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APPLIANCE & PLUG LOADS

GAS DRYER MODULATING VALVE, COMMERCIAL AND MULTIFAMILY

SWAP012-01

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MEASURE NAME

Gas Dryer Modulating Valve, Commercial and Multifamily

STATEWIDE MEASURE ID

SWAP012-01

TECHNOLOGY SUMMARY

This measure is a modulating two-stage unit that replaces the single-stage valve of an existing natural gas dryer. This device modulates the valve from low to high fire. The temperature sensor provides feedback that controls the flue exhaust to allow for a reduction of natural gas consumption per dryer load-cycle by the burner. In the initial stages of a dryer cycle, the moisture content is at maximum. Therefore, a high fire rate is needed to reduce the moisture. During the later stages of the cycle, the moisture content has been reduced; a higher fire rate creates more heat than necessary. The modulating valve allows for the lower fire rate to function when the moisture content has been reduced from maximum. Most standard dryers have a single fire rate. This modulating technology will reduce dryer energy consumption while performing the same function.

The *On-Premise Laundromat (OPL) Dryers Market Survey*[1] was conducted by TRC Energy Services from 2014 to 2015. The study provides a detailed market characterization of on-premise laundry applications including large commercial and industrial applications. Phone surveys were conducted from October 2014 to January 2015 of 260 facilities with 98 quantitative responses in 11 sectors. The sectors are: hospitality, in patient healthcare, fitness, correctional facilities, contract laundry, dry cleaners, education, fire stations, law enforcement, health care, and restaurants. Mail surveys were also conducted. This study was used to develop the loads per day value used to estimate the savings for each sector.

MEASURE CASE DESCRIPTION

The measure case is defined as a modulating valve replacing a non-modulating valve in a gas dryer with appropriate temperature probes installed in the exhaust stack. This measure applies to a natural gas dryer in the commercial or residential multifamily sector.

Measure Offerings

Statewide Measure Offering ID	Measure Offering Description
SWAP012A	Gas Dryer Modulating Valve

[1] TRC Energy Services. (n.d.) *On-Premise Laundromat Dryers Market Survey.* Prepared for Pacific Gas and Electric Company.

BASE CASE DESCRIPTION

The base case is defined as an unmodified natural gas dryer with a single stage valve without the required temperature sensors.

CODE REQUIREMENTS

Applicable state and federal codes are specified below. The California Appliance Efficiency Regulations (Title 20) is the only applicable code to dryer manufacturing in the state of California, however, there is no requirement for modulating technology, per section 1605.1 (q).

Applicable State and Federal Codes and Standards

Code	Applicable Code Reference	Effective Date
CA Appliance Efficiency Regulations – Title 20	1605.1 (q)	December 31,2016
CA Building Energy Efficiency Standards – Title 24	n/a	n/a
Federal Standards	n/a	n/a

Title 20 requirements that pertain to gas dryers are presented below.

Table Q-2: Standards for Vented Electric Clothes Dryers, Ventless Electric Clothes Dryers, and Vented Gas Clothes Dryers Manufactured on or After January 1, 2015

Appliance	Minimum Combined Energy Factor (CEF) (lbs/kWh)	
	Vented	Ventless
Electric, standard clothes dryers	3.73	--
Electric, compact, 120 volt clothes dryers	3.61	--
Electric, compact, 240 volt clothes dryers	3.27	2.55
Electric, combination washer-dryer	--	2.08
Gas clothes dryers	3.30	--

NORMALIZING UNIT

Each

PROGRAM REQUIREMENTS

Measure Implementation Eligibility

All combinations of measure application type, delivery type, and sector that are established for this measure are specified below. Measure application type is a categorization based on the circumstances and timing of the measure installation; each measure application type is distinguished by its baseline determination, cost basis, eligibility, and documentation requirements. Delivery type is the broad categorization of the delivery channel through which the market intervention strategy (financial incentives or other services) is targeted. This table also designates the broad market sector(s) that are applicable for this measure.

Note that some of the implementation combinations below may not be allowed for some measure offerings by all program administrators.

