



# Energy Efficiency in Water and Wastewater Treatment Plants

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## Industrial Program

- Water and Waste Water Treatment
- Oil Refineries and Extraction
- Industrial Manufacturing
  - Manufacturing
  - Process
  - Fabrication



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## Program Offerings

- Incentives for Retrofits and New Constructions
- Third Parties offerings
- Local Government Partnerships
- Includes water treatment, wastewater treatment, desalination and industrial waste water recovery.
- Measures involving process treatment and conveyance and transportation of water and wastewater.
- Measures include premium efficiency motors, variable speed drive, fine bubble aeration, screw press; low pressure UV system, SCADA systems to name a few.
- Process optimization



## Incentive Levels for Industrial Projects

<b>Lighting</b>	<b>5 cents per kWh</b>
<b>HVAC and Refrigeration</b>	<b>14 cents per kWh</b>
<b>Other (e.g. motors, pumps)</b>	<b>8 cents per kWh</b>
<b>Gas</b>	<b>80 cents per therm</b>

Pays up to 50% of project cost.

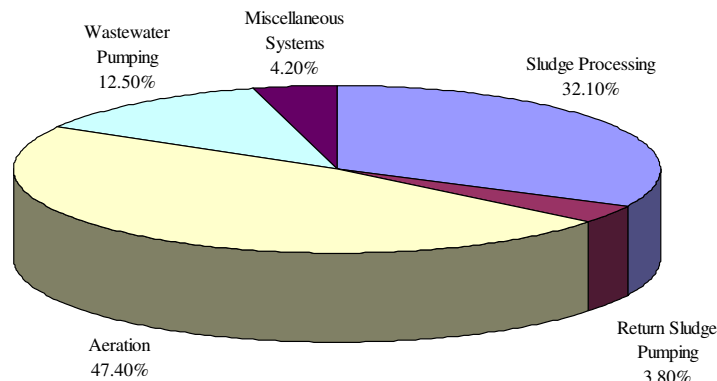


## Water & Wastewater Treatment – Potential Savings

- Approx. 480 wastewater treatment in PG&E's territories.
- According to a 1993 study (Metcalf & Eddy, 1993) these plants consume close to 1% of PG&E's electric power
- Significant untapped opportunity for energy and demand savings
- Energy account for about 35 % of Municipal energy usage
- Faced with increasing cost stemming from aging infrastructure, new health regulation and population growth



## Distribution of Energy Use in a Generic Activated Sludge Wastewater Treatment Plant





## Advanced Technologies

- Variable Frequency Drives (blowers, pumps, etc.)
- Automatic Continuous Dissolved Oxygen (DO) Control
- Fine Bubble Diffusers for Aeration Systems
- Retrofitting Hydraulic-Driven Systems with Electrical Drives
- High Efficiency Equipment (pumps and blowers)
- High Efficiency Lighting
- Premium Efficiency Motors
- Low-Pressure Ultraviolet (UV) Disinfection System
- Retrofitting Pneumatic Pumps with Electrical Pumps
- High Efficiency Air Compressor with VFD
- Anaerobic Digestion in Place of Aerobic Digestion of Sludge
- Gravity Belt Thickening of Sludge
- Screw-Type Sludge Dewatering



