

# **DEER Database: 2011 Update Documentation**

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# ES

## Executive Summary

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This report provides the documentation for the recommended parameter updates to the DEER (Database for Energy Efficiency Resources) to reflect the results of the Energy Division's 2006-08 impact evaluations and recent data on market conditions. Details on the methods used to decide which measures should be updated and the criteria used to determine if the new data were sufficiently robust to replace existing estimates are provided in the body of the report. This summary focuses on the significant changes proposed for use in estimating the ex ante gross and net energy and peak savings associated with the installation of energy efficiency measures for the 2013-2014 bridge portfolio.

### ES.1 Gross Load Impact Updates

The DEER team focused on assessing the adequacy of the data collected in the 2006-08 impact evaluations for the 2006-08 energy efficiency portfolios. The DEER team analysis revealed that sufficient data was only available to support load impact updates, given the Commission's direction and criteria for the bridge update, to three of the ten technology market segments analyzed: residential lighting, non-residential lighting and hot water heating systems.<sup>1</sup> The DEER team analysis supports changes in daily hours of use for residential CFL's, changes in the baseline energy use estimates and remaining useful life estimates for linear fluorescent lighting systems and slight changes to the input values used to estimate savings for low flow showerheads and faucet aerators that reduce the energy usage of residential hot water heating systems.

#### ES.1.1 Residential Lighting Impacts

The proposed changes for residential lighting systems and their estimated effect on energy saving estimates relative to current DEER values are summarized in Table ES-1. The reduced hours of usage leads to reduced (-) unit energy savings (UES) estimates for interior lighting and increased (+) unit energy savings estimates for the exterior CFLs.

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<sup>1</sup> Preliminary estimates of updated hours of use and delta watts ratios were developed for small commercial building types (See Appendix A-2.1) but were judged not to require more extensive analysis than was possible, given available time for this bridge update, in order to be used to update the current DEER values.

**Table ES-1: Proposed Changes in Hours of Use for Residential Lighting and Impact on Unit Savings UES Estimate**

Measure	Updated (2011) Daily Hours of Use	2008 DEER Daily Hours of Use	% change in Unit Energy Savings UES
Interior CFL's	2.18	1.48	-32%
Exterior CFL's	3.42	3.10	+10%

Table ES-2 compares the delta watts reduction ratio (WRR) estimated in the 2008 DEER to the WRR estimated in the 2011 update. The WRR is used to estimate the change in wattage between the CFL installed and the incandescent bulbs replaced. This estimate is combined with average daily hours of usage to estimate the unit energy savings associated with the installation of CFLs. An increase in the WRR will lead to an increase in savings estimates for interior reflector and exterior CFL bulbs and the small decrease in WRR for all other interior bulbs will lead to a corresponding decrease in unit energy savings estimates for the majority of basic spiral bulbs in interior applications.

The updated 2011WRR for three separate types of bulbs were calculated based on a significant increase in available wattage data contained in the 2006-08 impact evaluation data sets for reflectors, interior and exterior CFL bulb. These data are expected to lead to more accurate estimates of savings relative to the single WRR ratio used for all applications in 2008. Details of the methods used to update these estimates are provided in Section 3.

**Table ES-2: Wattage Reduction Ratio Recommendations (WRR) for Short Term Update**

Location	Lamp Shape	2011 DEER WRR	2008 DEER WRR
INTERIOR	REFLECTOR	4.09	3.53
INTERIOR	ALL OTHER	3.47	3.53
EXTERIOR	All	4.07	3.53

### **ES.1.2 Non-Residential Lighting Impacts**

As a result of changes in federal appliance standards in 2005 and 2009, the DEER team believes that older (or standard or pre-EPACT) magnetic ballasts cannot reasonably be used as a basis for determining baseline fixture wattage. For this reason, baseline wattages of fixtures in the DEER lighting fixture tables that include pre-EPACT magnetic ballasts have been revised to assume ES

magnetic ballasts. The impact of this change is to reduce the assumed baseline wattage used in the DEER models to estimate energy savings for a range of linear fluorescent systems by 10 % to 12%. In addition the federal lighting standard, EPACT, will prohibit of the shipment of most 4 and 8 foot T12 lamps as of July 14, 2012. This means that, at the end of a T12 lamp’s useful life, it will have to be replaced with a T8 lamp. The DEER team has therefore revised the remaining useful life (RUL) to be based on lamp life rather than ballast life for measures with baseline fixtures that include T12 lamps. This will lead to significant reductions in the RUL for some lamp systems ranging from 40% to 90% depending on the building type. Estimates on how these changes will affect electricity savings for a range of fixture types can be found in Section 4.

**ES.1.3 Residential Water Heating System Impacts**

Table ES-3 and Table ES-4 summarize the recommended changes in unit electricity and natural gas saving impacts for faucet aerators and low flow showerheads. The final column shows the percentage change in UES values resulting from the 2011 update. In most cases the result of the updated unit energy savings inputs are small, within plus or minus five percent of the existing DEER estimate.<sup>2</sup>

**Table ES-3: Recommended Statewide Average Electric Unit Energy Impacts for Faucet Aerators and Low-Flow Showerheads**

Measure Name	Bldg. Type	2005 DEER UEC*	2009 UEC	ESF*	2005 DEER Elec Impact (kWh/Unit)	Proposed Elec Impact (kWh/Unit)	2005 DEER Peak Impact (Watts/Unit)	Proposed Peak Impact (Watts/Unit)	% Change Energy Impact
Faucet Aerators	SF	2,384	3,112	3%	91.2	93.4	20	21	+2%
Faucet Aerators	MF	1,914	1,610	3%	47.6	48.3	10	11	+1%
Low Flow Showerhead	SF	2,384	3,112	4%	121.6	124.5	27	27	+2%

\*UEC – Unit Energy Consumption, ESF – Energy Savings Fraction

<sup>2</sup> The one exception is the 40% decrease in savings estimates associated with low flow showerheads for multifamily dwellings. The DEER team believes the baseline savings estimate for this application should have been 3.1 therms per day (102 therms (base UEC) \*.03) not 9.6 therms/day as is listed in the current database. Thus the increase in baseline UEC for this application is more likely to lead to an increase in natural gas savings since the estimated energy savings fraction did not change. Details are provided in Section 5.

**Table ES-4: Recommended Statewide Average Natural Gas Unit Energy Impacts for Faucet Aerators and Low-Flow Showerheads**

Measure Name	Bldg. Type	2005 DEER UEC	2009 UEC	ESF	2005 DEER Gas Impact (Therms/Unit)	Proposed Gas Impact (Therms/Unit)	% Diff.
Faucet Aerators	SF	110	189	3%	6.0	5.7	-4%
Faucet Aerators	MF	102	179	3%	9.0	5.4	-40%
Low Flow Showerhead	SF	110	189	3%	8.0	7.6	-5%

The DEER team is recommending the use of statewide savings values for both measures because the estimated direct energy savings<sup>3</sup> estimates at the utility level were not significantly different. Most of these changes in savings estimates are driven by changes in the estimated unit energy consumption of gas and electric water heating systems resulting from the 2009 Residential Appliance Saturation study. Details on the differences in unit energy consumption estimates are provided in Section 5.

## ES.2 Net to Gross Ratio Update

The DEER team proposes updates to net to gross ratios (NTGR) for a variety of energy efficiency measures and program delivery method combinations based on its review of the 2006-08 impact evaluation studies. For each measure, the DEER team compared the strengths and weaknesses of the latest evaluation method used to derive NTGR results and contrasted this to the relative strength of the method used to estimate NTGR for the 2008 DEER update. This includes an analysis of the relative merits of the methods and sampling plans used to derive NTGR estimates for the existing DEER data base and the evaluation methods used to produce new NTG results in 2006-08 evaluation studies.

The tables that follow summarize the recommended NTGR by energy efficiency measure (EEM), program delivery method and market segment. Following each table, the most significant changes in NTGR for specific technologies are identified.

Table ES-5 summarizes the recommended NTGR updates for the residential and non-residential lighting programs.

<sup>3</sup> These estimates do not include the potential indirect savings from the embedded energy used to deliver water to residential dwellings.

