Role of CHP to Reduce Ghg Emissions -- *A Public Utility Perspective*

California Energy Commission
2009 IEPR Committee Workshop
On
Combined Heat and Power To Support California's AB 32
Climate Change Scoping Plan
July 23, 2009

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RECD. July 27 2009

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Today's Topics

- CHP Drivers for SMUD
- Action Plan
  - Market Assessment
  - Feasibility Studies
  - Lessons Learned
- Utility Business Model and Incentives
- Next Steps

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SMUD Drivers For Pursuing CHP

- Supports adopted Core and Key Values
  - Competitive Rates
  - Reliability
  - Environmental Protection
  - Resource Planning
  - Research and Development
- Does so by:
  - Reducing greenhouse gases through more efficient use of natural gas and renewable fuels
  - Giving customers energy saving options
  - Improving system reliability
  - Reducing peak load
  - Developing and deploying cost effective, clean distributed generation

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Sustainable Energy

A sustainable power supply is defined as one that reduces SMUD's ***long-term greenhouse gas emissions from generation of electricity to 10% of its 1990 carbon dioxide emission levels by 2050*** (i.e. - <350,000 metric tonnes/year), 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.

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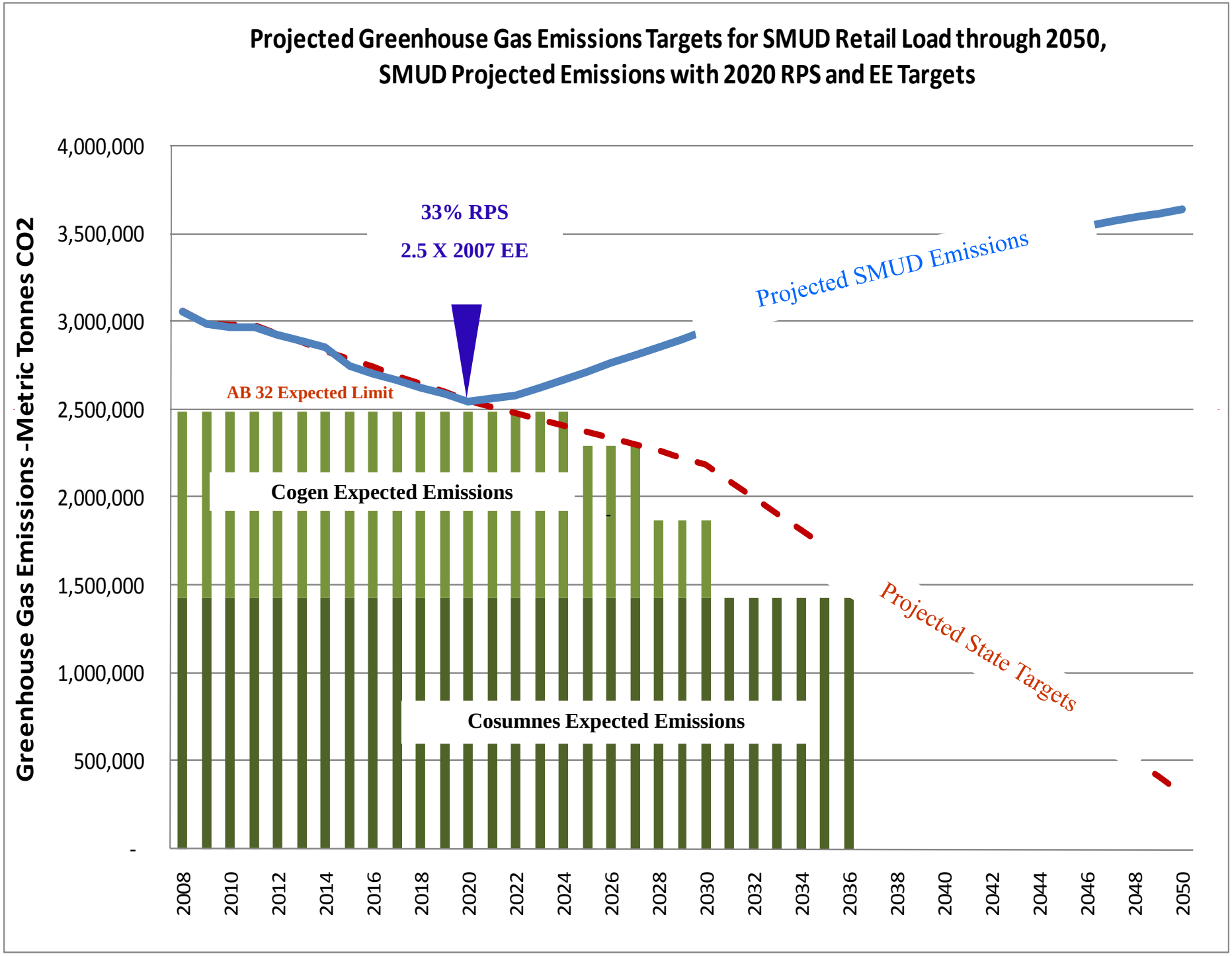
Projected Greenhouse Gas Emissions Targets for SMUD Retail Load through 2050,
SMUD Projected Emissions with 2020 RPS and EE Targets
Greenhouse Gas Emissions -Metric Tonnes CO2
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
-
33% RPS
2.5 X 2007 EE
Projected SMUD Emissions
AB 32 Expected Limit
Cogen Expected Emissions
Cosumnes Expected Emissions
Projected State Targets
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
2042
2044
2046
2048
2050