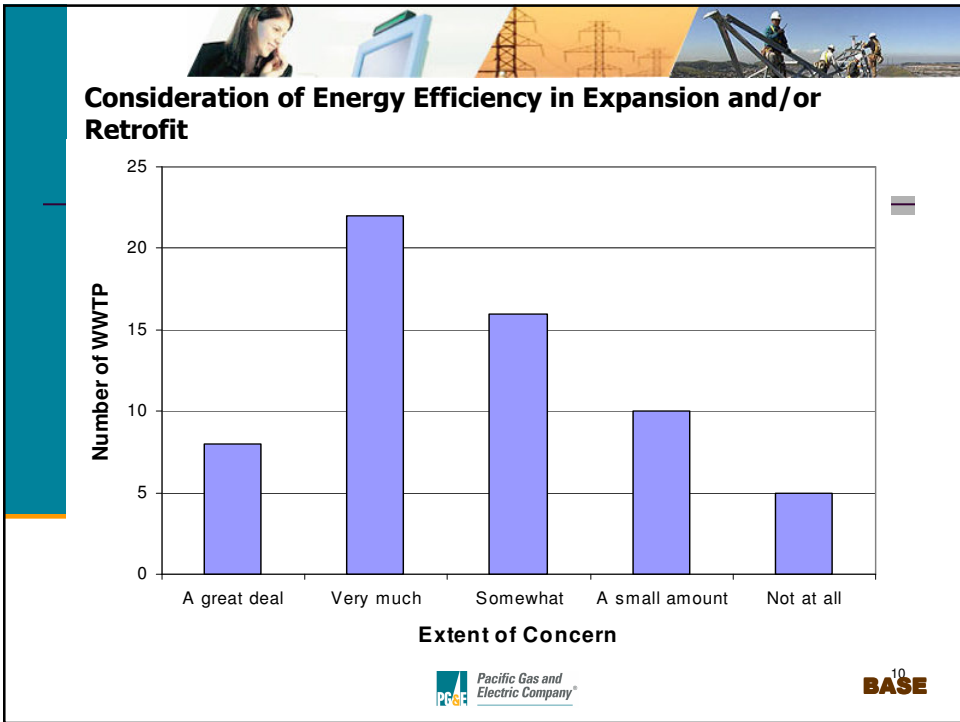
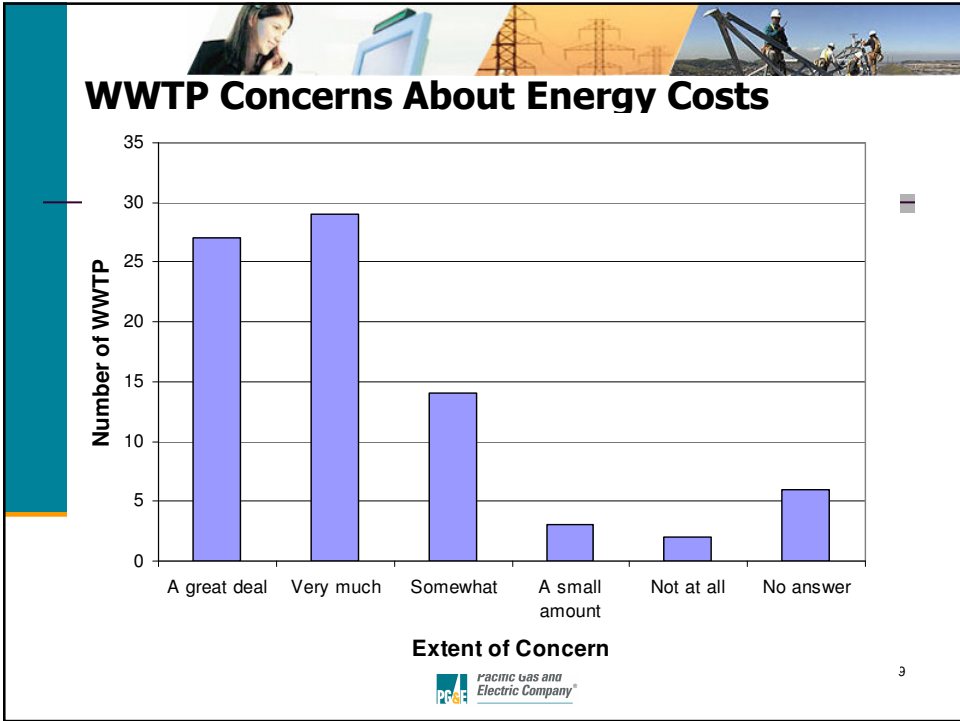
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