**Table ES-5: Recommended Changes in Net to Gross Ratios (NTGR) for Residential and Non-Residential Lighting Technologies by Program Delivery Method (Statewide Values)**

EEM	Sector	Program Delivery Method	NTGR 2008 Version-2.05	NTGR Derived from 2006-08 Studies	NTGR Recommended for 2011 Update
CFLs	Non-Res	Prescriptive Downstream or Customized rebate	0.81	0.53	0.53 kWh <sup>4</sup> 0.57 kW
CFLs	Non-Res	Direct Install	0.85	0.80	0.80
Linear Fluorescents	Non-Res	Prescriptive Downstream or Custom rebate	0.78	0.70	0.70
Linear Fluorescents	Non-Res	Direct Install	0.85	0.89	0.89
Lighting Controls	Non-Res	Prescriptive Rebate Downstream	0.84	0.60	0.60 kWh 0.59 kW
Lighting Controls	Non-Res	Direct Install	0.85	0.89	0.89 kWh 0.74 kW
Basic CFL	Res	Prescriptive Rebate Upstream	0.60	0.54	0.54

The most significant proposed NTGR changes include the revised NTGR for residential and non-residential CFLs. The documentation for these changes can be found in sections 6 and 7.

Table ES-6 provides the recommended NTGR changes for HVAC systems and related building envelope measures for the residential and non-residential sectors.

<sup>4</sup> Separate NTGR estimates are recommended for energy (kwh) and peak (kW) savings estimates due to different weighting of customer building with different coincident demand factors

**Table ES-6: Recommended Changes in NTGR for Residential and Non-Residential HVAC Systems by Program Delivery Method**

EEM	Sector	Program Delivery Method	NTGR 2008 Version-2.05	NTGR Derived from 2006-08 Studies <sup>5</sup>	NTGR Recommended for 2011 Update
HVAC Maintenance: Refrigerant Charge Adjustment	Non-Res	Prescriptive Rebate	0.70	PGE2068 0.54 (e) PGE2080 0.55 (e) SCE 0.94 (e) SDGE 0.70 (e)	0.53 kWh <sup>6</sup> 0.57 kW
Retrocommissioning Packages	Non-Res	Customized Incentives, Downstream rebate	0.90 (e), 1.0 (ng)	PGE 0.80 (e) 0.86 (ng) SCE 0.86 (e) 0.91 (ng) SCG 0.92 (ng) SDGE 0.75 (e) 0.68 (ng)	0.80
Chiller Replacement	Comm. only	Downstream Customized Incentives	0.64	SCE 0.59 (e) SDGE3010 0.70 (e) SDGE3025 0.56 (e)	0.70
Package and Split System AC and HP Replacement	Non-Res	Prescriptive Rebate Upstream	0.85	PGE 0.94 (e) SCE 0.96 (e) SDGE 0.94 (e)	0.89
Room Air Conditioner	Res	Prescriptive Downstream rebate	0.70	PGE2000 0.41 (e) SCE2501 0.36 (e) SDGE3024 0.31 (e)	0.36
HVAC Maintenance: Duct Sealing	Res	Prescriptive Rebate	0.78	PGE2000 0.54 (e) PGE2078 0.85 (e) SCE2501 0.79 (e) SCE2507 0.96 (e) SDGE3035 0.80 (e)	0.78
HVAC Maintenance: Refrigerant Charge Adjustment	Res	Prescriptive Rebate Midstream	0.78	PGE2000 0.63 (e) PGE2078 0.78 (e) SCE2501 0.78 (e) SCE2507 0.97 (e) SDGE3035 0.78 (e)	0.78
Roof and Wall Insulation	Res	Prescriptive Rebate Downstream	0.70	PGE 0.25 (e) 0.26 (ng) SCG 0.30 (e) 0.29 (ng) SDGE 0.25 (e) 0.25 (ng)	0.28
Air Cooled Packaged and Split System Air Conditioners and Heat Pumps	Res	Downstream rebates	0.67, Central AC >14 SEER; 0.80, Central AC >15 SEER; 0.55, Heat Pump-Energy Star	SCE2507 0.56 (e) SDGE3029 0.53 (e)	0.55

(e) = NTGR for electricity savings, (ng) = NTGR estimates for natural gas savings.

The most significant changes in recommended NTGR for the HVAC market segments are for residential room air conditioners, roof and wall insulation, and air cooled and packaged split system air conditioners and heat pumps. These suggested NTGR changes will reduce estimated net savings by 48% for room air conditioners, 60% for roof and wall insulation, and 18% for residential central air conditioners.

<sup>5</sup> NTGR Values are reported here for kWh and therms by each utility by program number.

<sup>6</sup> See footnote 4, Ibid.

Table ES-7, summarizes the remaining recommended NTGR changes for Energy Efficiency Measures (EEM) delivered using custom rebates in the large commercial and industrial sector, and for the Commercial Refrigeration market segment. The most significant upward revisions to the recommended NTGR are for pipe insulation, steam traps for small commercial applications, and custom electric measures. The most significant downward adjustments to NTGR are for custom gas measures.

**Table ES-7: Recommended Changes in Net to Gross Ratio (NTGR) for the Remaining Commercial and Industrial Measures**

EEM	Sector	Program Delivery Methods	NTGR 2008 Version-2.05	NTGR Derived from 2006-08 Studies	NTGR Recommended for 2011 Update
<b>Commercial and Industrial Custom</b>					
Pump-Off Controllers	Industrial	Calculated and Customized Incentives Downstream	0.54	PGE Major 0.45 PGE/SCE Major 0.42 PGE/SCE Independent 0.74	0.45
Pipe Insulation	Industrial	Calculated and Customized Incentives Downstream	0.54	SCG 0.72 PGE 0.49	0.71
Steam Traps	Small Comm.	Prescriptive Rebates	0.54	PGE 0.62 SCG 0.70 SDGE 0.72	0.68
Steam Traps, High Pressure	Industrial	Calculated and Customized Incentives	0.54	0.52	0.52
Steam Traps, Low Pressure	Industrial	Calculated and Customized Incentives	0.54	0.59	0.59
Custom Electric	Comm. / Industrial	Calculated and Customized Incentives Downstream	0.54	PGE 0.60 SCE Intgrtd. 0.63 SCE Std Prfrm 0.59 PGE Hi Tech 0.47 PGE Lg Com 0.60	0.60
Custom Electric-RFP or Bid	Comm. / Industrial	Customized Incentives	0.54	SDGE3010 0.70	0.70
Custom Gas	Comm. / Industrial	Calculated and Customized Incentives Downstream	0.64	PG&E 0.31 SCG 0.54	0.35
Agricultural Greenhouse Envelope – Heat curtains	Agri	Prescriptive Rebate Downstream, Calculated and Customized Incentives	0.50	0.63	0.63
Pump Tests	Agri	Service Provided to Customer at no cost	0.64	0.63	0.63
Agricultural Greenhouse Envelope – Infrared Film	Agri	Prescriptive Rebate Downstream, Calculated and Customized Incentives	0.50	0.46	0.46
All Other Agricultural Measures – Electric	Agri	Calculated and Customized Incentives Downstream	0.79	0.70	0.70
All Other Agricultural Measures - Natural Gas	Agri	Calculated and Customized Incentives Downstream	0.72	0.69	0.70
<b>Commercial Refrigeration</b>					
Door Gaskets	Non-Res	All delivery methods	0.46	0.19	0.19
Strip Curtains	NRES	Downstream Prescriptive Rebates	0.76	0.40	0.40



Table ES-8 summarizes Residential Water heating systems and Residential appliances. The most significant downward revisions to the NTGR are for faucet aerators and residential gas storage water heaters. These changes will lead to estimated reductions in net unit energy savings of roughly 25% for faucet aerators and 60% for residential gas storage water heaters.