2050 LOAD CHALLENGES

- Thermal/Carbon emitting - ~10%
- Large hydro - ~15-20%
- Other non-carbon resources - ~70-75%
  - Renewables (33%+?)
  - New demand-side/energy efficiency programs
  - Carbon sequestration
  - Other non-carbon generation
  - Purchasing carbon offsets

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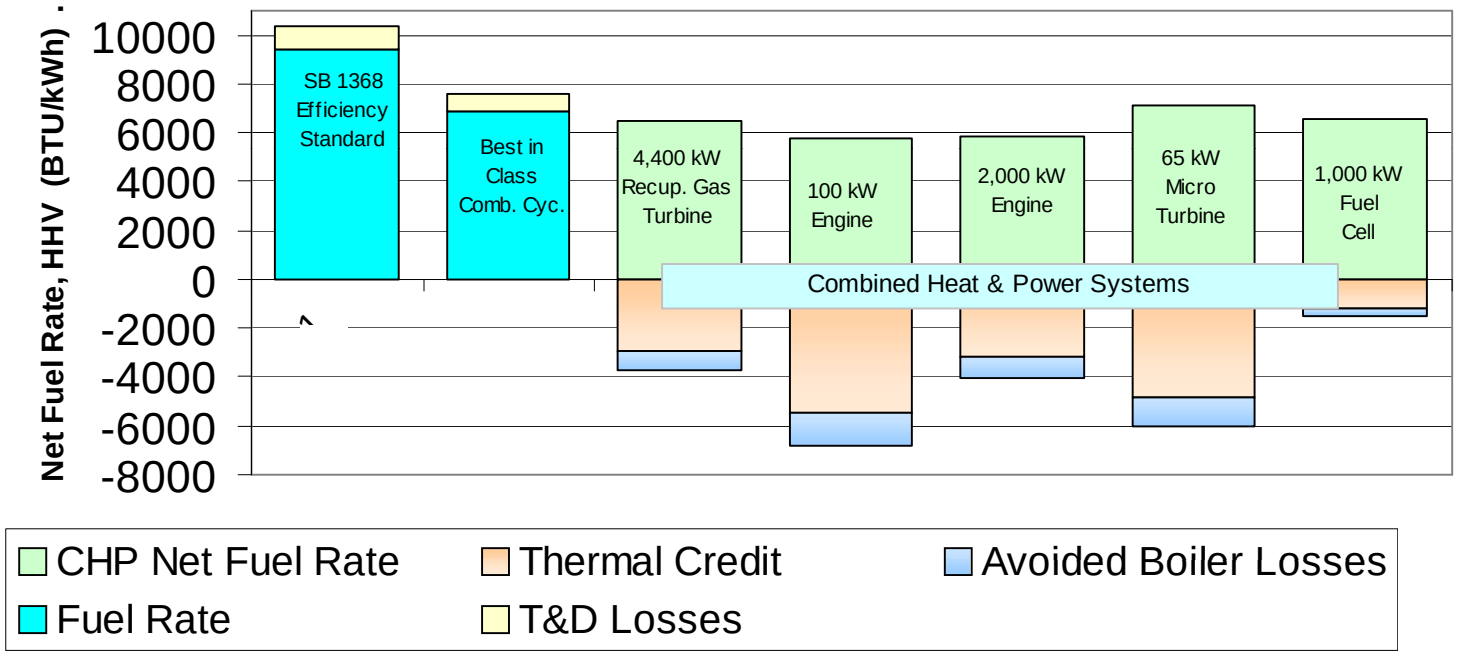
CHP Net Heat Rate Vs. SB 1368

SMUD has an internal hurdle of CHP projects needing to beat our new combined cycle plant on efficiency and GHG.