Implementation Eligibility

Measure Application Type	Delivery Type	Sector
Add-on equipment (AOE)	DnDeemed	Com
Add-on equipment (AOE)	DeemDI	Com
Add-on equipment (AOE)	DnDeemed	Res (multifamily only)
Add-on equipment (AOE)	DeemDI	Res (multifamily only)

This measure does not restrict the manufacturer of the device. Devices that can reduce the energy consumed by modulating the throughput of natural gas and monitor moisture/temperature of the unit qualify.

This measure applies to a natural gas dryer in the commercial or residential multifamily sector.

Eligible Products

A professional installer will be required for all installations of this product as the inlet natural gas line will have to be removed and reattached during installation.

The natural gas dryer must not be modified by any technology that would reduce the natural gas consumption beyond the manufacturer specifications.

The dryer must have an accessible gas valve assembly and room to install the modulating device in the unit and on the unit exhaust.

The dryer must have a drum capacity ranging from 20 lbs. to 200 lbs.

All applicants must have their dryers on site.

Natural gas must be supplied by a California utility.

Eligible Building Types and Vintages

This measure is applicable for all new and existing commercial or multifamily buildings of all vintages.

For the commercial sector, this measure will apply to the following building types: general commercial, hotels, motels, small retail, and nursing homes.

Eligible Climate Zones

This measure is applicable in all California climate zones.

PROGRAM EXCLUSIONS

A dryer that makes use of a common or dedicated steam system is not eligible.

This measure is not eligible for dryers with a capacity greater than 200 lbs or less than 20 lbs. For capacities outside of this range, a custom measure type is recommended.

DATA COLLECTION REQUIREMENTS

Data collection requirements are to be determined.

USE CATEGORY

Appliance and plug-load (AP).

ELECTRIC SAVINGS (kWh)

Not applicable.

PEAK ELECTRIC DEMAND REDUCTION (KW)

Not applicable.

GAS SAVINGS (THERMS)

The modulating gas dryer valve provides savings by reducing high fire minutes per dryer load cycle by alternating between low and high rates. A standard dryer burner will perform at a high fire rate until a set point temperature is reached in the flue-stack. The burner will shut off until a low temperature set point in the flue-stack triggers another high fire rate cycle. These baseline dryer cycles waste natural gas towards the end of a drying cycle; the clothes do not require a high input rate of heat due to lower moisture content in the drying cavity. The low fire rate will replace some of the high fire rate cycles of the baseline case and thus use less natural gas to dry the same load of clothing.

Summaries of Key Studies

Nicor Gas Commercial Dryer Modulation Retrofit (2014)[2]

- A standardized test and a long-term monitoring test were conducted on the same equipment at 5 test locations. Total of 11 dryer units. A savings resulted from the addition of the modulating gas unit.
- Six months of data was collected for the long-term study: 3 as a baseline and 3 as a measure case. The standardized test was in “lab-like” conditions. Markets covered were: laundromats, dry cleaning, hospitality, and healthcare.
- This study used monitoring equipment to gather dryer cycles, makeup air temp, and gas usage. It was then used to determine therm savings.

[2] Nicor Gas. 2014. *1036: Commercial Dyer Modulation Retrofit Public Project Report.* September 16.

- Study concluded the modulation valve produces a 12.4% reduction in natural gas consumed by a dryer.

PG&E Main Project Hotel – Dryer Modulating Gas Valve (2015) [3] [4] [5]

- Custom Rebate Project Report done by PG&E in 2015
- Project report for the installation of 2 modulating dryer units at a hotel. It explains the measured results and costs and time frame associated.
- Covers 2 months' time in the middle of 2015 at a large hotel with onsite laundry.
- The project used monitoring equipment to record actual gas usage during normal operation and during a standardized test period.
- This custom report is the basis for the cost data and validation of the technologies ability to provide savings.

SCG Engineering Data Collection La Mirada (2011-2012) [6] [7] [8] [9] [10]

- Study done by SoCalGas in December of 2011 and January of 2012
- Dryer gas usage data was gathered at two locations in La Mirada: a nursing home and a hotel.
- The monitoring period was approximately three months.
- A flow meter and recording equipment were connected to each dryer unit to collect relative parameters.
- This data was used to substantiate the claim of an average of 0.95 therm/load usage of commercial dryers. It was also confirmed the cycles-per-day of general commercial, health care, and hospitality sectors.
- The study is older than other studies used, which is why it was only used to substantiate other studies instead of using the values directly.