**Table ES-8: Recommended Changes in Net to Gross Ratio (NTGR) for Hot Water Heating Systems and Residential Appliances**

EEM	Sector	Program Delivery Methods	NTGR 2008 Version-2.05	NTGR Derived from 2006-08 Studies	NTGR Recommended for 2011 Update
<b>Residential and Non-Residential Hot Water Heating Systems</b>					
Faucet Aerators	Res	Direct Install	0.85	0.59 Single Family 0.65 Multi family	0.59 0.65
Low Flow Showerheads	Res	Direct Install	0.85	SCG(MF) 0.72 SDGE(MF) 0.68 SDG&E(SF) 0.70	0.70
Residential Gas Storage Water Heater EF>0.62 <0.65 Cap>30 gallons	Res	Prescriptive Downstream Rebate	0.58	SDGE 0.23 PGE 0.18	0.23
<b>Residential Appliances</b>					
Clothes Washers MEF 10% > than Energy Star	Res	Prescriptive Downstream Rebate	0.81	PGE2000 0.31 SDGE3023 0.31 SCG3517 0.29	0.31
Refrigerator Recycling	Res	Prescriptive Rebate: Downstream or Midstream	0.614	PGE2000 0.51 SCE2500 0.56 SDGE3028 0.58	0.53
Freezer Recycling	Res	Prescriptive Rebate: Downstream or Midstream	0.702	Not Evaluated	0.70

Table ES-9 contain recommended revisions to default NTGR by target market sector.

**Table ES-9: Recommended Changes in Default Net to Gross Ratio (NTGR)**

EEM	Sector	Program Delivery Methods	2008 DEER v2.05	2006 – 2008 Evaluation Studies	Recommended 2011 DEER Updates
<b>Default NTGR<sup>7</sup></b>					
No Evaluated NTGR, 2 years of less	All	Direct Install for Hard to Reach markets only	0.85	See Section 15 for derivation of NTGR values	0.85
No Evaluated NTGR, 2 years or less	Res, Comm., Industrial	All	0.70	See Section 15 for derivation of NTGR values	0.70
No Evaluated NTGR, greater than 2 years	Industrial, Comm, Agri	All	0.54	See Section 15 for derivation of NTGR values	0.60
No Evaluated NTGR, greater than 2 years	Res,	All	n/a	See Section 15 for derivation of NTGR values	0.55

<sup>7</sup> Refer to Section 15 for the reasoning and criteria used to develop the default NTGR values.

The final set of recommended changes, entitled Default NTGR, represent the DEER team recommendations for use in estimating net savings for those measures in utility portfolios that do not have an evaluated NTGR contained in the DEER database. These proposed values were informed by a review of the average NTGR found by sector in the 2006-08 energy efficiency program evaluations shown in Table ES-10 below.

**Table ES-10: Weighted Average NTGR Across All Evaluated Programs in 2006-08**

<b>NTGR Aggregation Level</b>	<b>Savings Weighted NTGR</b>
Statewide across all programs	0.58
Residential Sector Programs	0.56
Commercial Sector Programs	0.61
Industrial Programs	0.59
Agricultural Programs	0.61

Details of how the NTGR values were derived for four separate broad categories of energy efficiency measure as a function of number of years in the market and market sector are presented in Section 15.

# 1

## Introduction - DEER 2011 Update Analysis

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### 1.1 Introduction

This report presents recommended updates to a portion of the estimated load impacts and net-to-gross of energy efficiency measures currently found within the DEER data base and for some new measures likely to be promoted in the investor-owned utilities' energy efficiency programs starting in the bridge funding year of 2013. These updated values are intended for use as ex ante values, as directed by the October 25<sup>th</sup>, ACR in Rulemaking R09-11-014,<sup>1</sup> for estimating likely program savings and the cost effectiveness of measures and programs for the 2013-2014 bridge-portfolio.

The process used to develop these updates included the following steps:

1. Develop an analytical process to prioritize and to select which measure parameters both should and could be included in this cycle. This process includes a review of the existing uncertainties in the DEER estimates, ranking of the measures based on the forecast of their relative share of 2010-2012 overall energy savings at the statewide level, a consideration of the availability of new information from the 2006-2008 CPUC impact evaluation studies, and a consideration of technical, regulatory or other factors related to the feasibility and requirements of including particular updates in the DEER update for the 2013-2014 bridge period.
2. Select the measures for the development of analysis plans based on a review of available data from the 2006-08 evaluation studies and more recent market shipments data. This includes an assessment of whether the samples and data used to develop new parameter estimates were sufficiently large and representative of the population to support replacing the current parameter values.
3. Execute the analysis plans to derive proposed updates for inputs and output for each measure parameter.

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<sup>1</sup> *Assigned Commissioner's Ruling and Scoping Memo Regarding 2013-2014 Bridge Portfolio and Post-Bridge Planning, Phase IV.* October 25, 2011

4. Compare the resulting changes in DEER measure outputs, such as unit energy savings, with the outputs in the existing data base, to enhance quality control and identify and summarize the effect of the proposed changes on net and gross savings estimates
5. Prepare the final documentation for the analysis and insert the new values into the updated DEER data base. All of the DEER files can be viewed at the following link <ftp://deeresources.com/pub/SPTdb/Latest-SPTdb-Viewer.zip>. This provides access to the Frozen Ex Ante Database Viewer.

In addition, the DEER team has fixed some software bugs and made changes to building prototype characteristics and lighting impact estimates in DEER version 3.02. These changes are summarized in Appendix A-1.

The analytical process used to select the measure specific parameters to be updated in 2011 is detailed in Chapter 2 of this document. Below we provide an overview of the technology groups that were formed to execute the analysis steps described above.

The DEER Update analysis was performed by ten separate technology analysis teams. Each technology area was defined to cover a specific market segment, group of end users, and energy efficiency measures currently promoted by energy efficiency programs within the technology/market segment. Analysts were selected to serve on each technology group based on their prior experience and expertise in estimating baseline energy use, impact parameters, and net-to-gross values for measures in that area. An overview of these technology group market segments and common measures installed in them is provided in Table 1-1.

**Table 1-1: Organization Structure of DEER Analysis Teams**

Technology Group	Common Efficiency Measures
1. Nonresidential Lighting	CFL's, Linear Fluorescent Lamps and Ballast, High intensity discharge (HID) fixtures
2. Commercial HVAC	Water-Cooled Chillers, Quality Maintenance (refrigerant charge adjustment, coil cleaningretrocommisioning packages), "Frictionless" Chillers
3. Residential & Nonresidential Hot Water Systems	Multifamily boilers, heaters, gas instantaneous water heaters, pool heaters
4. Commercial Information Technology & Plug Loads	Computer Power Management programs, smart strips, CPU sleep programs
5. Commercial Refrigeration	Fan Motors, Efficient Lighting in Refrigeration cases, gaskets and covers
6. Industrial & Agriculture-All End Uses	Steam Traps, Greenhouse, process boilers and many custom measures
7. Residential Lighting	CFLs, LEDs, Linear fluorescent fixtures
8. Residential HVAC	Gas Furnaces, Room and Central Air Conditioners, duct sealing and refrigerant charge
9. Residential Appliances & Plug Loads	Clothes Washer, Refrigerator Freezer, Television, smart power strips, etc.
10. Commercial Foodservice	Gas Fryer, Gas Oven, Gas Convection Oven, Electric Oven, Electric Steam Cooker

These ten technology groups reviewed the ranked list of energy efficiency measures within their sector and assessing the quality and availability of data from the 2006-08 evaluation studies for use in the update. Based on this review, the DEER team concluded that there was not sufficient evaluation or market data available to provide any updates for energy efficiency measure in the Computer Information and Plug Loads and Commercial Food Service market segments as part of the 2011 update.

After reviewing the available evaluation data, the DEER team recommended that the 2011 update focus on revising the load impact estimates (unit energy saving and unit peak savings) for residential and non residential lighting and residential hot water systems. The team recommended that the residential and non residential lighting analysis concentrate on using the available evaluation data for estimated hours of operation by building type, usage area or type, and differences in more efficient wattage and the baseline wattage (delta watts) for selected

lighting technologies. In addition, the DEER team decided that there was sufficient data available to provide updated estimates of net to gross ratio (NTGR) estimates for eight of the ten technology groups. The technology parameter areas selected for update in 2011 are listed in Table 1-2 below.