Net Fuel Rate
At 80% Heat Utilization



Use of heat to offset gas use for water/steam heat is key to CHP fuel (heat) rate advantage.

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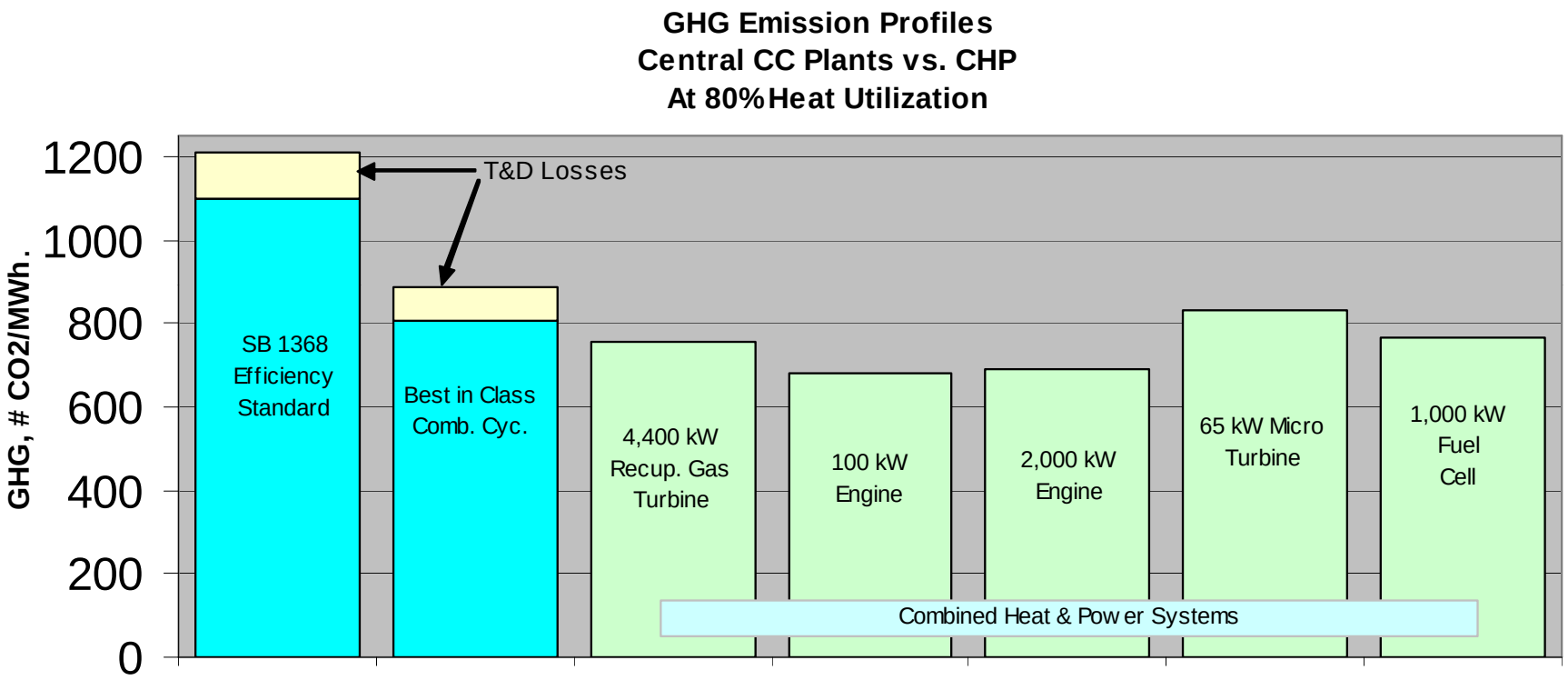
CHP GHG Profile Vs. SB 1368



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Action Plan

- Assess technical market opportunity
- Define economic opportunity through investment-grade economic analysis of specific projects
- Develop SMUD business model(s)
- Develop and deploy CHP program to our customers