PG&E Residential Clothes Dryers (2015)[11]

- Workpaper was developed to cover natural gas and electric residential clothes dryers.
- Used to help establish a EUL for a commercial natural gas dryer.

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[3] Pacific Gas & Electric (PG&E). 2015. "Pacific Gas & Electric (PG&E). 2015. "Main Project Hotel Preliminary Energy Calculation.xlsx.""

[4] Pacific Gas & Electric (PG&E). 2015. "Main Project Hotel Review Approval_Redacted.pdf."

[5] Pacific Gas & Electric (PG&E). 2015. "Main Project Hotel Savings Calculation.xlsx."

[6] Southern California Gas Company (SCG). 2012. "La Mirada Hotel All Data2of2.xlsx"

[7] Southern California Gas Company (SCG). 2012. "La Mirada Hotel All Data1of2.xlsx"

[8] Southern California Gas Company (SCG). 2012. "La Mirada Hotel Data Eval.zip"

[9] Southern California Gas Company (SCG). 2012. "La Mirada Nursing All Data.zip."

[10] Southern California Gas Company (SCG). 2012. "La Mirada Nursing Home Eval.zip."

[11] Pacific Gas & Electric (PG&E). 2015. "PGECOAPP129 Revision 0: Residential Clothes Dryers." September 18.

- No concerns noted regarding the analysis.

Commercial Clothes Dryers (2013)[12]

- Study completed by Yanda Shang and Julianna Wei of HMG in July of 2013.
- Study was performed during the first half of 2013 using the commercial clothes dryer markets.
- Survey based study.
- Established the EUL for commercial dryers adopted for this measure.
- No concerns noted regarding the parameters of this study.

Methodology

The gas modulation will directly affect the combustion parameter, the equivalence ratio. The equivalence ratio is defined as follows:

Equation 1

$$\phi = \frac{\left(\frac{F}{A}\right)_{actual}}{\left(\frac{F}{A}\right)_{stoichemetric}}$$

$$F = m_f = mass\ fuel\ rate$$

$$A = m_a = mass\ air\ rate$$

From combustion chemistry we observe how the change in equivalence ratio will affect the flame temperature and therefore reduce the heat available for drying.

Equation 2

$$C_xH_y + \left(\frac{x + {}^{y}/_{4}}{\phi}\right)(O_2 + 3.76N_2) \xrightarrow{\text{yields}} xCO_2 + \frac{y}{2}H_2O + 3.76\left(\frac{x + {}^{y}/_{4}}{\phi}\right)N_2 + \left(x + {}^{y}/_{4}\right)\left(\frac{1}{\phi} - 1\right)O_2$$

For Methane (CH_4), equation 2 becomes:

$$CH_4 + \left(\frac{1 + {}^{4}/_{4}}{\phi}\right)(O_2 + 3.76N_2) \xrightarrow{\text{yields}} 1CO_2 + \frac{4}{2}H_2O + 3.76\left(\frac{1 + {}^{4}/_{4}}{\phi}\right)N_2 + \left(1 + {}^{4}/_{4}\right)\left(\frac{1}{\phi} - 1\right)O_2$$

[12] Zhang, Y. and J. Wei (Heschong-Mahone Group, HMG). 2013. Commercial Clothes Dryers. Codes and Standards Enhancement (CASE) Initiative for PY2013: Title 20 Standards Development. Analysis of Standards Proposal for Commercial Clothes Dryers. Prepared for Pacific Gas & Electric Company (PG&E), Southern California Edison (SCE), San Diego Gas & Electric (SDG&E), and Southern California Gas Company (SCG). July.

