Annual

[1] Note: These goals do not take into account the potential impacts of the electrification of transportation.