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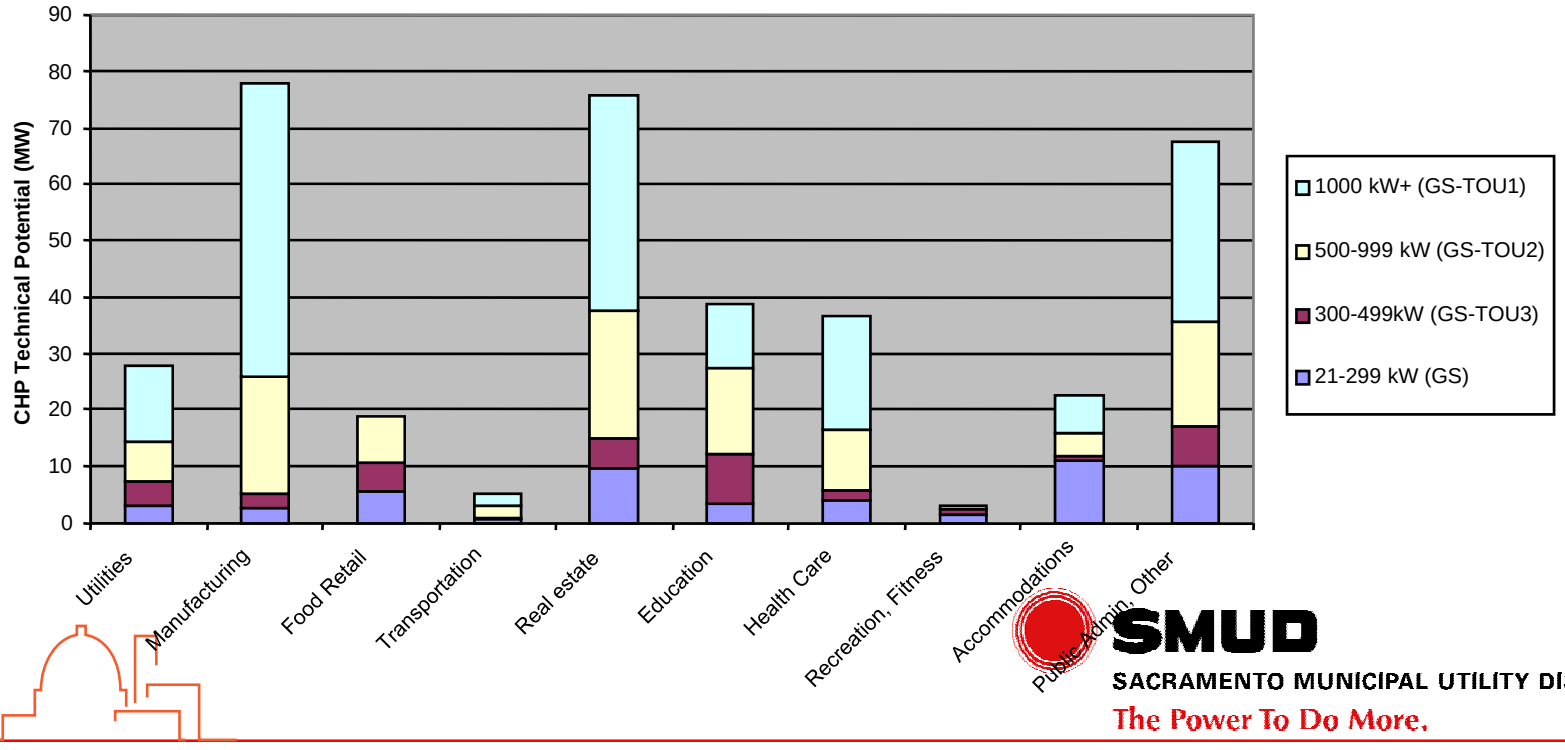
2006 Market Assessment - Opportunity

- Most industrial opportunities have been taken
- SMUD opportunity is in commercial and institutional sectors
- Technical potential for traditional CHP (heat only) is 375 MW
- Thermally-activated cooling doubles potential
  - Improves utilization for commercial and institutional loads with year round cooling



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Source: SMUD CHP Market Assessment, DE Solutions, June 2006

Feasibility Study Results

Project	System	NPV	CO2	NOx	Comments
Food Processor	1.4MW ICE	Pro	Pro	Con	Good thermal base load
Mixed Use Development	4.5MW GT 1,100 ton absorber	Pro	Pro	Pro	High capital cost of district energy system and slow load growth
Transportation Facility	1.0MW ICE 190 ton absorber	Pro	Pro	Con	24 x 7 load
Data Center	5 x 2MW ICE 2 x 1,075 ton absorbers	Con	Pro	Con	Cooling only load; large number of off-peak hours with reversed spark spread
Office Building	3 x 100kW 120 ton absorber	Con	Con	Con	8 x 5 load with minimal thermal load
PV Manufacturing Plant	1 x 25MW GT and 1x4MW steam turbine 7500 ton absorber	Con	Pro	Con	Cooling only load; large number of off-peak hours with reversed spark spread
Hospital	300kW ICE 60 ton absorber	Con	Pro	Con	Small thermal load; minimal annual savings
Prison	4.5MW GT	Pro	Pro	Con	Good thermal base load

Pro
Con

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So, What Have We Learned?

