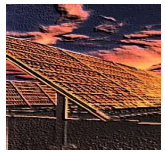

Utility Perspectives on Grid Connected Renewable Energy

Global Workshop on Grid Connected Renewable Energy

Washington, DC

29 August –6 September, 2009

Presented by Jaspal Deol, PE

Manager, New Services

Sacramento Municipal Utility District

USEA
United States Energy Association

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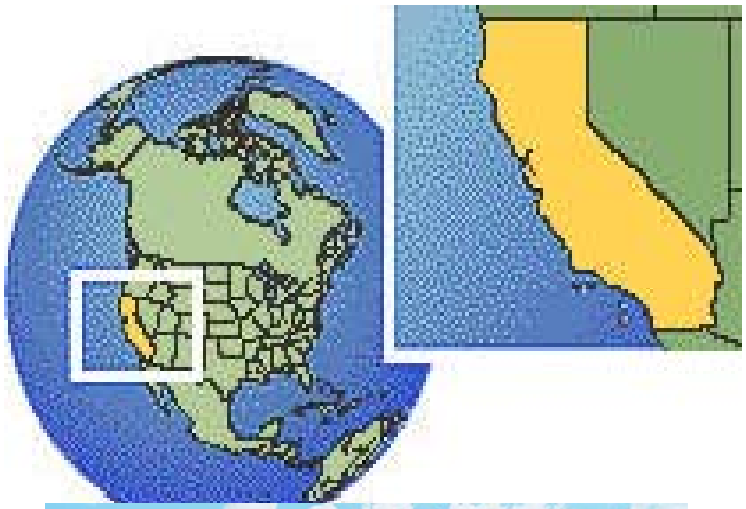
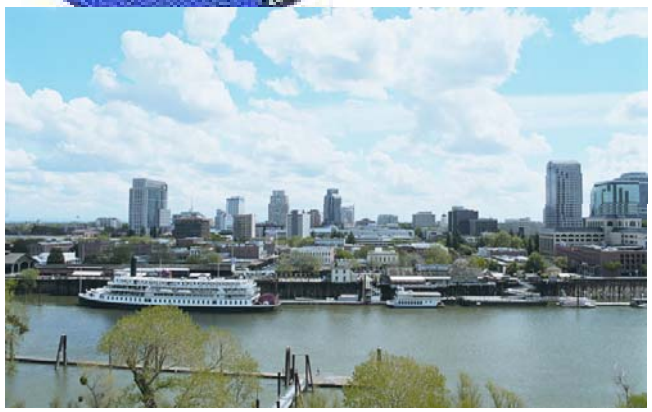
California





- Most populous state in the USA
- Area 159,000 sq. mi
- Population 36,000,000
- State since 1850 (31st)
- State economy among largest in the world
- Peak energy usage ~ 54,000 MW
- **SMUD Peak Demand 3299MW**

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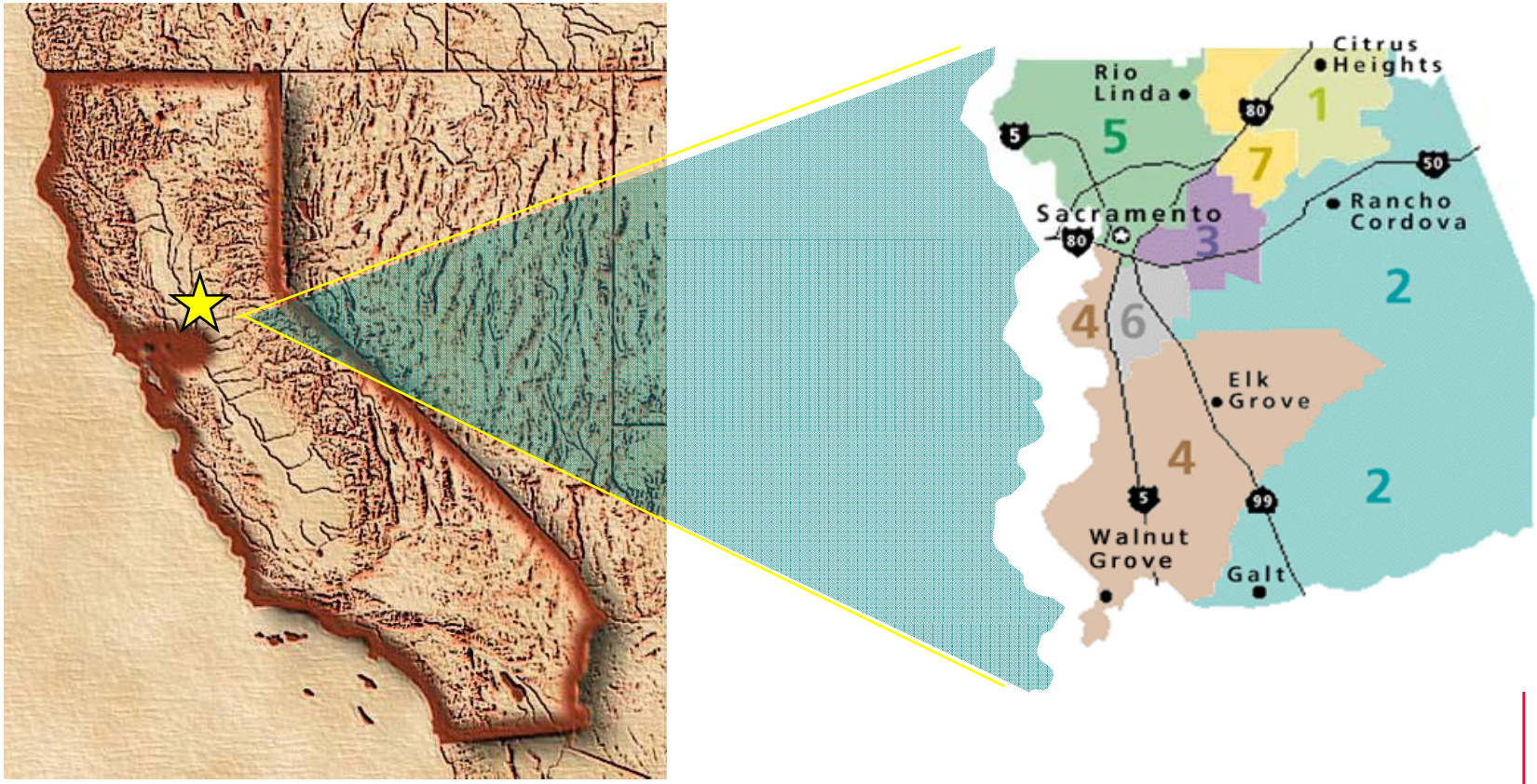
Sacramento Municipal Utility District *Serving the Capital Region*



