



PG&E Energy Efficiency Programs Commercial & Industrial Boilers

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The Numbers Talk...

In 1976, PG&E became one of the first utilities in the United States to offer energy efficiency and demand management programs for our customers.

From 1976 to 2008, PG&E's energy efficiency programs :

- Prevented the emission of over 155 million tons of carbon dioxide, based on cumulative lifecycle savings.**
- Saved enough annual electricity to power 23.5 million homes and enough annual natural gas to heat 25 million homes.**
- Saved customers over \$24 billion on their energy bills.**

Today's Discussion

PG&E Energy Efficiency Programs - Industrial and Commercial Projects

- Overview of PG&E calculated incentive & rebate programs
- Examples of calculated projects
- Overview of rebate program
- Examples of rebate projects

Program Design – Background

- Programs are diverse and delivered through multiple channels
 - ✓ PG&E
 - ✓ Third Party Program Implementers (at least 20%)
 - ✓ Partnerships with Local Governments, UC/CSU, Community Colleges, and Department of Corrections
- Portfolio also includes: education & classes on Energy Efficiency
- Incentives Offered for: Retrofit & New Construction, Industrial, Commercial, and Small Business
- Open to all PG&E Customers who pay the Public Purpose Program Surcharge on their utility bills

Program Design

Targeted Markets

- Food Processing / Ag.
- **Fabrication / Heavy Industry / Refineries**
- **Water / Waste Water Treatment**
- High Tech / Bio Tech
- Medical / Hospital
- Large Commercial / Institutions
- Schools / Colleges
- Retail / Hospitality
- Residential New Construction

NRR – DR (Non Residential Retrofit-Demand Response)

RETROFIT CALCULATED PROGRAM for Industrial & Commercial Customers

“Targeted Market Approach” - Retrofit of Existing Equipment/Systems

- Submit NRR-DRP Application
- PG&E Project Manager Assigned to oversee project and assist customer as required.
- Calculation Assistance Available
- Audits available w/ PG&E approval
- Followed by: Project Review, Customer Installation, Final Approval, Issuance of Incentive Check to Customer

Typical Schedule: 1-2 Month to Approval

1-2 Mo. from Project Completion to Payment

(Fast Tracking Available on Case by Case Basis)

NRNC (Non Residential New Construction Program)

NEW CONSTRUCTION CALCULATED PROGRAM for Industrial & Commercial Customers

“Targeted Market Approach” for New Construction Projects

- **Contact PG&E** As Early in the Design Phase As Possible
- **Help Provided** by PG&E Targeted Market Project Manager
- **PG&E / Consultant Engineers Compile Energy Efficiency Report** w/Calculations for Individual Measures
- **Followed by: Project Review, Customer Installation, Final Approval, Issuance of Incentive Check to Customer**

Typical Schedule: 4-6 Month Plus Time Required for Customer to Design & Build

NRR Calculations Method

Methods of Calculation for NRR & NRNC Industrial Programs:

- Hand Calculation
- NRR (SPC) Software
- Other Approved Modeling Programs

Baselines:

- **Individual Equipment:** Meet Government Requirements when Applicable or Standard Industry Practice.
- **Systems:** Generally Standard Industry Practice, or in some cases Existing Equipment Operation (Retrofit).

Calculated Incentives

The Incentives for PG&E NRR & NRNC Calculated Programs:

- Motors, drives, other: 9 cents/kWh saved.
- Refrigeration: 14 cents/kWh
- Lighting: 5 cents/kWh
- **Gas projects:** **\$1.00/therm**
- kW Kicker: \$100/kW (based on summer peak reduction)

Pays up to 50% of project cost (NRR) or 50% of incremental cost (NRNC).

Capped @ \$3.78 Million (NRR) & \$500,000 (NRNC)

Measures

Popular Measures / Typical “Actual” Savings*

- **Air compressors - (10% to 40%)**
- **Process and Non-process Boilers - (2 to 5%) or more for condensing**
- **Motors - (2% to 10%)**
- **Variable Speed Drives - (15% to 50%)**
- **Refrigeration - (10%+)**
- **Lighting - (15% to 35%)**
- **Process Equipment - (10% or more)**
- **Chillers - (10% to 30%)**
- **HVAC Equipment/Energy Management Systems - (10% to 30%)**
- **Waste Water Treatment Process - (10% to 30%)**

* Savings Potential is Dependent on Design/Condition of Existing System and Specifications of New Systems & Equipment