**Table 1-2: Technology Areas Selected for Update in 2011**

Load Impact Updates in 2011	NTGR Updates in 2011
Non Residential Lighting	Non Residential Lighting
Residential Lighting	Residential Lighting
Residential Water Heating Systems	Large Industrial and Commercial Custom Measures
	Commercial HVAC
	Commercial Refrigeration
	Residential HVAC
	Residential and Non Residential Water Heating
	Residential Appliances
	Defaults

The remainder of this report is organized as follows:

Chapter 2 – Ranked List of Energy Efficiency Measures by Technology Group

Chapter 3 – Non Residential Lighting Impact Update

Chapter 4 – Residential Lighting Impact Update

Chapter 5 – Residential Hot Water Heating Impact Update

Chapter 6– Non Residential Lighting NTGR Update

Chapter 7– Residential Lighting NTGR Update

Chapter 8 – Large Industrial and Commercial Measures NTGR Update

Chapter 9 – Commercial HVAC systems and Building envelope NTGR Update

Chapter 10 – Commercial Refrigeration NTGR Update

Chapter 11 – Residential HVAC NTGR Update

Chapter 12 – Residential and Non Residential Hot Water System NTGR Update

Chapter 13 – Residential Appliances NTGR Update

Chapter 14 – Overall Summary NTGR Tables

Chapter 15 – Recommended Default NTGR Update

# 2

## Ranked List of Energy Efficiency Measures by Technology Group

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The DEER team placed a higher priority on updating parameter estimates in technology areas which contain a higher relative share of the expected total savings for future programs. Table 2-1 shows the estimated electricity savings share for each technology group as estimated by the DEER team in mid 2010 compares to the more current share of portfolio savings based on the most recent utility tracking data from the second quarter of 2011. The share estimates in the middle column were based on forecasts of likely savings at the measure level based on projected savings from 2010-2012 portfolio at the statewide level that were performed in mid 2010. The share estimates in the final column come from the latest quarter of utility program tracking data.



**Table 2-1: Comparisons of the Technology Group Share of Electricity Savings Over Time**

<b>Technology Group</b>	<b>Share of 2010-2012 Portfolio Electric Savings (2010 Estimate)</b>	<b>Share of Portfolio Electricity Savings Based on Q2 2011 Tracking Data</b>
Non Res Lighting	17.8%	28.2%
Commercial HVAC & Bldg Envelope	13.5%	6.3%
Res and Non Res Water Heating	1.1%	0.3%
Commercial Plug Loads	1.3%	0.5%
Commercial Refrigeration	8.4%	5.9%
Large Commercial and Industrial	23.2%	9.3%
Residential Lighting	12.5%	30.1%
Residential HVAC & Bldg Envelope	0.5%	0.5%
Residential Appliances	15.1%	6.5%
Commercial Food Service	1.0%	0.2%
Whole House or Bldg/ Other Codes (Title 20/24)	5.5%	11.6%
<b>Totals *</b>	<b>98.90%</b>	<b>99.4%</b>

\* Totals don't equal 100% due to impact of undefined and miscellaneous measures

These technology group share estimates confirm that a focus on updating lighting parameter estimates will continue to be important given they represent between 30 and 50% of the expected energy savings in these two forecasts of future savings. Comparison of the last two columns in the table highlights a shift in more recent program activity towards a greater share of electricity savings being reported for measures in the residential and non residential lighting technology group and lower shares of electricity savings for Commercial HVAC, Large Commercial and Industrial End Uses, and Residential Appliances.

The Energy Efficiency Measure (EEM) Categories under consideration for this update in 2011 for each technology group are summarized in Table 2-2 through Table 2-10. The Technology Groups undertook the EEM prioritization analysis in late 2010 to identify which measure categories and associated parameters should be updated by the fall of 2011 or deferred to subsequent long term DEER updates. The tables indicate whether each measure group is within one of the existing DEER datasets, either 2005 v2.01 or 2008 v2.05, or whether the measure is new for the Non-Residential Lighting area. The prioritization was based upon rough estimates of the expected savings in the 2010-2012 utility portfolios, the relative need to improve the existing DEER parameters, and the available data to execute the updates, i.e., the 2006 - 2008 EM&V studies and other pertinent secondary sources. The EEM Measure categories listed in these tables appear in ranked order as determined by the DEER team members.

The rankings were derived after consideration of both the available EM&V data to affect an update, and the feasibility of completing the analysis within the study’s allocated timeframe and budget. EEMs ranked “A” are the highest priority updates, “B” are medium priority, and “C” are considered the lowest priority updates. The DEER Team Update only includes updates for measures in the “A” categories because they represent the highest priority. Measures placed in Category “B” or “C” will be included in the next formal DEER update. Comments were provided by program administrators during the process on these lists and measures that should be included in the next update.

**Table 2-2: Ranked Non-Residential Lighting EEM Categories**

	Energy Efficiency Measure Category	Rank	DEER
1	CFL, integral	A	2008 v2.05
2	Linear Fluorescent, de-lamping	A	2005 v2.01
3	Linear Fluorescent, lamp + ballast	A	2008 v2.05
4	Linear Fluorescent, fixture	A	2008 v2.05
5	HID, Mercury Vapor/HPS/LPS	B	2008 v2.05
6	HID, T5 HO	B	2008 v2.05
7	HID, Metal Halide	B	2008 v2.05
8	HID, LED	B	New
9	CFL, fixture	C	New
10	Side Daylighting Controls	C	2005 v2.01
11	Top Daylighting Controls	C	2005 v2.01
12	Exit, LED	C	2008 v2.05
13	Incandescent Lamp	C	N/A

**Table 2-3: Ranked Commercial HVAC and Building Envelope EEM Categories**

	Energy Efficiency Measure Category	Rank	DEER
1	HVAC Quality Maintenance: Refrigerant Charge Adjustment	A	2008 v2.05
2	HVAC Quality Maintenance: Airflow Adjustment	A	New
3	HVAC Quality Maintenance: Condenser Coil Cleaning	A	2005 v2.01
4	HVAC Quality Maintenance: Evaporator Coil Cleaning	A	New
5	HVAC Quality Maintenance: RCx Packages	A	New
6	Package Terminal Air Conditioner	A	2005 v2.01
7	Water-Cooled Centrifugal Chiller	A	2008 v2.05
8	Water-Cooled Screw Chiller	A	2008 v2.05
9	Water-Cooled Scroll Chiller	A	New

	<b>Energy Efficiency Measure Category</b>	<b>Rank</b>	<b>DEER</b>
10	Water-Cooled Reciprocating Chiller	A	2008 v2.05
11	Water-Cooled Centrifugal Chiller with Variable Speed Drive	A	2008 v2.05
12	Water-Cooled Screw Chiller with Variable Speed Drive	A	New
13	Water-Cooled “Frictionless” Chiller	A	New
14	Water-Cooled “Frictionless” Chiller with Variable Speed Drive	A	New
15	Air-Cooled Screw Chiller	A	2008 v2.05
16	Air-Cooled Scroll Chiller	A	New
17	Air-Cooled Reciprocating Chiller	A	2008 v2.05
18	Air-Cooled Screw Chiller with Variable Speed Drive	A	New
19	Air-Cooled “Frictionless” Chiller	A	New
20	Air-Cooled “Frictionless” Chiller with Variable Speed Drive	A	New
21	Central Cooling Plant Reset Controls	A	2005 v2.01
22	Central Heating Plant Reset Controls	A	2005 v2.01
23	Air-Cooled Package Heat Pump	B	2005 v2.01
24	Water Source Heat Pump	B	2005 v2.01
25	Air-Cooled Split System Air Conditioner	B	2008 v2.05
26	Air Cooled Split System Heat Pump	B	2005 v2.01
27	Water-Cooled Package Air Conditioner	B	New
28	Water-Cooled “Frictionless” Compressor	B	New
29	Air-Cooled “Frictionless” Compressor	B	New
30	HVAC Quality Maintenance: Duct Sealing	B	2008 v2.05
31	Chilled Water Variable Frequency Drive Pump	B	2005 v2.01
32	Hot Water Variable Frequency Drive Pump	B	2005 v2.01
33	Water Loop Heat Pump Variable Frequency Drive Pump	B	New
34	Water Loop Heat Pump Variable Flow Loop	B	2005 v2.01
35	Variable Air Volume Distribution	B	2005 v2.01
36	Air-Cooled Package Air Conditioner	B	2008 v2.05
37	Steam Traps in HVAC Applications	B	New
38	Furnace	B	2008 v2.05
39	Package Terminal Heat Pump	B	2005 v2.01
40	Hot Water Boiler	B	2005 v2.01
41	Steam Boiler	B	2005 v2.01
42	Central Cooling Plant Water-side Economizer/Pre-cooler	B	2005 v2.01
43	Room Air Conditioner	C	New
44	Hot/Dry Climate Air-Cooled Package Air Conditioner	C	New
45	Hot/Dry Climate Air-Cooled Split System Air Conditioner	C	New