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Sacramento Municipal Utility District

- Established December 31, 1946
- Service area 900 sq. miles
- Service area population 1.4 m
- Total customers 592,490
- Total employees 2,197
- Revenues $1.48 billion
- 6th largest municipal in U.S.

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Governance Profile

- Seven member Board of Directors
- Popularly elected by ward
- Staggered four-year terms
- Representation ≅ 200,000 residents per Director
- Serve as regulatory body in accordance with statutory authority
- Decide all issues of policy
- Set rates and conditions of service

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Our Customers

- 10.9 billion Kilowatt-hours in retail energy sales
- Total Residential sales: 4.7 billion kWh (43% of sales)
- Total Commercial/Industrial and Agricultural sales: 6.2 billion kWh (57% of sales)
- Average kWh sale per residential customer: 8,982 kWh

*J.D. Power Rated #1 Residential & Commercial in the U.S.

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Energy Resource Profile

- Renewable Energy 20 %

  (Biomass, Geothermal, Small hydro, Solar & Wind)

- Coal 1 %
- Large Hydro 17 %
- Natural Gas 62 %
- Nuclear < 1 %

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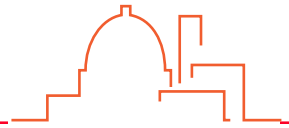
California Clean Energy Goals

- Assembly Bill 32
  - Greenhouse Gas Reduction
  - 80% reduction from 1990 Ghg levels by 2050
- Assembly Bill 2021
  - Energy Efficiency Goals
  - 10% efficiency over 10 years
- Senate Bill 1
  - Solar Photovoltaic
  - “1 million solar roofs”



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California Clean Energy Goals

- Senate Bill 14
  - Renewable Portfolio Standard
  - 33% renewable by 2020
- Assembly Bill 1368
  - Fossil Fuel Intensity Standard
  - No imports to California that exceed 1,100 lbs/MWh
- Energy Title 24
  - State Building Codes

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SMUD VISION

- ***SMUD's Vision is to empower our customers with solutions and options that increase energy efficiency, protect the environment, reduce global warming, and lower the cost to serve of region***