Boiler/Steam System Energy Efficiency Measures

Measure

Approx. Savings Potential

- Boiler Cleaning - Water Side / Tube Side: Up to 1% or More
- Excess Flue Gas Temperature (over 300 °F):
Cause: Original Design, Scaling, Water / Tube Side 1% per 40°F Reduction
- Excess Combustion Air:
Cause: Original Design, Burner out of Adjustment,
Lacks current metering controls (example: O2 trim) 0.5% to 1%
- Loss of Condensate: 0.1% per 1% of Lost Condensate
- Loss of Steam (Leaks): Equal Btu's in Steam Lost
- Insulation (Missing or Inadequate): Can be significant—see example
- Boiler Blowdown Losses: 0.2% to 1.5%
- Gas Bypassing (baffle or internal gas leaks) Up to 1% or More
- Reduce Steam Boiler Pressure (125 to 90 psig) 0.5%
- Replace Steam Boiler/System w/ Hot Water 3% + or –
- Replace Old/Leaking Industrial Steam Trap: On average = 4 #/hr of steam/hr

Flue Gas - Stack Losses – Natural Gas

Natural Gas Stack Loss [%]															
Flue Gas O ₂ Content (%)	Δ = Flue Gas Temperature - Combustion Air Temperature [°F]														
	230	250	270	290	310	330	350	370	390	410	430	450	470	490	510
1.0	14.7	15.1	15.5	16.0	16.4	16.9	17.3	17.7	18.2	18.6	19.1	19.5	20.0	20.4	20.9
2.0	14.9	15.4	15.8	16.3	16.7	17.2	17.7	18.1	18.6	19.1	19.5	20.0	20.5	20.9	21.4
3.0	15.2	15.7	16.1	16.6	17.1	17.6	18.1	18.6	19.1	19.5	20.0	20.5	21.0	21.5	22.0
4.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.1	19.6	20.1	20.6	21.1	21.6	22.2	22.7
5.0	15.8	16.3	16.9	17.4	18.0	18.5	19.1	19.6	20.1	20.7	21.2	21.8	22.3	22.9	23.4
6.0	16.2	16.8	17.3	17.9	18.5	19.1	19.6	20.2	20.8	21.4	22.0	22.5	23.1	23.7	24.3
7.0	16.6	17.2	17.8	18.5	19.1	19.7	20.3	20.9	21.5	22.2	22.8	23.4	24.0	24.6	25.3
8.0	17.1	17.8	18.4	19.1	19.7	20.4	21.1	21.7	22.4	23.1	23.7	24.4	25.1	25.7	26.4
9.0	17.7	18.4	19.1	19.8	20.5	21.2	22.0	22.7	23.4	24.1	24.8	25.6	26.3	27.0	27.7
10.0	18.4	19.2	19.9	20.7	21.5	22.2	23.0	23.8	24.6	25.4	26.1	26.9	27.7	28.5	29.3
11.0	19.2	20.1	20.9	21.7	22.6	23.4	24.3	25.1	25.7	26.9	27.7	28.6	29.4	30.3	31.2
Flue Gas T [°F]	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580
Ambient T [°F]	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
Reference: US Dept. of Energy, Steam System Assessment Training Module, Table pg. 121															

Piping Heat Transfer Losses

Nominal Pipe Diameter, (inches)	Heat Transfer from Uninsulated Pipe Exposed to a 10 mph Wind and 70°F Ambient Temperature, (Btu/hr/linear foot)					
	Process Temperature, (°F)					
	200	400	600	800	1,000	1,200
0.5	274	731	1,279	1,963	2,865	4,030
1	354	959	1,712	2,694	3,995	5,708
2	514	1,416	2,591	4,167	6,324	9,247
3	708	1,849	3,425	5,605	8,619	12,728
4	845	2,352	4,132	6,838	10,605	15,776
5	982	2,751	5,126	8,105	12,671	18,938
6	1,107	3,128	5,868	9,726	14,692	22,055
8	1,336	3,824	7,237	12,089	18,973	27,785
10	1,575	4,532	8,642	14,543	22,945	34,498
12	1,792	5,183	9,932	16,826	26,678	40,274
16	2,135	6,210	12,009	20,491	32,705	49,623
20	2,534	7,443	14,509	24,932	40,034	61,039
24	2,934	8,699	17,078	29,315	47,283	72,352

Examples / Steam System Savings – 1 of 2

Example: 20,000 #/hr steam boiler operating at full load and 125 psig:

– 1% Savings (40°F Excess Flue Gas Temp):