- CHP is not difficult technically
  - Some CHP pencils out, even with low SMUD electric rates!
  - Turbines and engines best suited to needs
  - Need good coincidence of electric and heat loads
  - High heat utilization is a must
- The business side is difficult
  - Utility culture
    - Preferring big generators and control
    - Owning and operating small customer-sited generation (i.e., working on the customer side of the meter)
  - Revenue loss mentality
  - Willingness to value capacity

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Business Model and Program Design

Our Next Steps

- Executive Management decision on ownership
  - SMUD should proactively pursue ownership of multiple customer sites (e.g., district energy)
  - Create incentives for customers to own single customer sites
- District Energy
  - Assessing district energy opportunities within our service territory
- Beginning to design incentives and CHP Program(s)
  - Feed-In Tariff recently approved
  - Looking around country to see who's doing what
    - US EPA CHP Partnership
    - NYSERDA CHP Performance Program
    - Austin Energy and other utilities
    - Third Party Providers/Developers
- Continuing R&D to better define locational value

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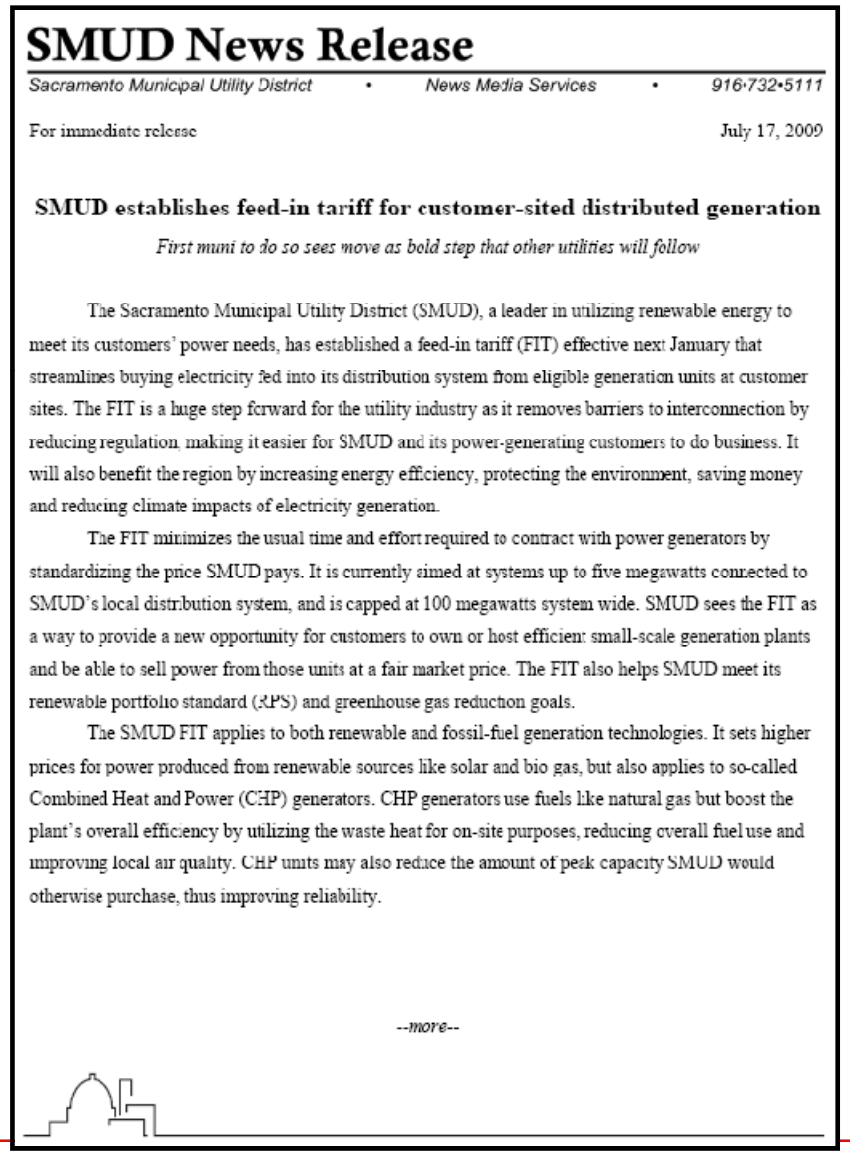
Feed-In Tariff