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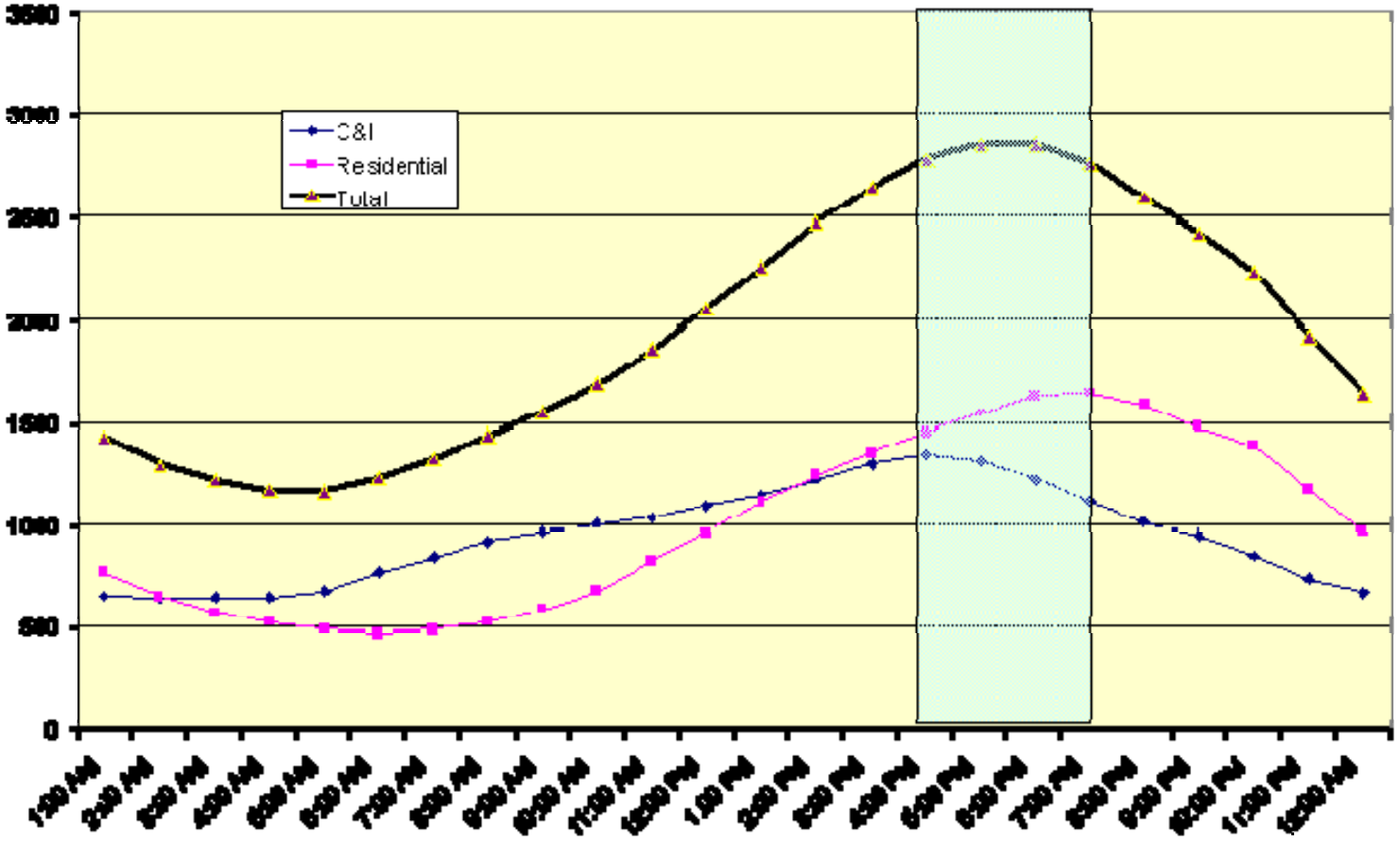
The Challenges for SMUD



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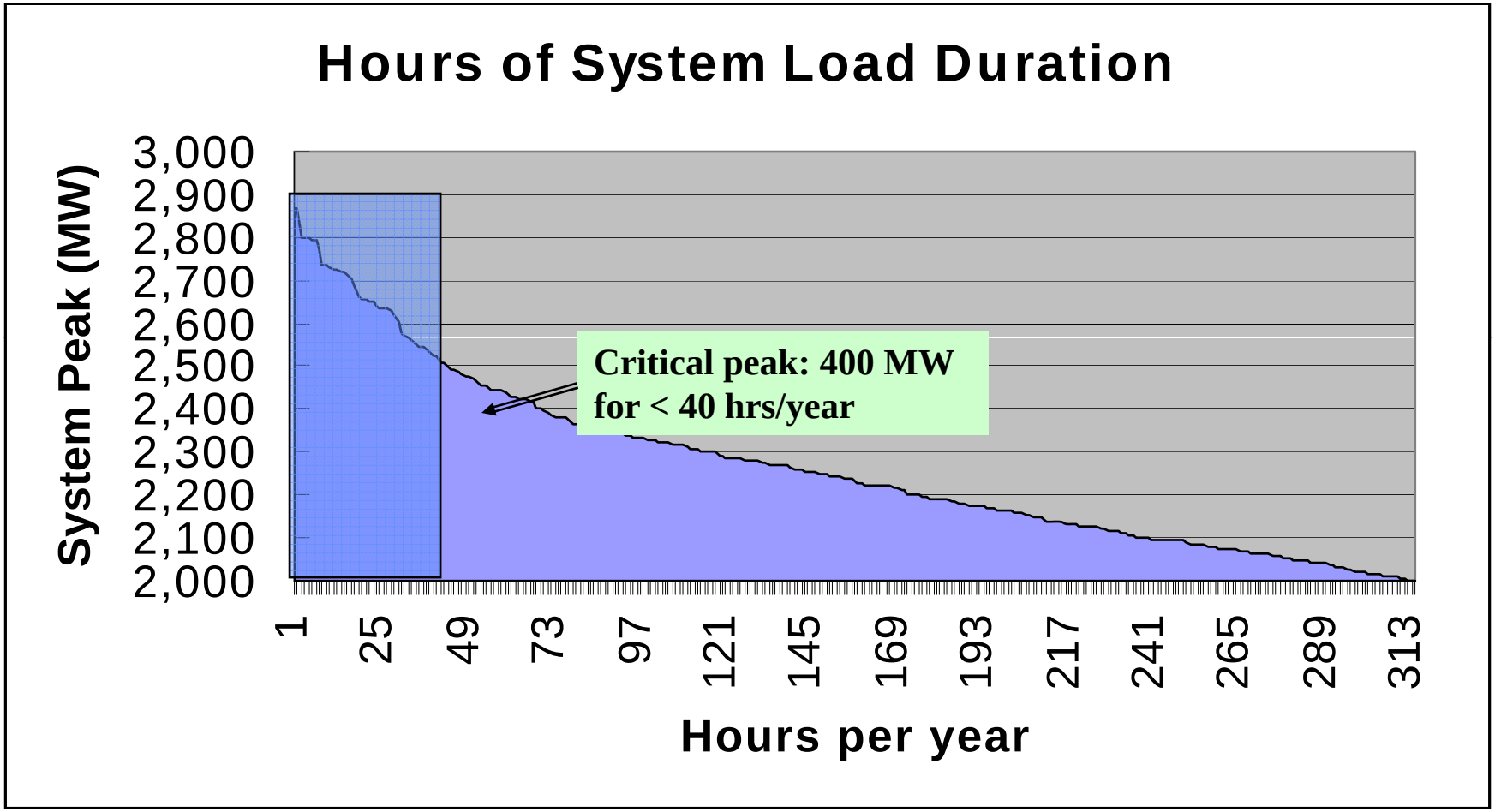
The Challenges for SMUD