Equation 3

$$CH_4 + \left(\frac{2}{\phi}\right)(O_2 + 3.76N_2) \xrightarrow{\text{yields}} 1CO_2 + 2H_2O + \left(\frac{7.52}{\phi}\right)N_2 + \left(\frac{2}{\phi} - 2\right)O_2$$

If,

$$a = \frac{2}{\phi}, \quad b = \frac{7.52}{\phi}, \quad c = \left(\frac{2}{\phi} - 2\right)$$

Then equation 3 becomes,

Equation 4

$$CH_4 + a(O_2 + 3.76N_2) \xrightarrow{\text{yields}} 1CO_2 + 2H_2O + bN_2 + cO_2$$

This measure will alter the value of equation 1. By reducing the mass fuel rate of the numerator (actual mass of air to fuel ratio), with all other values kept constant, the equivalence ratio magnitude will decrease. This will cause the value of a, b, and c to increase in magnitude. As a, b, and c increase, the flame temperature of combustion will decrease, thus providing a smaller heat rate during the low fire rate.

The adiabatic flame temperature is derived from the following expression.

Equation 5

$$N\sum H_{reactants}(T_{i,}P) = N\sum H_{products}(T_{adiabatic,}P)$$

$$H_{products} = N[h_f + C_p(T_{adiabatic} - T_{initial\ reactant\ temperture})]$$

$$H_{reactantse} = Nh_f$$

$N = number\ of\ molecules$
$h_f = enthalpy\ of\ formation$
$T_{adiabatic} = adiabatic\ flame\ temperature$
$T_{itr} = Initial\ Temperature\ of\ reactants$

Solving for $T_{adiabatic}$,

$$N_{reactants} * h_{f-reactants} = N_{products}[h_{f-products} + C_p(T_{adiabatic} - T_{itr})]$$

Equation 6

$$T_{adiabatic} = \left[\frac{(N_{reactants} * h_{f-reactants}) - (N_{products} * h_{f-products}) + (N_{products} * C_p * T_{itr})}{(N_{products} * C_p)}\right]$$

By observation, (N=a,b,c), for each respective molecule. From equation 6, as $N_{products}$ increases, the magnitude of $T_{adiabatic}$ decreases. This will occur due to the compounds (CH_4, CO_2, H_2O) having exothermic reactions; they release heat and have a negative enthalpy of formation. To further prove this concept, the figure below shows the change of flame temperature due to the equivalence ratio.

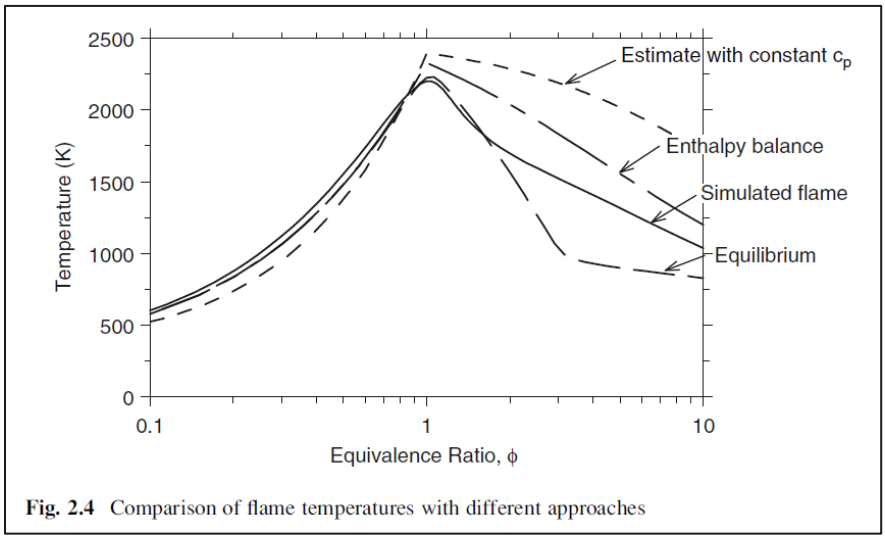


Fig. 2.4 Comparison of flame temperatures with different approaches

Figure 1: Adiabatic Flame Temperature Vs Equivalence Ratio[13]

It is important to reiterate that as the mass flow rate of fuel in equation 1 is reduced, the magnitude of the equivalence ratio decreases. This will cause the magnitude of N (where N = a, b, c) to increase. As these values increase, from equation 6, the magnitude of the flame temperature decreases. This is important for a lower flame temperature, decrease the temperature differential for heat transfer (ΔT), therefore providing a smaller heat rate.