SMUD News Release

Sacramento Municipal Utility District • News Media Services • 916•732•5111

For immediate release July 17, 2009

SMUD establishes feed-in tariff for customer-sited distributed generation

First muni to do so sees move as bold step that other utilities will follow

The Sacramento Municipal Utility District (SMUD), a leader in utilizing renewable energy to meet its customers' power needs, has established a feed-in tariff (FIT) effective next January that streamlines buying electricity fed into its distribution system from eligible generation units at customer sites. The FIT is a huge step forward for the utility industry as it removes barriers to interconnection by reducing regulation, making it easier for SMUD and its power-generating customers to do business. It will also benefit the region by increasing energy efficiency, protecting the environment, saving money and reducing climate impacts of electricity generation.

The FIT minimizes the usual time and effort required to contract with power generators by standardizing the price SMUD pays. It is currently aimed at systems up to five megawatts connected to SMUD's local distribution system, and is capped at 100 megawatts system wide. SMUD sees the FIT as a way to provide a new opportunity for customers to own or host efficient small-scale generation plants and be able to sell power from those units at a fair market price. The FIT also helps SMUD meet its renewable portfolio standard (RPS) and greenhouse gas reduction goals.

The SMUD FIT applies to both renewable and fossil-fuel generation technologies. It sets higher prices for power produced from renewable sources like solar and bio gas, but also applies to so-called Combined Heat and Power (CHP) generators. CHP generators use fuels like natural gas but boost the plant's overall efficiency by utilizing the waste heat for on-site purposes, reducing overall fuel use and improving local air quality. CHP units may also reduce the amount of peak capacity SMUD would otherwise purchase, thus improving reliability.

--more--

- SMUD Board adopted in June 2009 – available in January 2010
- Consistent with SMUD vision to empower customers with solutions/options
- Mutually advantageous to SMUD and customers
  - Standardizes purchase offers by streamlining time and effort to contract
  - Provides new opportunity to sell power at fair market price
- Applicable to two types of customer-sited DG (i.e., CHP and renewables)
  - Must be interconnected directly to SMUD distribution system (i.e., within SMUD Service Territory)
  - 5 MW and smaller
  - Qualify under SMUD terms as CHP or Renewable Generation facility
- Capped at 100 MW District-wide initially
- Prices will be posted on SMUD's Web site and updated periodically

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Feed-In Tariff (Cont'd)

- Tariff Structure
  - Prices vary according to year of initial operation
  - Contract lengths of 10, 15 or 20 years
  - Prices differentiated by Time of Delivery
- Price Determination
  - Reflects SMUD's underlying marginal costs for comparable power
  - Cost components include
    - Market energy price including losses
    - Ancillary services
    - Generation capacity
    - Transmission capacity
    - Sub-transmission capacity
    - Cost offsets for avoided Ghg mitigation (renewable projects only)
    - Risk avoidance for future NG price increases (renewable projects only)

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Incentive Model Pros and Cons

Attributes	Feed-In Tariff	Pay As You Save	Progress Payment	Upfront Incentive	Comments
Peak Load Reduction	🟢	🔴	🟢	🔴	Energy based (performance) and TOD payment structures put emphasis to operate on peak; upfront incentives do not
Reliability Enhancement (to customer and/or SMUD)	🟢	🟢	🟢	🔴	Encouraging peak load operation helps reliability when SMUD system stressed
Ghg Reduction	🟢	🟢	🟢	🟢	Minimum efficiency threshold ensures Ghg benefits realized; coupling with performance-based incentives provides additional assurances
Revenue Lose	🔴	🔴	🔴	🔴	All models result in SMUD losing revenue
Customer Energy Cost Savings	🟢	🔴	🟢	🟢	Customer savings deferred in “Pay As You Save” model
Complexity of Program	🔴	🔴	🟢	🟢	On-bill financing of “Pay As You Save” and FIT models have ongoing administrative costs
Technical/Business Risk	🟢	🔴	🟢	🔴	Models with capital costs paid upfront by SMUD are riskier since less leverage to ensure performance and benefits get realized