	<b>Energy Efficiency Measure Category</b>	<b>Rank</b>	<b>DEER</b>
46	Room Heat Pump	C	New
47	Chilled Water Circulation Pump Motor	C	2005 v2.01
48	Hot Water Circulation Pump Motor	C	2005 v2.01
49	Air Distribution Variable Frequency Drive Fan	C	2005 v2.01
50	Air-side Heat Recovery	C	2005 v2.01
51	Evaporative-Cooled Package Air Conditioner	C	2005 v2.01
52	Evaporative-Cooled Split System Air Conditioner	C	New
53	Chilled Water Circulation Pipe Insulation	C	New
54	Hot Water Circulation Pipe Insulation	C	New
55	Steam Circulation Pipe Insulation	C	New
56	Condenser Water Circulation Pump Motor	C	2005 v2.01
57	Water Loop Heat Pump Circulation Pump Motor	C	2005 v2.01
58	Air Distribution Fan Motor	C	2005 v2.01
59	Central Cooling Plant Cooling Tower Variable Frequency Drive Fan	C	2005 v2.01
60	Central Cooling Plant Cooling Tower Fan Motor	C	2005 v2.01
61	Evaporative Coolers	C	2005 v2.01

**Table 2-4: Residential and Commercial Hot Water Heating EEM Categories Parameter Updates**

Energy Efficiency Measure Category		Rank	DEER
1	Residential Aerator	A	2005 v2.01
2	Residential Showerheads	A	2005 v2.01
3	Residential Pool Heaters	A	New
4	Commercial Gas Instantaneous Water Heater	A	2005 v2.01
5	Commercial Electric Instantaneous Water Heater	A	2005 v2.01
6	Residential Multifamily Boiler controller	A	New
7	Residential Gas Storage Water Heater	B	2008 v2.05
8	Residential Electric Storage Water Heater	B	2008 v2.05
9	Residential Gas Instantaneous Water Heater	B	2008 v2.05
10	Residential Electric Instantaneous Water Heater	B	2008 v2.05
11	Residential Pipe Insulation w/Gas Water Heat	B	2005 v2.01
12	Residential Pipe Insulation w/Electric Water Heat	B	2005 v2.01
13	Commercial Gas Storage Water Heater	B	2008 v2.05
14	Commercial Electric Storage Water Heater	B	2008 v2.05
15	Commercial Gas Water Heating Boiler	B	2005 v2.01
16	Commercial Electric Water Heating Boiler	B	New
17	Residential Gas Water Heating Boiler	B	New
18	Residential Electric Water Heating Boiler	B	New
19	Automatic Closing Thermostatic Shower Valve	B	New
20	Commercial Pipe Insulation w/Gas Water Heat	C	New
21	Commercial Pipe Insulation w/Electric Water Heat	C	New
22	Residential Tank Insulation w/Gas Water Heat	C	2005 v2.01 <sup>2</sup>
23	Residential Tank Insulation w/Electric Water Heat	C	2005 v2.01
24	Commercial Tank Insulation w/Gas Water Heat	C	2005 v2.01
25	Commercial Tank Insulation w/Electric Water Heat	C	2005 v2.01

<sup>2</sup> The 2005 DEER deleted these measures due to code requirements and saturation of old tank replacements. 2004-2005 DEER Update, Final Report, pages 2-20 and 3-20.

**Table 2-5: Ranked Commercial Information Technology Equipment and Plug Loads EEM Categories<sup>3</sup>**

	Energy Efficiency Measure Category	Rank	DEER
1	Computer Power Management Network Software	B	New
2	Computer CPU	B	New
3	Personal Computer Monitors/Displays	B	New
4	Televisions	B	New
5	Photocopiers	C	2005 v2.01
6	Multi Function Peripherals	C	New
7	Printers	C	New
8	Occupancy Sensor Controls	C	2005 v2.01
9	Efficient Vending Machine	C	New
10	Vending Machine Time Clock	C	2005 v2.01
11	Server Farms	C	New
12	Laptop Computer	C	New

**Table 2-6: Ranked Commercial Refrigeration EEM Categories**

	Energy Efficiency Measure Category	Rank	DEER
1	Vertical Reach-in Refrigerated Display Case Fan Motor	A	2005 v2.01
2	Horizontal Reach-in Refrigerated Display Case Fan Motor	A	2005 v2.01
3	Vertical Open Refrigerated Display Case Lighting	A	New
4	Horizontal Reach-in Refrigerated Display Case Lighting	A	New
5	Horizontal Open Refrigerated Display Case Lighting	A	New
6	Vertical Reach-in Refrigerated Display Case Lighting	A	New
7	Vertical Reach-in Refrigerated Display Case	B	2005 v2.01
8	Horizontal Reach-in Refrigerated Display Case	B	New
9	Vertical Reach-in Refrigerated Display Case Door Gasket	B	New
10	Horizontal Reach-in Refrigerated Display Case Door Gasket	B	New
11	Walk-in Cooler Door Gasket	B	New
12	Walk-in Freezer Door Gasket	B	New
13	Vertical Open Refrigerated Display Case Night Cover	B	2005 v2.01
14	Vertical Open Refrigerated Display Case Fan Motor	B	2005 v2.01
15	Horizontal Open Refrigerated Display Case Fan Motor	B	2005 v2.01
16	Strip Curtains	B	New
17	Walk-in Cooler Door Closer	C	2005 v2.01

<sup>3</sup> There are no A categories for this measure because the energy savings for this category was less than 1% of total electricity savings and there were no evaluations of these technologies in 2006-08.

	<b>Energy Efficiency Measure Category</b>	<b>Rank</b>	<b>DEER</b>
18	Walk-in Freezer Door Closer	C	2005 v2.01
19	Occupancy Sensor Controls for Refrigerated Display Case Lighting	C	New
20	Anti-Sweat Heater Controller	C	New

**Table 2-7: Ranked Industrial and Agricultural EEM Categories**

	<b>Energy Efficiency Measure Category</b>	<b>Rank</b>	<b>DEER</b>
1	Steam Traps	A	New
2	Greenhouse Envelope	A	2005 v2.01
3	Premium Efficiency Motors	A	2005 v2.01
4	Storage Tank Insulation	A	New
5	Micro Irrigation Systems	B	2005 v2.01
6	Pump Off Controllers	B	New
7	Process Boilers	B	New
8	Variable Frequency Drive (VFD) on System Pumps	B	2005 v2.01
9	Pipe Insulation	B	New
10	Air Compressor	C	New
11	Reverse Osmosis	C	New
12	Injection Molding	C	New
13	Waste Heat Recovery	C	New
14	Direct Digital Controls	C	New
15	Heat Recovery Devices	C	New
16	Condensing Economizers	C	New
17	Process Boiler Controls	C	New

**Table 2-8: Ranked Residential Lighting EEM Categories**

Energy Efficiency Measure Category		Rank	DEER
1	Indoor Lighting – LED Exit Sign	A	New (to Residential)
2	Indoor Lighting – CFL, Integral	A	2008 v2.05
3	Exterior Lighting – CFL, Integral	A	2008 v2.05
4	Indoor Lighting – CFL, Specialty <sup>4</sup>	A	2008 v2.05; some New
5	Exterior Lighting – CFL, Specialty	A	2008 v2.05; some New
6	Exterior Lighting – LED Seasonal Lights	B	New
7	Indoor Lighting – LED Task	B	New
8	Indoor Lighting – LED Ambient	B	New
9	Indoor Lighting – CFL, Fixture	B	2008 v2.05
10	Exterior Lighting – CFL, Fixture	B	2008 v2.05
11	Indoor Lighting – LED Night Light	C	New
12	Indoor Lighting -- Linear Fluorescent, Lamp + Ballast	C	New (to Res)
13	Indoor Lighting -- Linear Fluorescent, Fixture	C	New (to Res)
14	Indoor Lighting -- Linear Fluorescent, De-Lamping	C	New (to Res)

<sup>4</sup> “Specialty” includes CFLs **other than** those that are medium screw base twister-style CFLs between 9 and 30 Watts. This includes 3-Way, Dimmable, Reflector, Small Screw Base, Pin-based, Globe, Candelabra, and other non-standard CFL styles.