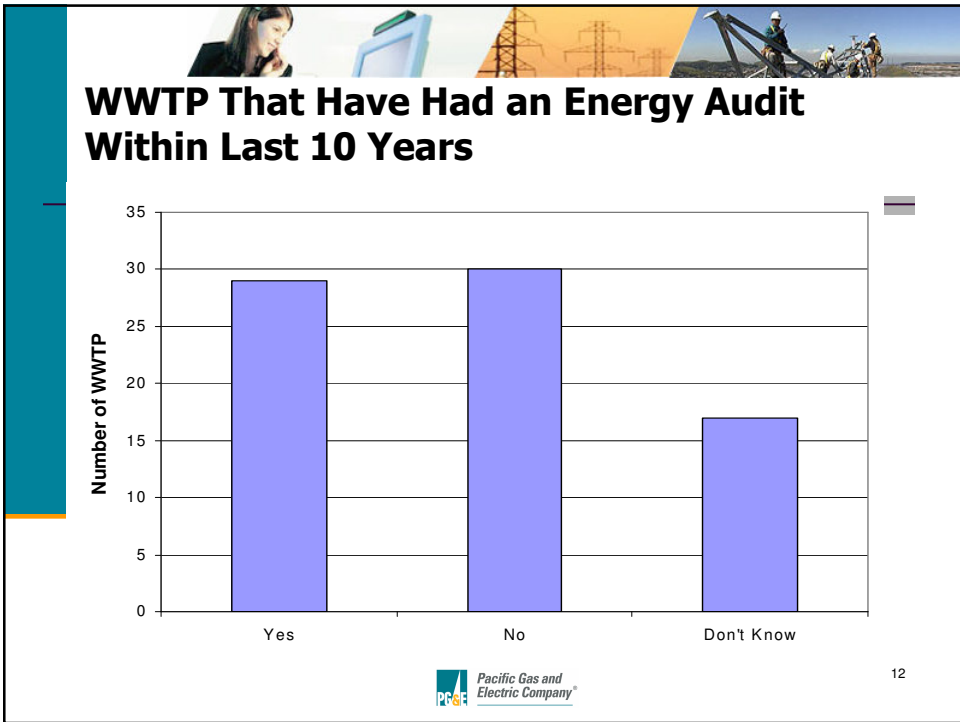
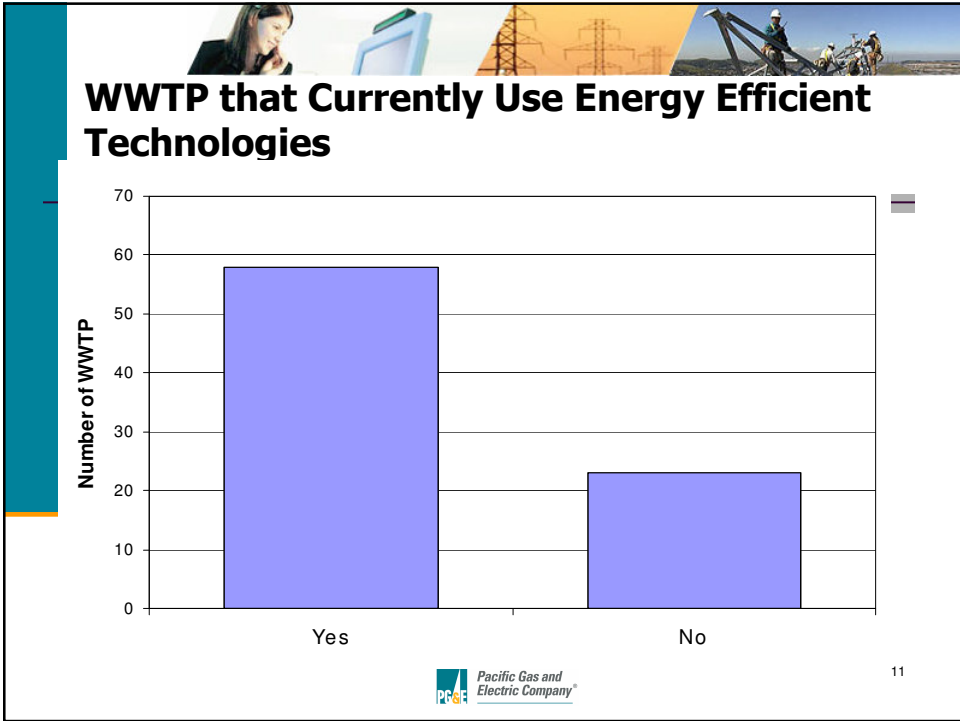