🟢 Pro 🔴 Con

Locational Value of CHP and other DER

- Used Optimal Technologies to study optimization of SMUD load serving and import capability using DG and capacitor banks
- Compound objective: minimize real and reactive power losses and minimize voltage variation
- Results used in part by Transmission Planning for placing recent capacitor additions
- Work planned for 2009/2010 to expand effort for DG (including CHP, PV and other renewables), demand response and storage
  - Learn from CEC-funded work done by SCE with New Power Technologies and Optimal Technologies
  - Update transmission model
  - Integrate distribution system
  - Incorporate modeling “validation” functions for Transmission Planning
  - Understand operational requirements
  - Determine optimal locations for DG and storage
  - Compare costs to traditional solution costs

Thank You

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Additional Information

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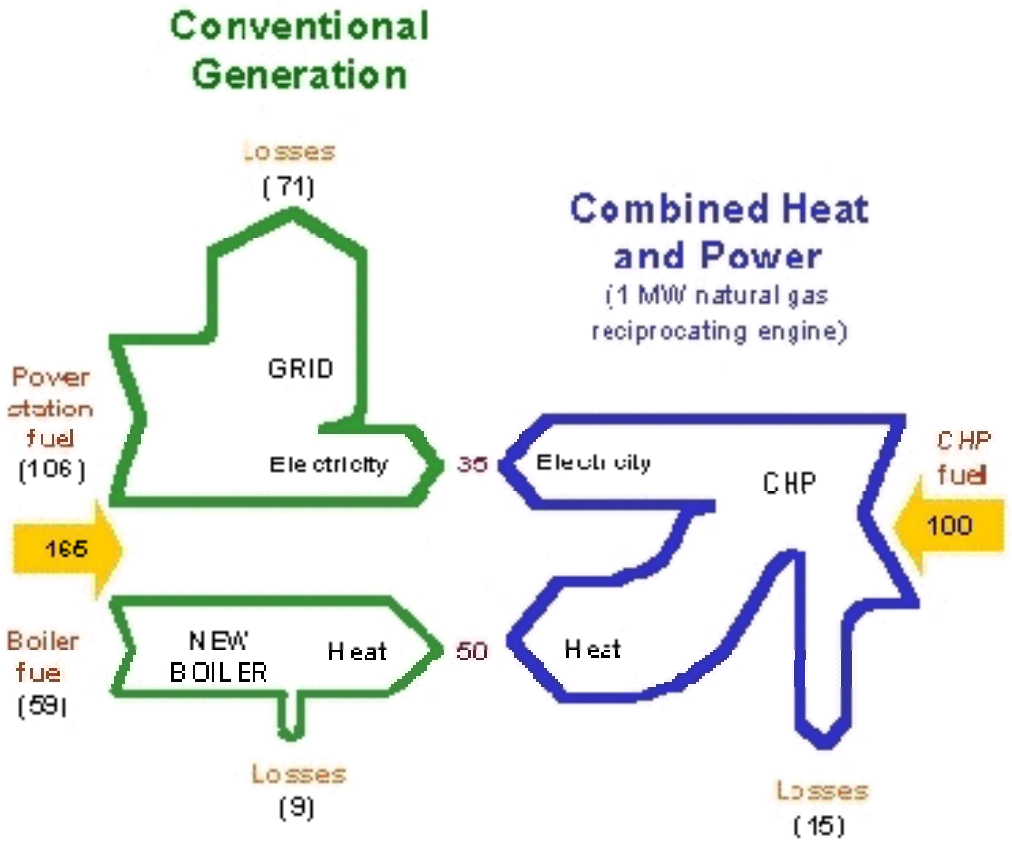
CHP Benefits

- Significant improvements in fuel efficiency giving customers energy cost savings and reliability



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CHP Technologies

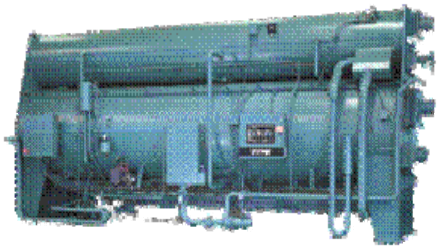
System sizes vary from kW to MW depending on the application.