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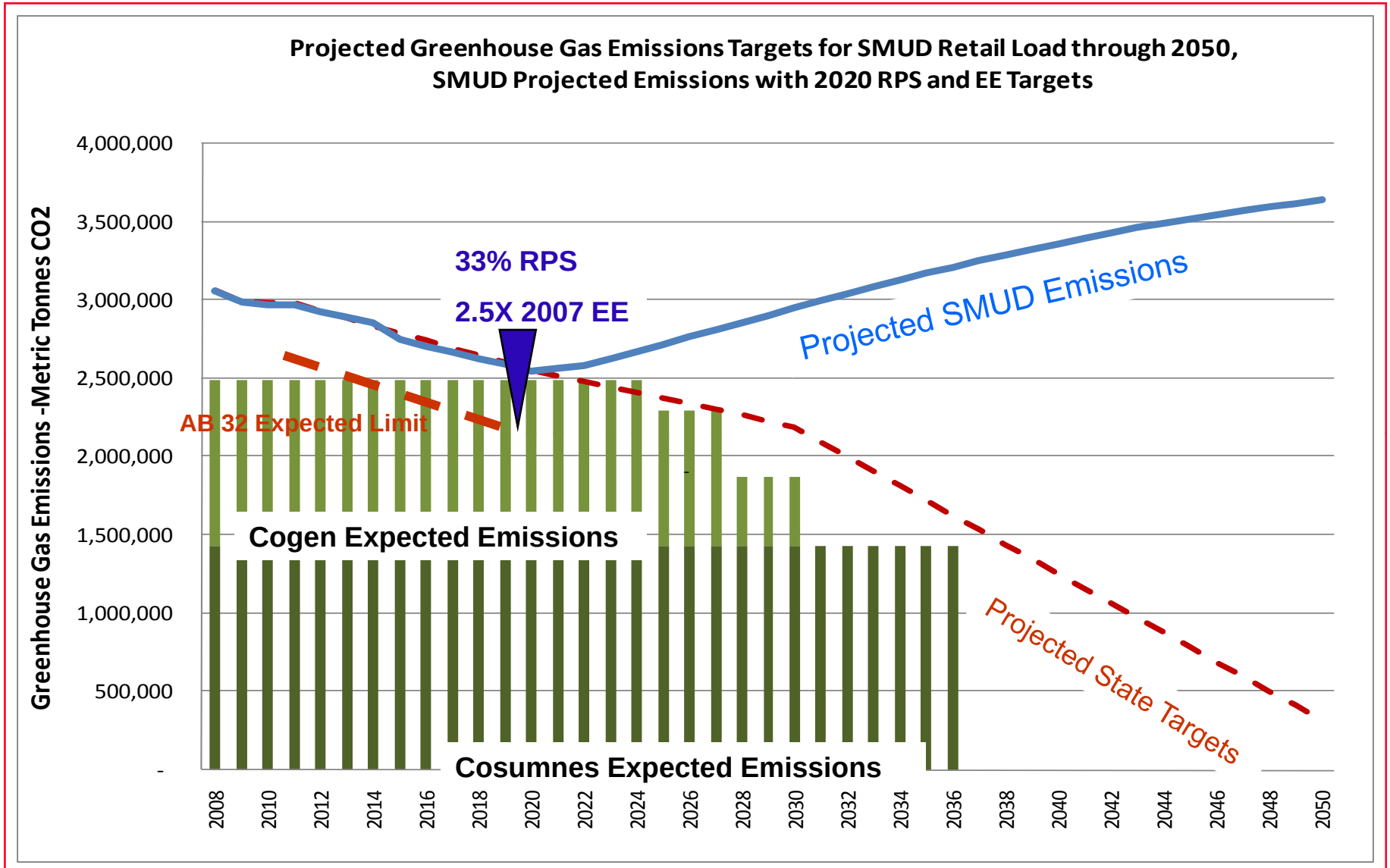