**Table 2-9: Ranked Residential HVAC and Building Envelope EEM Categories**

	Energy Efficiency Measure Category	Rank	DEER
1	Programmable Thermostats	A	2005 v2.01
2	Furnaces	A	2008 v2.05
3	Room Air Conditioners	A	New
4	Quality Maintenance: Duct Sealing	A	2008 v2.05
5	Quality Maintenance: Refrigerant Charge Adjustment	A	2008 v2.05
6	Quality Maintenance: Airflow Adjustment	A	New
7	Quality Maintenance: Condenser Coil Cleaning	A	New
8	Quality Maintenance: Evaporator Coil Cleaning	A	New
9	Quality Maintenance: RCx Packages	A	2008 v2.05
10	Roof Insulation	A	2005 v2.01
11	Wall Insulation	A	2005 v2.01
12	Integral Vertical Fenestration (Windows)	A	2005 v2.01
13	Building Envelope Air Leakage	A	2005 v2.01
14	Water Cooled Packaged Air Conditioners	A	New
15	Floor Insulation	A	2005 v2.01
16	Air Cooled Packaged Air Conditioners	A	New
17	Air Cooled Split System Air Conditioners	A	2008 v2.05
18	Evaporative Cooling Systems	B	2005 v2.01
19	Room Heat Pumps	B	New
20	Evaporatively Cooled Packaged Air Conditioners	B	New
21	Evaporatively Cooled Split System Air Conditioners	B	2008 v2.05
22	Whole House Fans	B	2005 v2.01
23	Water Source Heat Pumps	B	New
24	Air Cooled Packaged Heat Pumps	B	New
25	Split System Heat Pumps	B	2005 v2.01
26	Hot Water Boiler (space heating)	B	New
27	Central Heating Plant Reset Controls	B	New
28	Hot Water Circulation VFD Pump	B	New
29	Hot Water Circulation Pump Motor	B	New
30	Hot Water Heating Pipe Insulation	B	2005 v2.01
31	Low Solar Heat Gain Coefficient (SHGC) Coatings (window films)	B	2005 v2.01
32	Cool Roofs	C	New
33	Packaged Terminal Air Conditioner	C	New
34	Packaged Terminal Heat Pump	C	New

	Energy Efficiency Measure Category	Rank	DEER
35	Hot/Dry Climate Air Cooled Packaged Air Conditioner <sup>5</sup>	C	New
36	Hot/Dry Climate Air Cooled Split System Air Conditioner	C	New
37	Air-Side Heat Recovery	C	New
38	Room Air Conditioner Recycling (EEM moved to TG 9, Residential Appliances)	-	New
39	Room Heat Pump Recycling (EEM moved to TG 9, Residential Appliances)	-	New

**Table 2-10 Ranked Residential Appliance and Plug Load EEM Categories**

	Energy Efficiency Measure Category	Rank	DEER
1	Appliances: Clothes Washer	A	2005 v2.01
2	Appliances: Refrigerator & Freezer Recycling	A	2008 v2.05
3	Consumer Electronics: Televisions	A	New
4	Home Office: Power Supplies / Power Strips	A	New
5	Home Office: Computer CPU	B	New
6	Home Office: Computer Display	B	New
7	Home Office: Miscellaneous (Printers/Routers/MFD/etc.)	B	New
8	Consumer Electronics: Miscellaneous (Set-top Boxes/DVD/Audio/etc.)	B	New
9	Appliances: Self-Contained Refrigerator	C	2008 v2.05
10	Appliances: Dishwasher	C	2005 v2.01
11	Appliances: Self-Contained Freezer	C	2008 v2.05
12	Room Air Conditioner Recycling (EEM moved from TG 8, Residential HVAC)	C	New
13	Room Heat Pump Recycling (EEM moved from TG 8, Residential HVAC)	C	New

<sup>5</sup> A check on the commercial availability of units that meet the hot/dry specification is necessary for both packaged and split systems air conditioners.

# 3

## Residential Lighting Impact Input Updates for DEER

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### 3.1 Introduction

The Database for Energy Efficient Resources (DEER) team was tasked with providing updated impact inputs for residential lighting measures based on the significant share of savings represented by these programs and the availability of high quality lighting logger data. The two key inputs that are being included in this short-term update are the Hours-of-Use profiles and the wattage-reduction ratios that go into the impact savings calculations for residential lighting measures. KEMA used data collected during the 2006-2008 Upstream Lighting Program (ULP) evaluation to develop the new savings inputs for the DEER calculations. These new inputs have been produced in collaboration with the DEER team and are being used in the interactive effects models to produce measure specific impact savings estimates. Below we provide an overview of the methods used for developing the values being suggested for the short-term updates.

### 3.2 Wattage Reduction Ratio Estimates

The DEER team produced an updated wattage reduction ratio (WRR) by using the residential lighting inventory collected in the 2006-2008 ULP evaluation. The primary assumption used in developing the new wattage reduction ratio is that CFLs are replacing non-CFLs for residential savings. KEMA and the DEER team identified five different scenarios for interior lighting based on lamp shape; these scenarios reflect different aggregations of lamp types and are shown in Table 3-1.

**Table 3-1: Wattage Reduction Ratio Interior Scenarios Sample Sizes**

	CFL Lamp Shape	CFL Sample Size	Non-CFL Sample Size
Scenario 1	A-LINE	162	10287
	GLOBE	173	971
	ALL OTHER	391	877
	REFLECTOR	426	2754
	SPIRAL	6070	-
Scenario 2	A-LINE/SPIRAL	6232	10287
	GLOBE	173	971
	ALL OTHER	391	877
	REFLECTOR	426	2754
Scenario 3	A-LINE/SPIRAL	6232	10287
	ALL OTHER	990	4602
Scenario 4	REFLECTOR	426	2754
	ALL OTHER	6796	12135
Scenario 5	All	7205	14889

The different scenarios for interior lighting were evaluated on the underlying samples sizes for each breakdown and for how well the different lamp shapes could be compared to their non-CFL equivalents. Scenario 1 show the most disaggregated set of lamp types, with other scenarios showing various aggregation strategies. The DEER team decided that since A-lamp and spiral both used A-lamp as the non-CFL equivalents that those two categories could be combined (Scenarios 2 and 3). The small sample sizes for Globe CFLs, along with a hard-to-define non-CFL comparison group, was the deciding factor in combining them into the All Other category. Scenarios 3 and 4 show two aggregation strategies that break out A-lamp and spiral lamps (Scenario 3) and reflector lamps (Scenario 4) from all other lamps. Reflectors were considered unique in their application, and had large enough sample sizes for both CFLs and non-CFLs that they were assigned their own WRR. Ultimately the DEER team decided upon Scenario 4 for interior lighting analysis. Exterior lighting was assessed across all lamp shapes due to limited sample sizes in the inventory. Table 3-2 shows the final wattage reduction ratios calculated using the data set from the 2006-08 evaluation and compares it to the current values in DEER. The DEER team recommends use of the 2011 DEER WRR for estimating energy savings for the three classes of CFLs described in this table.

**Table 3-2: Wattage Reduction Ratio Recommendations for Short Term Update**

Location	Lamp Shape	2011 DEER WRR	2008 DEER WRR
INTERIOR	REFLECTOR	4.09	3.53
INTERIOR	ALL OTHER	3.47	3.53
EXTERIOR	All	4.07	3.53

### 3.3 Hours-of-Use Profile Estimates

The DEER team developed projections of lighting profiles for years 2012 through 2014. The lighting profiles were estimated using the CPUC 2006-2008 evaluation data and models as a starting point and then adjusted these estimates with projected increments in CFL saturations for the years of interest (2010-2014). The DEER team estimated saturation increments, by updating the Installation Analysis, which was previously constructed for the 2006-2008 evaluation report (KEMA 2010b) and updated for 2009. Finally the DEER team estimated hourly lighting profiles by several levels of aggregation, including IOU, lamp type, dwelling unit type, space type, and by variables indicating different parts of a year.