Tecogen 75 kW Rich Burn Engine CHP Unit

Capstone 30 kW Microturbine

Caterpillar 2 MW Lean Burn Engine Generator

Solar 5.5 MW Simple cycle gas Turbine



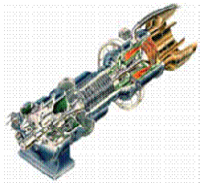
York Single Effect Chiller

Fuel Cell Energy 300 kW MCFC

Source: SMUD CHP Market Assessment, DE Solutions, June 2006

Technology / Application Match

CHP Prime Movers	Applications
Gas Turbines	Universities, Food Processing, Manufacturing, Large Hospitals, Pulp & Paper, Chemicals, Refining, Pharmaceuticals
Microturbines	Junior Colleges, Office Buildings, Hotels, Jails
Reciprocating Engines	Hospitals, Hotels/Casinos, Colleges, Plastics, Nursing Homes, Schools, Health Clubs, Light Industrial
Fuel Cells	Data Centers, other high reliability loads



Market Position

- Strong Market Position
- Secondary Market Position
- Emerging Market Position
- Weak Market Position

50 kW | 100 kW | 1,000 kW (1 MW) | 10 MW | 20 MW

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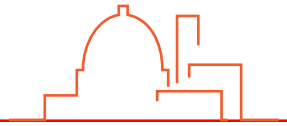
Draft CHP Feed-In Tariff

Feed-In Tariff for Eligible Combined Heating and Power Generation
Nominal $/kWh

Start Year	Term	Time of Delivery Period									Annual Average
		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	
2010	10-Year	$0.0662	$0.0833	$0.1031	$0.0551	$0.0709	$0.0763	$0.0688	$0.0783	$0.2543	$0.0864
	15-Year	$0.0694	$0.0874	$0.1079	$0.0574	$0.0737	$0.0793	$0.0721	$0.0820	$0.2645	$0.0903
	20-Year	$0.0735	$0.0926	$0.1137	$0.0609	$0.0780	$0.0840	$0.0762	$0.0869	$0.2751	$0.0952
2011	10-Year	$0.0666	$0.0841	$0.1042	$0.0553	$0.0709	$0.0763	$0.0693	$0.0785	$0.2577	$0.0870
	15-Year	$0.0705	$0.0889	$0.1097	$0.0583	$0.0746	$0.0803	$0.0733	$0.0831	$0.2690	$0.0917
	20-Year	$0.0751	$0.0947	$0.1162	$0.0622	$0.0795	$0.0855	$0.0779	$0.0887	$0.2800	$0.0972
2012	10-Year	$0.0676	$0.0854	$0.1058	$0.0559	$0.0714	$0.0768	$0.0703	$0.0791	$0.2615	$0.0882
	15-Year	$0.0720	$0.0910	$0.1121	$0.0594	$0.0759	$0.0816	$0.0749	$0.0846	$0.2737	$0.0935
	20-Year	$0.0771	$0.0971	$0.1189	$0.0637	$0.0812	$0.0873	$0.0799	$0.0905	$0.2849	$0.0994

For more information see, General Manager's Report and Recommendation on Rates and Services at:
http://www.smud.org/en/news/Documents/09archive/GMRateReport-03-31-09.pdf



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Draft Renewable Feed-In Tariff

Feed-In Tariff for Eligible Renewable Generation
Nominal $/kWh

Start Year	Term	Time of Delivery Period									Annual Average
		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	
2010	10-Year	$0.0828	$0.0999	$0.1197	$0.0717	$0.0875	$0.0929	$0.0854	$0.0949	$0.2709	$0.1030
	15-Year	$0.0900	$0.1081	$0.1285	$0.0780	$0.0943	$0.1000	$0.0928	$0.1026	$0.2851	$0.1109
	20-Year	$0.0981	$0.1172	$0.1383	$0.0854	$0.1026	$0.1085	$0.1008	$0.1115	$0.2997	$0.1198
2011	10-Year	$0.0850	$0.1024	$0.1225	$0.0736	$0.0892	$0.0946	$0.0877	$0.0968	$0.2760	$0.1054
	15-Year	$0.0930	$0.1114	$0.1323	$0.0808	$0.0971	$0.1028	$0.0958	$0.1056	$0.2915	$0.1142
	20-Year	$0.1017	$0.1214	$0.1428	$0.0888	$0.1061	$0.1122	$0.1045	$0.1153	$0.3066	$0.1238
2012	10-Year	$0.0880	$0.1058	$0.1262	$0.0762	$0.0918	$0.0972	$0.0907	$0.0994	$0.2819	$0.1085
	15-Year	$0.0967	$0.1156	$0.1368	$0.0841	$0.1005	$0.1063	$0.0996	$0.1093	$0.2984	$0.1182
	20-Year	$0.1059	$0.1259	$0.1478	$0.0926	$0.1100	$0.1161	$0.1088	$0.1193	$0.3138	$0.1282

For more information see, General Manager's Report and Recommendation on Rates and Services at:
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