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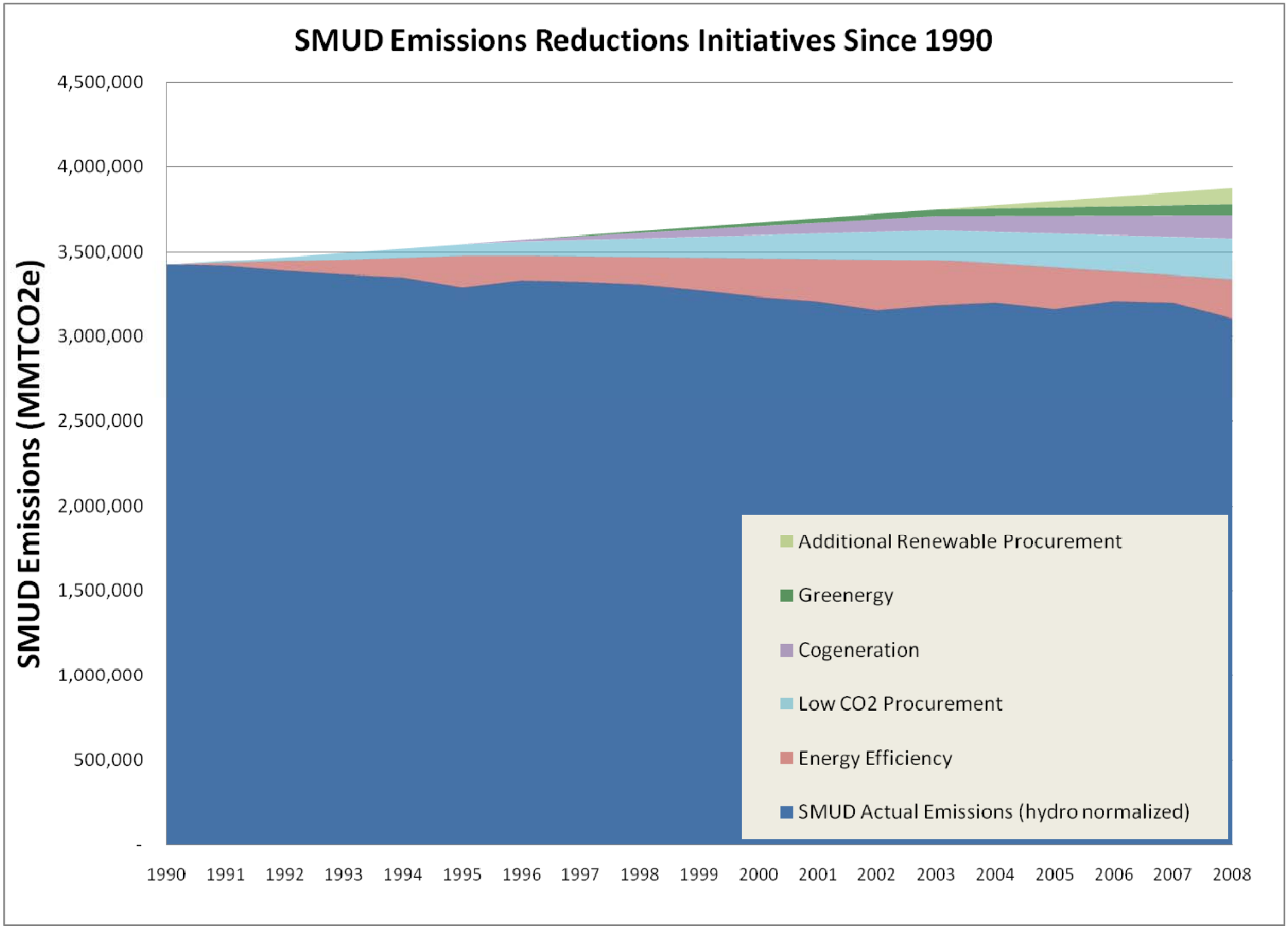
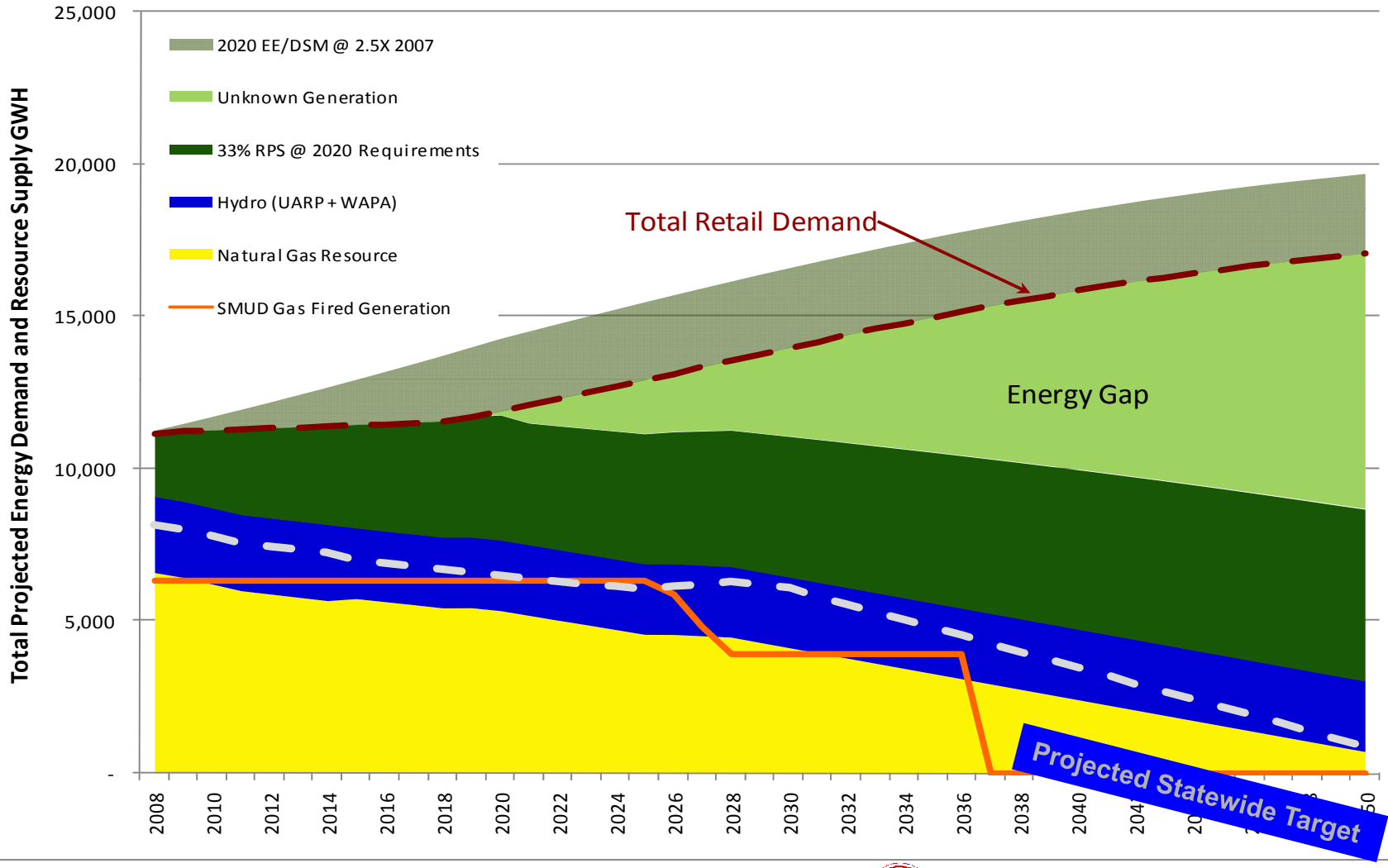