## Market Related Survey Results

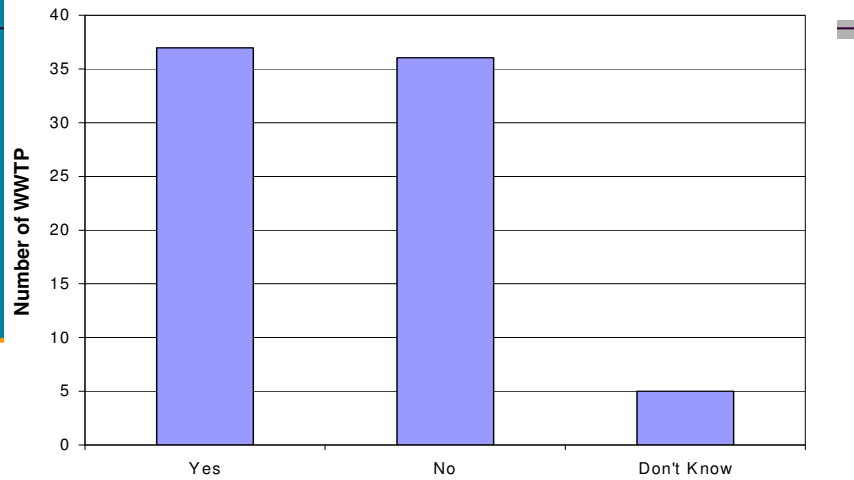


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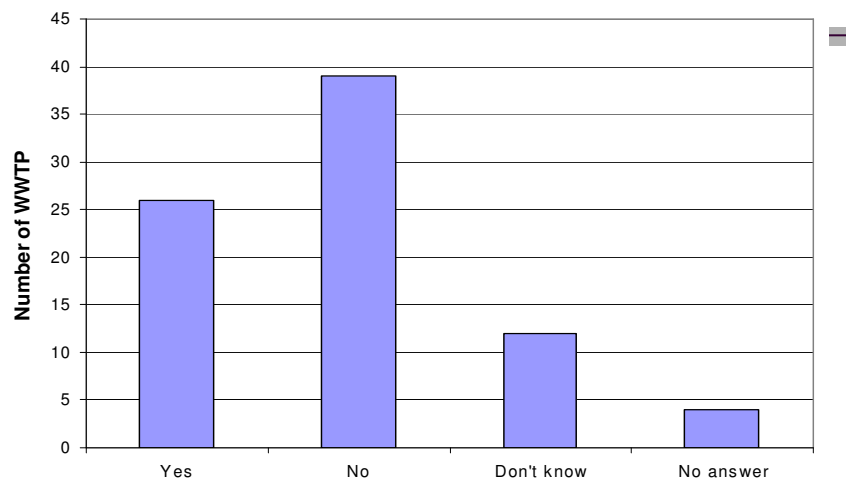




## WWTP that Have Had Energy Efficiency Projects Within Last 5 Years



## WWTP that Have Used PG&E Rebates in Their Projects





## Energy Efficiency Implementation Barriers

- **Lack of information on facility or system performance, available technologies and available energy efficiency programs**
- **Lack of facility benchmarking data to compare performance**
- **Time commitment required to identify energy efficiency opportunities**
- **Lack of operator training in energy efficiency best practices.**
- **Capital budget competing with operating expense budget**
- **Reliable power and capacity issues are often the drivers rather than energy efficiency savings.**
- **Lack of energy efficiency champion within organization**



## Emerging Technology



## Oxygen Injection for Wastewater Treatment

- Inject O<sub>2</sub> rather than air in aerobic pond
- Oxygen is only 21% of air volume
  - 4/5 of blowers air flow are useless
  - On site energy savings may be as much as 80%
- Air injection requires about 1.1 kWh/pound of organic load

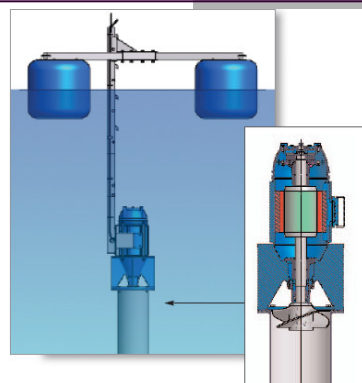


*Blowers in a municipal wastewater treatment facility*



## Technology

- Floating 15 Hp to 45 Hp units replacing 100 Hp to 300 Hp blowers
- Oxygen cost about \$.06 per pound
- Simple Payback of 2.5 years