The savings found in the Commercial Dryer Modulation Retrofit emerging technologies project conducted by Nicor Gas ("Nicor Study"),[14] have a 12.4% natural gas consumption reduction. This result was adopted from Nicor "Standardize Test"; a test was conducted at different sites with dryers in modulation and no modulation, drying the exact same laundry load. The image below extracted from the Nicor Study presents each test result and the derivation of a 12.4% gas reduction when annually extrapolated. The 12.4% reduction encompasses all the test results in the table above that are not shaded. The shaded values were found to have discrepancies and are not included in the calculation.

[13] McAllister, S., J. Chen, and A. Carlos Fernandez-Pello. 2011. *Fundamentals of Combustion Processes*.

[14] Nicor Gas. 2014. *1036: Commercial Dyer Modulation Retrofit Public Project Report.* September 16.

Table 5: Short Term, Standardized Testing Annualized Results

Site	Dryer	Annual Gas Use Baseline (therms)	Annual Gas Use Modulation (therms)	Annual Gas Savings (therms)	Annual Gas Savings (%)	Annual Cost Savings	Payback (years)	Dryer Size (lb)
Dry Cleaner	Dryer #2	2,410	2,265	145	6.0%	$109.28	4.80	50
Healthcare Site	Dryer #1	4,738	4,678	60	1.3%	$45.25	11.60	75
	Dryer #2	-	-	-	-	-	-	-
Hotel #1	Dryer #1	2,678	2,613	65	2.4%	$48.53	10.82	170
	Dryer #2	4,011	3,255	755	18.8%	$567.92	0.92	170
Hotel #2	Dryer #1	1,384	1,392	-8	-0.6%	-$6.24	Never	120
	Dryer #2	2,354	2,219	135	5.8%	$101.79	5.16	75
Laundromat	Dryer #1	1,903	1,728	174	9.2%	$131.07	4.01	30
	Dryer #2	1,163	1,019	144	12.4%	$108.10	4.86	30
	Dryer #3	2,035	1,425	610	30.0%	$458.83	1.14	45
	Dryer #4	1,320	1,199	121	9.2%	$90.90	5.78	45
Average				286	12.4%	$214.84	2.44	

Dry Cleaner had pressure supply problem where the supply pressure to the dryer would vary and make results unreliable
Dryer was found later to have low pressure less than 1" WC on low fire (when it had been set at 1.45" WC)
Dryer was found to have a flame sense problem later where it would shut off the dryer when low fire was engaged

The Nicor Study "Standardized Test" values were considered more conservative and more applicable to multiple sectors over the long-term monitoring that was done in the study. In this report a baseline and measure gas consumption were established using information gathered from current switches that measure the amount of time the burner was running in high or low fire rates during a drying cycle. The times found for each mode were multiplied by the high or low firing heat rate. The high fire heat rate and manifold pressure associated to it were acquired from the equipment name plate. The low fire heat rate was tabulated through equation 7 known as the "square root law" and associated manifold pressure was measured. (The manifold pressure was measured with a digital manometer at the gas valve.)

Equation 7

$$Q_N = Q_O * \sqrt{\frac{P_N}{P_O}}$$

$Q_N = Low\ Firing\ Rate\ (\frac{Btu}{hr})$

$Q_O = High\ Firing\ Rate\ (\frac{Btu}{hr})$

$P_N = Low\ Fire\ Heat\ Rate\ Manifold\ Pressure\ (inch\ water\ column)$

$P_O = High\ Fire\ Heat\ Rate\ Manifold\ Pressure\ (inch\ water\ column)$

Equation 7 results from decreasing the mass fuel ratio during modulation mode, when there is less fuel flow, the adiabatic flame temperature as shown above will decrease thus decreasing the heat rate.