- **Boiler Therm Use** = $20,000 \text{ lb/hr} \times 1000 \text{ btu/lb} \times 8760 \text{ hr/yr} / 0.80$ (boiler efficiency) / $100,000 \text{ btu/therm} = \mathbf{2,190,000 \text{ therm/year}}$
- **1% Savings = 21,900 therms/yr**
- At a **Cost** of \$1/therm, this is a cost of **\$21,900/year**
- Note, savings would be proportionally more for adding a new economizer (perhaps 5 times)

– 1% Condensate loss (180 °F relative to 70°F makeup):

- **Btu value relative to cold water** of 200 #/hr = $(148 - 38)\text{btu/\#} \times 200 \text{ \#/hr} = \mathbf{22,000 \text{ btu/hr}}$
- **Savings:** $22,000 \text{ btu/hr} \times 8,760 \text{ hr/year} / 0.80 / 100,000 \text{ therm/btu} = \mathbf{2400 \text{ therm/year}}$
- **Cost** for 1% loss @ \$1/therm = **\$2,400/year**

Examples / Steam System Savings – 2 of 2

Example: 20,000 #/hr steam boiler, full load, 125 psig (Cont.):

- 1% Steam Loss / 2% Reduction in Combustion Air / Typical Blowdown Heat Recovery Installation
 - These all can provide approximately **1% Energy Savings, or \$21,900/year**
- 1 Failed Steam Trap
 - $4 \text{ \#/hr} \times 1000 \text{ btu/\#} \times 8760 \text{ hr/year} / 100,000 \text{ btu/therm} \times 0.80$ (boiler efficiency)
Savings: 438 therms/year
@ \$1/therm, Cost Savings = \$438 / failed trap per year
- Insulate 100 feet of 6" Steam Line @ 125 psig, 350 °F:
 - Reference "Steam Assessment Training – US Dept. of Energy, pg 234, outside air temp 70°F, wind 10 mile/hr, Loss per foot for 6" pipe = 2,600 btu/hr
 - **Loss/Year for 100 ft = $2,600 \times 100 \times 8,760 / 0.80 / 100,000$ btu/therm = 28,500 therm/year**
 - Insulation can recover 90%;
@ \$1 per therm, Cost Savings (100' 6" pipe) = \$28,500/year

Small Business Mass Market Process

Small Business Rebate Application

- Purchase and install qualifying products shown on technology catalogs.
- Submit application with proof of purchase within 90 days of purchase date to qualify for a rebate.
- Applications can be submitted electronically using the e-Rebate Program or hard copy applications can be submitted.
- No caps on Project Incentives.
- All rebates paid on a per item basis.

Please check technology catalogs for updated listing of products qualified for rebates before purchasing and installing as they are subject to change without notice

Energy Efficiency Rebates for Your Business Boiler and Water Heating Catalog

Space Heating Boiler

- Very efficient heat exchangers, insulation, burners & controls
- Small: Rated by Annual Fuel Utilization Efficiency (AFUE) for units < 300 MBtuh ($\geq 77\%$ - steam; $\geq 82\%$ - water)
- Large: Rated in Thermal Efficiency for units ≥ 300 MBtuh - $\leq 5,000$ MBtuh ($\geq 84\%$ steam & water)
- Rebate: \$1.00/MBtuh (i.e., 300 MBtuh unit = \$300.00 rebate)
- Example: 4,000 #/hr Boiler, 125 psig, @ \$1 = \$4,000 Rebate

Energy Efficiency Rebates for Your Business Boiler and Water Heating Catalog

Large Domestic Hot Water Boiler

- Commercial end-use customers
- Boilers must be greater than 75,000 Btuh
- Rated in Thermal Efficiency 84%
- Not for industrial (process), space conditioning
- Rebate: \$1.50MBtuh
- Example: 500,000 Btu/hr: $500 \times \$1.50 = \750

Energy Efficiency Rebates for Your Business Boiler and Water Heating Catalog

Direct Contact Water Heater

- Industrial end-use customers who manufacture a saleable product (such as machinery, furniture textiles, computers, etc.)
- Rated in Annual Fuel Utilization Efficiency (AFUE) $\geq 88\%$ for ≤ 300 MBtuh
- Rated in Thermal Efficiency $> 90\%$ for > 300 MBtuh
- Rebate: \$2.00/MBtuh (i.e., 300 MBtuh unit = \$600.00 rebate)