SMUD Emissions Reductions Initiatives Since 1990
SMUD Emissions (MMTCO2e)
4,500,000
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
-
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Additional Renewable Procurement
Greenergy
Cogeneration
Low CO2 Procurement
Energy Efficiency
SMUD Actual Emissions (hydro normalized)

SMUD Projected Resource Mix Through 2050



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SMUD's Sustainable Energy Supply Goals

- Strategic Directive 9 – Resource Planning
- *It is a core value of SMUD to provide its customer-owners with a sustainable power supply through the use of an integrated planning process*
- *A sustainable power supply is one that meets the regulatory goals of the State and federal Government while assuring reliability of the system, minimizing environmental impacts on land, habitat, water and air quality; maintaining a competitive position relative to other California electricity providers*

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SMUD's Sustainable Energy Supply

- Thermal - ~10%
- Large Hydro - ~20%
- Other Non-carbon resources - ~70%
  - Renewables
  - New demand-side programs
  - Carbon sequestration
  - Other non-carbon generation
  - Purchasing Carbon Offsets

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SMUD Distributed Renewable Facts

- 1,725 Photovoltaic Solar Installations
  - Typically 1.0kW to 1.0MW
  - 150 Commercial (10.9MW total)
  - 1,575 Residential (3.8MW total)
- 2 – Dairy Digester Generators
- 2 – Wind Generators
- Capstone Microturbines, and Hess and Tecogen natural gas engines with cogeneration (heat recovery)