Unit Energy Savings Calculation

Savings values for the typically sized dryer for each building sub sector were calculated using a regression analysis.[15] The approach starts with manufacturer data on the pound sizes of the dryer drums and their corresponding burner rates. These rates were then converted to therm/hr rates and multiplied by the estimated time a burner is ON during a drying cycle; this ON time was estimated[16] [17] [18] [19] [20] [21] [22] [23] , which translates to a burner being run for 65% of the time a single load of laundry is drying. The La Mirada Data[4] establishes an average time of 35 min per drying cycle. Thus, multiplying the percentage of time the burner is running in hours by the therms per hour rate of the burners for each dryer equates to a therms used per cycle of laundry. This does change based on dryer drum size (See column E of the Energy Analysis[3]). This was graphed and used to derive an equation that relates drum size to therms used to dry. The equation was used to generate a set of values on 10 lb increments that yielded a therm used value. The Nicor savings value of 12.4% was then applied to each to establish a savings amount.

Most dryers are operated inside a conditioned space with little to no variations in ambient conditions per climate zone. Thus, the savings apply all California climate zones.

[15] Southern California Gas Company (SCG). 2017. "Energy Analysis of SCG and PGE Data Collection.xlsx"

[16] Southern California Gas Company (SCG). 2012. "La Mirada Hotel All data1of2.xlsx"

[17] Southern California Gas Company (SCG). 2012. "La Mirada Hotel All data2of2.xlsx"

[18] Southern California Gas Company (SCG). 2012. "La Mirada Hotel Data Eval.zip"

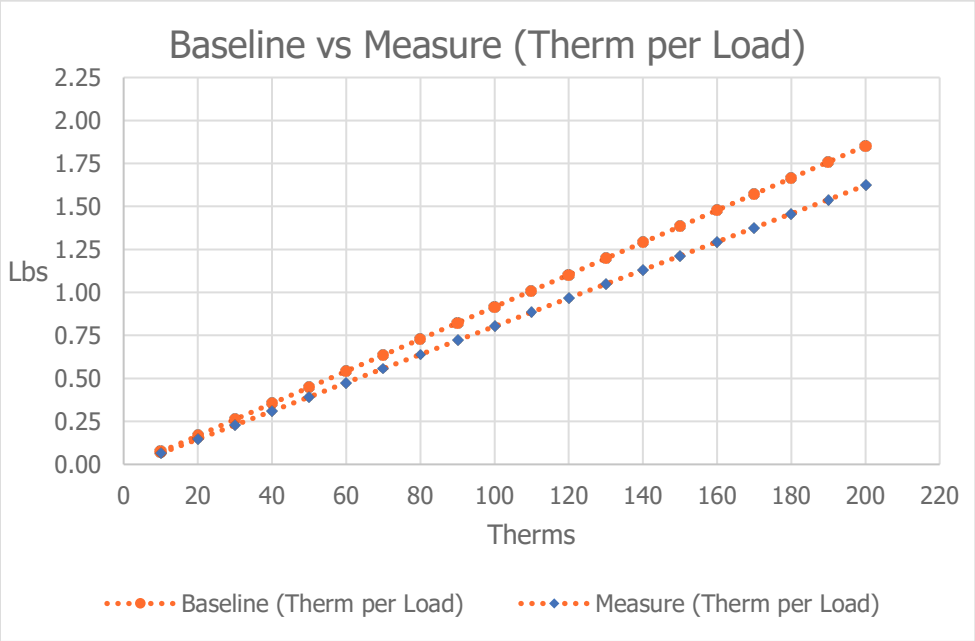
[19] Southern California Gas Company (SCG). 2012. "La Mirada Nursing All Data.zip"

[20] Southern California Gas Company (SCG). 2012. "Mirada Nursing Home Eval.zip"

[21] Pacific Gas & Electric (PG&E). 2015. "Main Project Hotel Preliminary Energy Calculation.xlsx"

[22] Pacific Gas & Electric (PG&E). 2015. "Main Project Hotel Review Approval_Redacted.pdf"

[23] Pacific Gas & Electric (PG&E). 2015. "Main Project Hotel Savings Calculation.xlsx"



Sample Calculation

Hotels were found to run each dryer for 4,432 loads annually and the dryers were found to have an average capacity of 69 lbs. Using these values, the following baseline consumption was established.