#### 3.3.1 Installation Analysis and Saturation Increment

Underlying the projections of lighting profiles are changes in saturation of CFLs for the years of interest. To estimate the saturation increment, we extended the installation analysis that was conducted for the 2006-2008 evaluation report and later updated for 2009. In particular, we updated two key input variables: the number of program bulbs shipped and the number of residential households in the IOUs' service territory. Extending the analysis forward through 2014 produced estimates of number of bulbs in sockets per home for each year (saturation).

We obtained information on the number of program bulbs shipped each year from IOU tracking data. We gathered information on the number of bulbs shipped from 2004 through 2010, as shown in Table 3-3. (Note that figures for 2010 do not include deferred installations.) To estimate projected shipments for 2011 through 2014 (shaded in grey), we used two scenarios:

**Constant:** Assume that 2011-2014 shipments will be the same as 2010.

**Half:** Assume that 2011 will have the same amount of shipments as 2010, but that shipments will be half of that number from 2012 through 2014.

**Table 3-3: Program Bulbs Shipped by IOU (in millions)**

		Shipments per Year (in Millions)										
		Actual							Projected			
IOU	Scenario	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Overall	Constant	10.0	10.0	14.8	38.4	43.6	11.8	28.6	28.6	28.6	28.6	28.6
	Half	10.0	10.0	14.8	38.4	43.6	11.8	28.6	28.6	14.3	14.3	14.3
PG&E	Constant	4.1	4.1	7.6	19.2	26.2	6.0	11.2	11.2	11.2	11.2	11.2
	Half	4.1	4.1	7.6	19.2	26.2	6.0	11.2	11.2	5.6	5.6	5.6
SCE	Constant	4.7	4.7	6.3	15.4	13.6	4.0	14.1	14.1	14.1	14.1	14.1
	Half	4.7	4.7	6.3	15.4	13.6	4.0	14.1	14.1	7.1	7.1	7.1
SDG&E	Constant	0.8	0.8	1.0	3.8	2.8	1.7	3.2	3.2	3.2	3.2	3.2
	Half	0.8	0.8	1.0	3.8	2.8	1.7	3.2	3.2	1.6	1.6	1.6

The second updated parameter is the number of residential households served by the IOUs. We developed tables with actual and projected sales for the Retail Energy Outlook, Issue 9, Q2 2011 (KEMA 2011). Historical data, from 2003 through 2009, comes from the EIA Annual Electric Power Industry Report (Form EIA-861, File 2). The remaining years are projected. We estimated the number of customer accounts using data from EIA Short Term Energy Outlook (STEO) for 2010 through 2012, and growth rates from the EIA Annual Energy Outlook for 2013 and 2014. Table 3-4 shows the actual and projected number of residential households for each IOU, from 2004 through 2014, with projected years shaded in grey.

**Table 3-4: Projected Number of Residential Households by IOU (in millions)**

Residential Households by Year											
	Actual						Projected				
IOU	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Overall	9.4	9.5	9.7	9.8	9.9	9.8	9.5	9.7	9.9	9.7	9.6
PG&E	4.3	4.3	4.4	4.5	4.5	4.5	4.3	4.4	4.5	4.4	4.4
SCE	4.0	4.0	4.1	4.1	4.2	4.2	4.0	4.1	4.2	4.1	4.1
SDG&E	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2

With these updated household numbers and with the assumption that previous relationships remain constant through the period of interest, we produced the estimated number of CFLs in use per home at the end of each year.

Finally, we calculated the increment in CFL saturation for each year,  $\Delta_{sat,y}$ , as the ratio of the increment in number of CFLs in use per home in that year,  $\Delta_{cfl,y}$ , to the average number of sockets in each household. The CFL increment is the projected number of CFLs in use in year  $y$  minus the number of CFLs in 2008, the base year. The number of sockets is the average number of sockets in the household, for each IOU. Note that the subscript for each scenario is omitted; in practice each value of  $y$  is a combination of year and scenario.

$$\Delta_{sat,y} = \frac{\Delta_{cfl,y}}{\#sockets} = \frac{(\#CFLS_y - \#CFLS_{2008})}{\#sockets}$$

The estimated values for CFL saturation increment are shown in Table 3-5.

**Table 3-5: CFL Saturation Increment by IOU and IOU**

			Scenario					
			Constant			Half		
IOU	Year	Average Number of Sockets	CFLs in Use per Home	Increment in CFLs (Base 2008)	CFL Saturation Increment (Base 2008)	CFLs in Use per Home	Increment in CFLs (Base 2008)	CFL Saturation Increment (Base 2008)
PG&E	2008	54	11.8	0.0	0.0%	11.8	0.0	0.0%
	2009	54	14.4	2.6	4.8%	14.4	2.6	4.8%
	2010	54	17.3	5.4	10.1%	17.3	5.4	10.1%
	2011	54	19.0	7.2	13.3%	19.0	7.2	13.3%
	2012	54	20.5	8.7	16.1%	20.1	8.3	15.4%
	2013	54	22.6	10.8	20.0%	21.9	10.0	18.6%
	2014	54	24.2	12.4	22.9%	23.1	11.3	20.9%
SCE	2008	49	9.9	0.0	0.0%	9.9	0.0	0.0%
	2009	49	10.8	0.9	1.9%	10.8	0.9	1.9%
	2010	49	12.9	3.1	6.3%	12.9	3.1	6.3%
	2011	49	14.3	4.5	9.1%	14.3	4.5	9.1%
	2012	49	15.5	5.6	11.5%	14.8	4.9	10.1%
	2013	49	17.1	7.2	14.7%	15.7	5.8	11.8%
	2014	49	18.3	8.4	17.2%	16.2	6.4	13.0%
SDG&E	2008	53	7.4	0.0	0.0%	7.4	0.0	0.0%
	2009	53	8.3	0.9	1.8%	8.3	0.9	1.8%
	2010	53	9.8	2.4	4.6%	9.8	2.4	4.6%
	2011	53	10.7	3.3	6.3%	10.7	3.3	6.3%
	2012	53	11.5	4.1	7.7%	11.1	3.7	7.0%
	2013	53	12.6	5.2	9.8%	11.8	4.4	8.4%
	2014	53	13.4	6.0	11.4%	12.3	4.9	9.3%

### 3.4 Projections of Lighting Profiles

Even though a few of the saturation estimates may appear to be too high, it is worth emphasizing that the ultimate goal of the analysis is to provide projections of lighting profiles, not projections of CFL saturation. The estimated CFL saturation increments were used to adjust our projections of lighting hours of use estimates, but had a limited impact on the adjusted lighting profiles.



### **3.4.1 Cross-Sectional Model and Projected Lighting Profiles**

A complete explanation of the approach used for developing lighting profiles can be found in the 2006-2008 ULP evaluation report and in the additional analysis memorandum of 2010 (KEMA 2010a). A brief review of the lighting models is presented followed by an explanation of how the profiles were adjusted. In the interest of clarity, and where ambiguity does not arise, subscripts will be omitted. This omission is noted in the text.

The 2006-2008 ULP evaluation work that KEMA developed lighting profiles by means of two models: a seasonal and a cross-sectional model. The seasonal model is used to provide annualization of the analyzed logger data. Because each logger recorded only part of a year, KEMA extrapolated to the rest of the year by regressing hourly percent on (originally, hours of use) as a function of a sine wave with peak at winter solstice (December 21) and trough at summer solstice (June 21). The sine wave approximates hours of daylight or darkness in a day. This sinusoid model is estimated for each logger, for each day type, and for each hour of the day. To simplify our discussion, the choice of day type will be omitted from all equations. Hourly percent of time on for each logger, day of year, and hour is estimated by:

$$pct_{idh} = \alpha_{ih} + \beta_{ih} \sin(\theta_d) + \varepsilon_{idh}$$

where

$pct_{idh}$  = Percent on for logger  $i$ , on day of the year  $d$ , at hour  $h$

$\alpha_{ih}$  = Intercept coefficient for logger  $i$ , hour  $h$

$\beta_{ih}$  = Sinusoid coefficient for logger  $i$ , hour  $h$

$\theta_d$  = Angle for day of the year  $d$ , with  $\theta_d = 0$  at spring and fall equinox,  $\theta_d = \pi/2$  on December 21, and  $\theta_d = -\pi/2$  on June 21

$\varepsilon_{idh}$  = Residual error.