Energy Efficiency Rebates for Your Business Boiler and Water Heating Catalog

Tank Insulation

- Foam or fiberglass qualify
- Rated by thickness (1" or 2")
- Rebated by tank solution temperature
- Must be added to existing bare tanks
- Rebates range from \$2.00 - \$4.00/Square Foot

Energy Efficiency Rebates for Your Business Boiler and Water Heating Catalog

Pipe Insulation

- Foam, fiberglass, or calcium silicate qualify
- Rated by thickness (1" or 2")
- Rebated by steam or water process
- Must be added to existing bare pipe systems
- Rebates range from \$2.00 - \$4.00/Linear Foot

Energy Efficiency Rebates for Your Business Boiler and Water Heating Catalog

Boilers and Water Heating:

STEAM TRAPS FOR GAS BOILERS (Retrofit Only)

All replaced steam traps in an existing steam system are eligible. Steam trap type designation for the replacement steam trap must be provided, along with a specification sheet for the replacement steam trap(s).

Industrial steam traps are for industrial or agricultural/food processing end-use customers who manufacture a saleable product. Commercial steam traps are for commercial end-use customers who are dry cleaners and all other commercial facilities.

Cash rebate amounts are as follows:

Product Code Rebate/Unit Measure

H221 Commercial Steam Traps:	\$50.00/Unit
H201 Industrial Low Pressure Steam Traps <15 psig:	\$100.00/Unit
H202 Industrial High Pressure Steam Traps > 15 psig:	\$200.00/Unit

Challenges - EE Boiler Projects – 2010 thru 2012

Challenges:

- CPUC rules for estimating savings as basis for incentives
 - Standard Industry Practice (baseline) is higher than actual efficiency (retrofit)
 - Actual Savings can be significantly more than incentivized savings
- Local Air Regulations often establish “new” baselines
 - The current technology to meet NOx requirements etc. establishes the baseline
- Greenhouse rules going into effect in mid 2010 for largest customers with other customers (graduated in by size) to be included over the next few years
 - It is currently unclear what impact this will have on PG&E EE programs and the way we set baselines.
 - Will the greenhouse emissions rules impact the way we currently set baselines (i.e., we currently use T-24 for commercial boilers)

Challenges - EE Boiler Projects – 2010 thru 2012

Challenges – Continued (2):

- Identifying Viable Projects
 - Due to relatively high cost for new boilers & related equipment, simple (project) payback for a boiler can be up to 10 years or more.
 - To justify projects, usually need to consider all savings including maintenance and environmental benefits
 - Consider including other boiler measures in project that may be more cost effective than the boiler replacement alone
- Promote Other Measures Related to Boilers to get More Savings and improve project payback (goal is 2 years or less)
 - Return condensate, add economizers (including condensing if applicable), tune boilers (reduce excess air), repair steam leaks and missing/broken insulation, replace leaking steam traps.

Challenges - EE Boiler Projects – 2010 thru 2012

Challenges – Continued (3):

- Getting the Word out to Customers:
 - Making them aware of program services such as audits & calculation assistance.
 - Helping them with analysis for their projects in order to navigate thru the other challenges noted above.
- Identifying Opportunities for Condensing Boilers
 - Not all plants are candidates (in fact on retrofit, it is challenging)

Contact Information

PG&E Website: www.pge.com/mybusiness/energysavingsrebates/

Business Customer Service Center: 1.800.468.4743

For Calculated Programs:

Sr Program Manager: Bob Wherritt (REWd@pge.com; 415-972 5024)

Sr Project Manager: Joan Cromosini (JCCh@pge.com; 650-413-4630)

For Rebate Programs:

Sr Project Manager: Emily Juan (EWJ4@pge.com; 415-973-0806)

Energy Efficiency Programs Calculated / Rebate Projects

Questions?

Example of VSD Project – 1 of 2

Project Description:	Add VSD to Existing 100 hp Pump/Throttling Valve Control
VSD Project Cost:	\$250/hp (Labor & Material) = \$25,000
Flow Conditions:	1000 gpm 100 psig (231 feet), 90% dynamic, 10% static
Basis of Calculation:	8000 hrs/yr 30% hrs @ 90% flow 40% hrs @ 70% flow 30% hrs @ 50% flow
Project EE Savings:	194,000 kWh / Yr
Incentive paid @ \$0.09 & \$100/kW:	\$12,500 (cap @ 50%)
Simple Payback (\$0.10 electricity):	8 Months

Example of VSD Project – 2 of 2

Power consumption vs. Flow
with Throttling and Frequency Converter control

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