Therms per load for a 69 lb capacity dryer is estimated by the following calculation:

$$\frac{Therm}{Load} = .626 \text{ based on regression analysis}$$

$$Baseline\ Consumption = .626 * 4432 = 2774.43\ Therms$$

$$Savings = 2774.43 * .124 = 344.06\ Therms$$

LIFE CYCLE

Effective useful life (EUL) is an estimate of the median number of years that a measure installed through a program is still in place and operable. Remaining useful life (RUL) is an estimate of the median number of years that a technology or piece of equipment replaced or altered by an energy efficiency program would have remained in service and operational had the program intervention not caused the replacement or alteration.

The methodology to calculate the RUL conforms with Version 5 of the Energy Efficiency Policy Manual, which recommends "one-third of the effective useful life in DEER as the remaining useful life until further study results are available to establish more accurate values."[24] This approach provides a reasonable RUL

[24] California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 32.

estimate without the requiring any a priori knowledge about the age of the equipment being replaced.[25] Further, as per Resolution E-4807, the California Public Utilities Commission (CPUC) revised add-on measures so that the EUL of the measure is equal to the lower of the RUL of the modified system or equipment or the EUL of the add-on component."[26]

The EUL and RUL are specified below. Due to this being an add-on equipment measure, the RUL value will be used in place of the EUL value for evaluating the measure. RUL is defined as one-third of the EUL of the technology being modified. In this case, the technology being modified is the gas dryer installed in either a commercial or multifamily building. (The EUL of the modulating gas unit, itself, was established from manufacture specifications.) There is no defined value in DEER for commercial dryers.[27]

Effective Useful Life and Remaining Useful Life

Parameter	Value	Source
EUL (yrs) – measure	10.00	Manufacturer specifications.
EUL (yrs) – host	14.00	Zhang, Y. and J. Wei (Heschong-Mahone Group, HMG). 2013. *Commercial Clothes Dryers. Codes and Standards Enhancement (CASE) Initiative for PY2013: Title 20 Standards Development. Analysis of Standards Proposal for Commercial Clothes Dryers.* Prepared for Pacific Gas & Electric Company (PG&E), Southern California Edison (SCE), San Diego Gas & Electric (SDG&E), and Southern California Gas Company (SCG). July.
RUL (yrs)	4.67	

BASE CASE MATERIAL COST ($/UNIT)

Not applicable.

MEASURE CASE MATERIAL COST ($/UNIT)

Measure case costs were based on a Pacific Gas and Electric (PG&E) custom project report completed in 2015.[28] [29] [30] This price included labor and material costs for both units. It is estimated that the total cost per unit is half of the total installed cost.

[25] KEMA, Inc. 2008. "Summary of EUL-RUL Analysis for the April 2008 Update to DEER." Memorandum submitted to Itron, Inc.

[26] California Public Utilities Commission (CPUC). 2016. *Resolution E-4807.* December 16. Page 13.

[27] Zhang, Y. and J. Wei (Heschong-Mahone Group, HMG). 2013. Commercial Clothes Dryers. Codes and Standards Enhancement (CASE) Initiative for PY2013: Title 20 Standards Development. Analysis of Standards Proposal for Commercial Clothes Dryers. Prepared for Pacific Gas & Electric Company (PG&E), Southern California Edison (SCE), San Diego Gas & Electric (SDG&E), and Southern California Gas Company (SCG). July.

[28] Pacific Gas & Electric (PG&E). 2015. "Main Project Hotel Review Approval_Redacted.pdf."

[29] Pacific Gas & Electric (PG&E). 2015. "Main Project Hotel Savings Calculation.xlsx."

[30] Pacific Gas & Electric (PG&E). 2015. "Main Project Hotel Preliminary Energy Calculation.xlsx."

Separate material costs are not currently available. Navigant, working as a consultant, had a verbal conversation with a manufacturer that yielded the below information. Estimates for labor per installation is approximately 46% to 58% of the total measure cost. This was gathered by using the Btu ratings of the dryers in the PG&E custom project report to find how much the materials should cost. In this case, the dryers had a rating of 300,000 and 370,000 Btuh, respectively. By estimates, this set the materials cost to $850 to $1,100 per installation. The cost for material with a regulator was chosen as a reasonable estimate. Total cost of $2050 minus $1100.00 yields a possible labor cost of $950.00 per installation.