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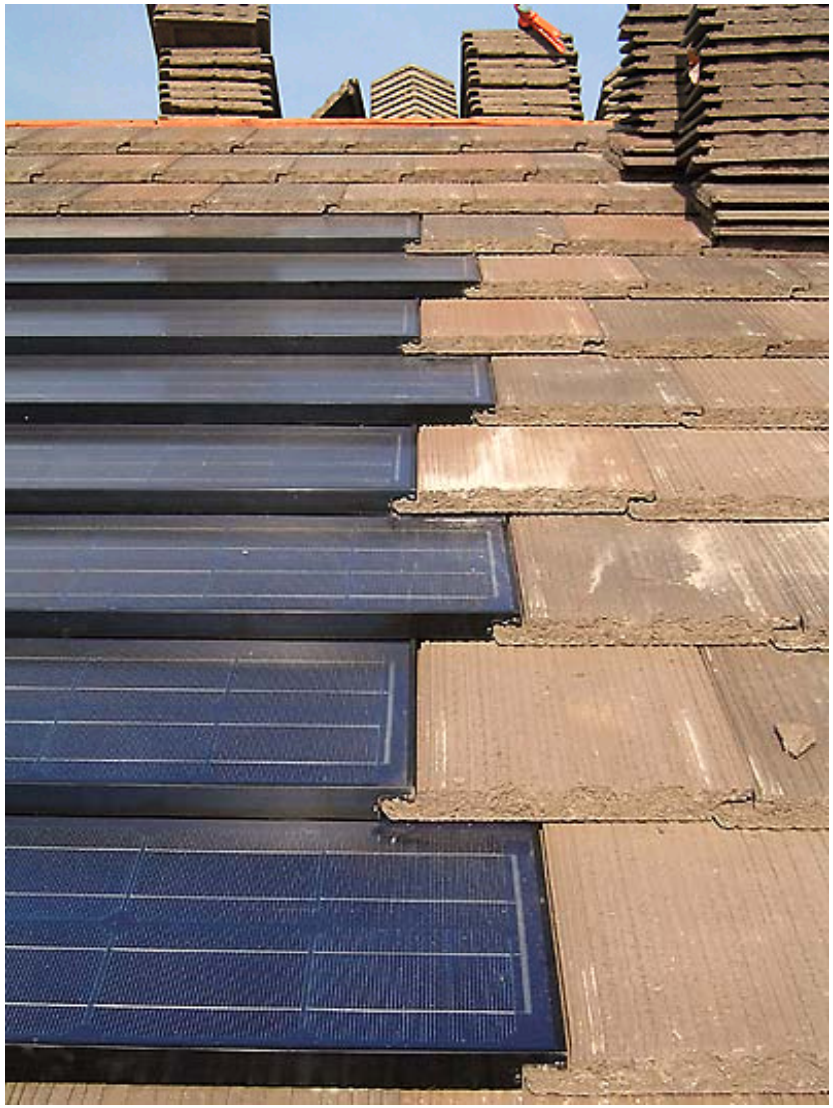
Premier Gardens – Photovoltaics Entire Subdivision (95 homes) have 2kW systems



Building integrated Installation

- Roofers can do most of the construction, rather than certified solar technicians or licensed electricians

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SMUD's Hydrogen Refueling Station

Joint venture with BP

- Grid interconnected solar supplements the energy required
- Water is split into Hydrogen and oxygen, using electric power

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Kaiser, Elk Grove – Sacramento , CA
Project: 240 kW Capstone Cogen System

- The 240 kW plant, which produces about two-thirds of the building electricity needs and all of its domestic hot water and heating.

- System consists of four (4) 60 kW Microturbine generators.

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Cal Denier Dairy Digester

- The covered lagoon collects methane
- Scrubbers remove the sulfur
- The engine runs solely on methane producing 65kW from an induction generator

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Tollenaar Dairy Digester

- The engine runs solely on methane producing 250kW from an synchronous generator

- The covered lagoon collects methane

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Solar Shares – 1MW (thin film)

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Marquiss Wind Turbine

- 6kW 3 phase alternator, rectified to DC, and converted to AC (single phase)
- About 12ft. X 12ft
- Breaking resisters allow high wind speed operation
- Manufactured in Sacramento

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Grid Interconnection

- Simplified and standardized rules for interconnection
- Reduced time to deploy
- Lower cost to connect
- Eliminated uncertainty
- Enable renewable energy interconnection and development
  - Established an environment that supports renewable technologies
  - Incentivize distributed generation (Solar, PV, Wind, CHP, micro-turbines, fuel cells, etc)

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SMUD Net-Metering

- Allows sources to be connected on the Customer side of the meter
- Provision for Utility to receive power
- Bi-directional metering
- Residential Settlement – annual basis
- Commercial Settlement – Monthly
- Settlement on existing rate basis – no special provisions

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SMUD Solar Shares

- Allows solar participation regardless of housing situation (e.g. apartment, rental, tree shaded lot, etc.)
- Fixed monthly per kW capacity charge (lifetime)
- Monthly credit based on solar produced on a local “solar farm”
- Settlement on existing rate basis – no special provisions

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SMUD Feed In Tariff

- Allows customer sited resources to deliver power directly to SMUD
- Up to 5MW installations
- Fixed price for the duration of the contract - 10,15, and 20 year
- Present offering is up to 100MW system-wide total
- Interconnections @ 12kV, 21kV and 69kV assumed
- For projects larger than 5MW custom contracts are available

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SMUD Feed In Tariff- cont.