*Oxygen injectors – MVO (Praxair)*



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## Potential applications

- About 150 appropriate sites in PG&E Territory
  - Wineries, Municipal facilities (sewage only), Dairies, Fruit processors, Breweries
- Total potential energy saving:
  - 140 GWh/year



## Water Energy Efficiency: Opportunities for Embedded Energy Savings



## Water Energy Relationship

	Electricity (GWh)	Natural Gas (MM Therms)
<b>Water Supply &amp; Treatment</b>		
Urban	7,554	19
Agricultural	3,188	
<b>End Uses</b>		
Agricultural	7,372	18
Residential		
Commercial	27,887	4,220
Industrial		
<b>Wastewater Treatment</b>	2,012	27
<b>Water Related TOTAL</b>	48,013	4,284
<b>2001 Calif. Consumption Total</b>	250,494	13,571
<b>Percent of Statewide Energy Use</b>	<b>19%</b>	<b>32%</b>

Source: CEC [http://energy.ca.gov/process/water/2006-03-28\\_symposium/WHITE\\_CEC.PDF](http://energy.ca.gov/process/water/2006-03-28_symposium/WHITE_CEC.PDF)



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## Embedded Water-Energy



	Northern California kWh/MG	Southern California kWh/MG
Conveyance	150	8,900
Treatment	100	100
Distribution	1,200	1,200
Wastewater Treatment	<u>2,500</u>	<u>2,500</u>
<b>Regional Total</b>	<b>3,950</b>	<b>12,700</b>

Source: CEC [http://energy.ca.gov/process/water/2006-03-28\\_symposium/WHITE\\_CEC.PDF](http://energy.ca.gov/process/water/2006-03-28_symposium/WHITE_CEC.PDF)

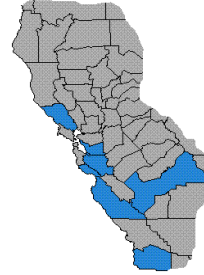


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## Embedded Water-Energy

- PG&E researching specific values for various hydrological regions
  - North Bay
  - East Bay
  - South Bay
  - Central Valley
  - Coast
- Report available end of October
- Preliminary data averaging well above CEC estimates



## Water-Energy Savings Potential

Urban water use In PG&E service territory:

- ~4 million AF per year\*
- >1/3 of current water use can be conserved with current tech, or ~ 1.3 million AF\*
- If 4,000 kWh/MG, or 1,300 kWh/AF, then potential for 1,600 GWh savings
- This is >1% of all electric consumption

\*Pacific Institute, "California Water 2030: An Efficient Future", Sept. 2005



## Next Steps

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- **Water Energy Partnership**
  - **Statewide team focused on the mutual advancement of water-energy savings**
  - **Members include**
    - **IOU's**
    - **Water districts**
    - **Wastewater districts**
    - **Environmental groups**
    - **Leading industry consultants**
    - **CEC**



## Next Steps

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- **CPUC**
  - **Public comment and reply comments submitted to the CPUC in August.**
  - **Administrative Law Judge assigned to make a decision.**
- **CEC**
  - **Pursue additional studies and data refinement**
  - **Ensure EM&V can be performed**



## Next Steps

- **IOU's and Water Districts**
  - **Develop strategic joint measures**
  - **Focus on specific market opportunities**
    - **Find synergies (CII has great potential)**
  - **Develop regional pilot projects**



## Next Steps

- **Savings Potential for Mass Market Measures**
  - Clothes washers (6,000 gal/yr)
  - High efficiency toilets (15,000 gal/yr)
  - Waterless urinals (30,000 gal/yr)
  - Pre-rinse spray nozzles (50,000 gal/yr)
  - Commercial dishwashers (90,000 gal/yr)





## Next Steps

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- **Savings Potential for Target Markets (CII)**
  - **Steam Sterilizer Retrofit (1 MG/yr)**
  - **X-ray Developer Recirc (1 MG/yr)**
  - **Boiler Blowdown (.1 – 1 MG/yr)**
  - **Cooling Tower Control (.5 - 2 MG/yr)**
  - **Wash Processes (> 1 MG/yr)**
  - **Quench/Scald Processes (> 1 MG/yr)**



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## Q & A

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