Materials Cost

Burner Size (Btuh)	Material Cost (No Regulator)	Material Cost with Regulator*	Installation Cost with Regulator
Under 100,000	$700	$950	-
Up to 400,000	$850	$1,100	$950
Above 400,000	N/A	$1,500 Starting	-

* Regulators are required for large drummed dryers to operate a modulating unit properly. They are normally supplied with the modulating valve kits for an additional cost.

BASE CASE LABOR COST ($/UNIT)

Not applicable. The base case is to not modify the dyer with the modulating valve measure.

MEASURE CASE LABOR COST ($/UNIT)

The measure case labor cost would equal the full amount of labor and materials. Labor is considered as a cost in this measure because the installation process requires a technician to complete and is not within the realm of “DIY” measures.

NET-TO-GROSS (NTG)

The net-to-gross (NTG) ratio represents the portion of gross impacts that are determined to be directly attributed to a specific program intervention. These NTG values are based upon the average of all NTG ratios for all evaluated 2006 – 2008 commercial and residential programs, as documented in the 2011 DEER Update Study conducted by Itron, Inc. These sector average NTGs (“default NTGs”) are applicable to all energy efficiency measures that have been offered through commercial and residential sector programs for more than two years and for which impact evaluation results are not available.

Net-to-Gross Ratios

Parameter	Value	Source
NTG – commercial	0.60	Itron, Inc. 2011. *DEER Database 2011 Update Documentation.* Prepared for the California Public Utilities Commission. Page 15-4 Table 15-3.
NTG – residential	0.55	

GROSS SAVINGS INSTALLATION ADJUSTMENT (GSIA)

The gross savings installation adjustment (GSIA) rate represents the ratio of the number of verified installations of the measure to the number of claimed installations reported by the utility. This factor varies by end use, sector, technology, application, and delivery method. This GSIA rate is the current "default" rate specified for measures for which an alternative GSIA has not been estimated and approved.

Gross Savings Installation Adjustment

Parameter	GSIA	Source
GSIA - Default	1.00	California Public Utilities Commission (CPUC), Energy Division. 2013. *Energy Efficiency Policy Manual Version 5*. Page 31.

NON-ENERGY IMPACTS

Non-energy benefits for this measure have not been quantified.

DEER DIFFERENCES ANALYSIS

This section provides a summary of inputs and methods based upon the Database of Energy Efficient Resources (DEER), and the rationale for inputs and methods that are not DEER-based.

DEER Difference Summary

DEER Item	Comment
Modified DEER methodology	No
Scaled DEER measure	No
DEER Base Case	No
DEER Measure Case	No
DEER Building Types	No
DEER Operating Hours	No
DEER eQUEST Prototypes	No
DEER Version	N/A
Reason for Deviation from DEER	No available DEER measure to allow for comparison
DEER Measure IDs Used	N/A
NTG	Source: DEER READI. NTG of 0.6 associated with NTG ID: *All-Default <=2yrs*
GSIA	The GSIA of 1.0 is associated with GSIA ID: *Def-GSIA*
EUL/RUL	Source: Commercial Clothes Dryer-CASE Initiative[31]. The value of 14 years is associated with EUL ID: *Com-GasDryer*

[31] Zhang, Y. and J. Wei (Heschong-Mahone Group, HMG). 2013. Commercial Clothes Dryers. Codes and Standards Enhancement (CASE) Initiative for PY2013: Title 20 Standards Development. Analysis of Standards Proposal for Commercial Clothes Dryers. Prepared for Pacific Gas & Electric Company (PG&E), Southern California Edison (SCE), San Diego Gas & Electric (SDG&E), and Southern California Gas Company (SCG). July.

REVISION HISTORY

Measure Characterization Revision History

Revision Number	Revision Complete Date	Primary Author, Title, Organization	Revision Summary and Rationale for Revision
01	6/15/2019	Rebecca Jenkins, Engineer, SoCalGas	Draft of consolidated text for this statewide measure is based upon: WPSCGNRAP170103, Revision 0 (March 21, 2017) Consensus reached among Cal TF members.