Start Year	Term	Time of Delivery Period								
		Winter Off-Peak	Winter On-Peak	Winter Super-Peak	Spring Off-Peak	Spring On-Peak	Spring Super-Peak	Summer Off-Peak	Summer On-Peak	Summer Super-Peak
2009	10-Year	$0.0810	$0.0976	$0.1170	$0.0696	$0.0855	$0.0909	$0.0832	$0.0934	$0.2668
	15-Year	$0.0874	$0.1049	$0.1250	$0.0754	$0.0916	$0.0972	$0.0898	$0.1000	$0.2795
	20-Year	$0.0948	$0.1133	$0.1341	$0.0822	$0.0991	$0.1049	$0.0973	$0.1081	$0.2933
2010	10-Year	$0.0828	$0.0999	$0.1197	$0.0717	$0.0875	$0.0929	$0.0854	$0.0949	$0.2709
	15-Year	$0.0900	$0.1081	$0.1285	$0.0780	$0.0943	$0.1000	$0.0928	$0.1026	$0.2851
	20-Year	$0.0981	$0.1172	$0.1383	$0.0854	$0.1026	$0.1085	$0.1008	$0.1115	$0.2997
2011	10-Year	$0.0850	$0.1024	$0.1225	$0.0736	$0.0892	$0.0946	$0.0877	$0.0968	$0.2760
	15-Year	$0.0930	$0.1114	$0.1323	$0.0808	$0.0971	$0.1028	$0.0958	$0.1056	$0.2915
	20-Year	$0.1017	$0.1214	$0.1428	$0.0888	$0.1061	$0.1122	$0.1045	$0.1153	$0.3066
2012	10-Year	$0.0880	$0.1058	$0.1262	$0.0762	$0.0918	$0.0972	$0.0907	$0.0994	$0.2819
	15-Year	$0.0967	$0.1156	$0.1368	$0.0841	$0.1005	$0.1063	$0.0996	$0.1093	$0.2984
	20-Year	$0.1059	$0.1259	$0.1478	$0.0926	$0.1100	$0.1161	$0.1088	$0.1193	$0.3138

Period	Months	Super Peak	On Peak	Off Peak
Summer Fall & Winter Spring	June - Sept Oct - Feb Mar - May	2-8 PM Mon – Sat except holidays	6 AM – 2 PM & 8 PM – 10 PM Mon-Sat except holidays	All other hours
Holidays	New Years, July 4th, Memorial Day, Labor Day, Thanksgiving, Christmas			

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Fast Facts About the Solano Wind Project

The Wind Plant Resource

- 6,755 acres of District-owned land in the Collinsville-Montezuma Hills WRA
- Existing ancillary facilities: Four meteorological towers, Russell Generation Step-Up Transformer Station, collection system, Operations and Maintenance (O&M) Building
- 230 MW of wind resource potential

Phase 1 Project (2003-2004)

- 16 WTGs installed in 2003 (660 kilowatts [kW] each)
- 7 WTGs installed in 2004 (660 kW each)
- Total Phase 1 capacity: 15 MW

Phase 2 Project (2005-2007)

- Phase 2A: 8 WTGs installed in May 2006 (24 MW total)
- Phase 2B: 21 WTGs installed in December 2007 (63 MW total)
- Total Phase 2 capacity: 87 MW

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Fast Facts About Solano Wind Project

Total Phase 1 and Phase 2 Project (2007)

- 102 MW of wind power
- 52 WTGs on a project site of 2,100 acres

Phase 3 (December 2010)

- With ±3-MW WTGs, will more than double the capacity of Phase 1 and Phase 2 projects, for a total of 230 MW
- Land has been acquired
- Additional collection system and generation step-up transformer capacity required
- New Environmental Impact Report required

"Each year, one of the Phase 2 wind turbines can produce enough energy to power more than 1,000 homes"

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Phase 2A Wind Turbines - May 2006

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Industry Trend Toward Larger Turbines

Original WTG 330kW 132 feet

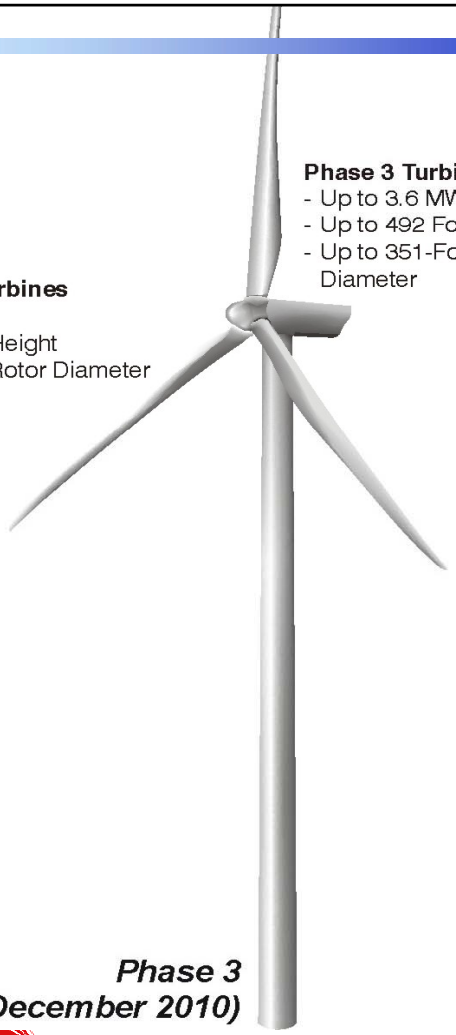
Statue of Liberty
- 305-Feet High

Phase 1 Turbines
- 660 kW
- 292-Foot Height
- 154-Foot Rotor Diameter

Phase 1 (2004)

Phase 2 Turbines
- 3.0 MW
- 415-Foot Height
- 295-Foot Rotor Diameter

Phase 2 (2005-2008)



Phase 3 Turbines
- Up to 3.6 MW
- Up to 492 Foot Height
- Up to 351-Foot Rotor Diameter

Phase 3 (December 2010)

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Questions?

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Thank you!!!

Jaspal Deol

Sacramento Municipal Utility District