Equipped with the sinusoid model and proper sampling weights, we are capable of estimating weighted usage for any time of the year directly from the sample, a method that we call direct expansion. This method is well suited for generating results at highly aggregated levels, but it is limited by the number of sample points that are available for any segment of interest.

The second model that the DEER team developed for lighting profiles aimed to mitigate the sample size issue for fine cuts of the data. The idea is to leverage the inventory data that was collected at the same time as the metering study. The inventory data contains complete information about all space types and lamp types in the households of the study. The logger

sample is a subset of the inventory. The cross-sectional model is an analysis of covariance (Ancova) model estimated using the coefficients from the seasonal model as a function of a number of customer characteristics, including demographics, distribution of space types, and CFL saturation. Here we restrict our attention to CFL saturation, which is the coefficient used for our adjustment. The complete model specification can be found in Table 82 of the 2006-2008 ULP report.

The coefficients from the sinusoid model,  $\alpha_{ih}$  and  $\beta_{ih}$ , are modeled separately as a function of CFL saturation and other customer characteristics. It is the coefficients of CFL saturation,  $\lambda_{\alpha,h}$  and  $\lambda_{\beta,h}$ , that are used to adjust the projections of lighting profiles.

$$\begin{aligned}\alpha_{ih} &= int_{\alpha,h} + \lambda_{\alpha,h}sat + \dots + \mu_{\alpha,ih} \\ \beta_{ih} &= int_{\beta,h} + \lambda_{\beta,h}sat + \dots + \mu_{\beta,ih}\end{aligned}$$

where

$\alpha_{ih}, \beta_{ih}$	=	Coefficients from the sinusoid model
$int_{\alpha,h},$ $int_{\beta,h}$	=	Ancova intercepts for $\alpha$ and $\beta$
$sat$	=	CFL Saturation in the household
$\lambda_{\alpha,h}, \lambda_{\beta,h}$	=	CFL Saturation coefficients for $\alpha$ and $\beta$
$\mu_{\alpha,ih}, \mu_{\beta,ih}$	=	Residual errors.

The coefficients of CFL saturation provide a measure of how much a unit change in CFL saturation will affect the sinusoid coefficients, which in turn determine the lighting profiles. Since the DEER team has projections of CFL saturation increment for all years of interest, one can calculate adjustments for the sinusoid coefficients by multiplying the saturation coefficient and the saturation increment:

$$\begin{aligned}adj_{\alpha,yh} &= \lambda_{\alpha,h} \times \Delta_{sat,y} \\ adj_{\beta,yh} &= \lambda_{\beta,h} \times \Delta_{sat,y}\end{aligned}$$

These adjustments can be applied to profiles developed using either the direct expansion or Ancova methods. When applied to the direct expansion results, we first calculate adjusted coefficients:

$$\begin{aligned}\alpha'_{iyh} &= \alpha_{ih} + adj_{\alpha,yh} \\ \beta'_{iyh} &= \beta_{ih} + adj_{\beta,yh}\end{aligned}$$

We then calculate projections of percent on for each logger and each year by:

$$pct'_{iydh} = \alpha'_{ih} + \beta'_{ih} \sin(\theta_d)$$

The calculation is analogous for the Ancova method, but it is performed for each fixture group in the inventory instead of each logger in the sample. With either approach we can create lighting profiles by taking weighted averages of the individual profiles at the levels of aggregation of interest.

For the short-term DEER update, we produced projections of lighting profiles using the Ancova model, not the direct expansion approach. This is because the DEER update required profiles at particular levels of analysis for which only a limited sample size was available. The team emphasizes that in aggregate, both approaches give nearly indistinguishable results; it is only for finer cuts that we recommend using the Ancova model because it takes advantage of information from the inventory.

Because the lighting profiles span thousands of lines, we provide them in a separate appendix. To give an overview, we present projections of annual hours-of-use for CFLs in Table 3-6 and Table 3-7. As expected, the projected hours-of-use decrease across the years, but at a relatively small rate.

**Table 3-6: Projected CFL Hours-of-Use by IOU and Space Type for Scenario “Constant”**

		Space Type					
		Overall		Interior		Exterior	
IOU	Year	Num Obs	HOU	Num Obs	HOU	Num Obs	HOU
PG&E	2009	3,946	1.60	3,479	1.40	467	3.32
	2010	3,946	1.58	3,479	1.38	467	3.31
	2011	3,946	1.57	3,479	1.37	467	3.29
	2012	3,946	1.56	3,479	1.36	467	3.28
	2013	3,946	1.54	3,479	1.35	467	3.27
	2014	3,946	1.53	3,479	1.34	467	3.26
SCE	2009	3,519	1.96	3,108	1.76	411	3.71
	2010	3,519	1.95	3,108	1.74	411	3.70
	2011	3,519	1.94	3,108	1.73	411	3.69
	2012	3,519	1.93	3,108	1.72	411	3.68
	2013	3,519	1.92	3,108	1.71	411	3.67
	2014	3,519	1.91	3,108	1.70	411	3.66
SDG&E	2009	1,679	1.39	1,456	1.18	223	3.11
	2010	1,679	1.38	1,456	1.17	223	3.10
	2011	1,679	1.37	1,456	1.16	223	3.10
	2012	1,679	1.37	1,456	1.16	223	3.09
	2013	1,679	1.36	1,456	1.15	223	3.08
	2014	1,679	1.35	1,456	1.14	223	3.08

**Table 3-7: Projected CFL Hours-of-Use by IOU and Space Type for Scenario “Half”**

		Space Type					
		Overall		Interior		Exterior	
IOU	Year	Num Obs	HOU	Num Obs	HOU	Num Obs	HOU
PG&E	2009	3,946	1.60	3,479	1.40	467	3.32
	2010	3,946	1.58	3,479	1.38	467	3.31
	2011	3,946	1.57	3,479	1.37	467	3.29
	2012	3,946	1.56	3,479	1.36	467	3.29
	2013	3,946	1.55	3,479	1.35	467	3.28
	2014	3,946	1.54	3,479	1.34	467	3.27
SCE	2009	3,519	1.96	3,108	1.76	411	3.71
	2010	3,519	1.95	3,108	1.74	411	3.70
	2011	3,519	1.94	3,108	1.73	411	3.69
	2012	3,519	1.93	3,108	1.73	411	3.68
	2013	3,519	1.93	3,108	1.72	411	3.68
	2014	3,519	1.92	3,108	1.72	411	3.67
SDG&E	2009	1,679	1.39	1,456	1.18	223	3.11
	2010	1,679	1.38	1,456	1.17	223	3.10
	2011	1,679	1.37	1,456	1.16	223	3.10
	2012	1,679	1.37	1,456	1.16	223	3.09
	2013	1,679	1.37	1,456	1.15	223	3.09
	2014	1,679	1.36	1,456	1.15	223	3.09

### 3.5 Possible Shortcomings of the Study

This short-term update to DEER benefits from a number of advances that were not available in earlier studies, including an extensive metering sample and statistical methods that take into account multiple customer characteristics, in contrast to simple averages. However, to create projections of lighting profiles the DEER team had to make a number of assumptions. Although THE DEER TEAM believes these are realistic assumptions, they may turn out not to hold in practice. We discuss the possible shortcomings to the study in this section.

The installation analysis was developed for the 2006-2008 evaluation study and updated for 2009. It relies on assumptions about the flow of CFL bulbs in California. In particular, it

assumes that sales of non-program bulbs remain fixed since 2008 and at the same time it assumes that the program net-to-gross ratio is fixed at the 2008 estimated level, independent of program volume. These assumptions may be problematic, especially for distant years, but they are used for lack of better information.

The sinusoid annualization has a reasonable foundation, but it has some limitations that have already been discussed in the context of the 2006-2008 evaluation report.

The Ancova model was originally developed for daily hours of use. The DEER team used the same principle when estimating hourly percent on. Although this approach produces results that are statistically indistinguishable from the direct expansion for most hours of the day, there are exceptions. For early evening hours of the summer season, such as 6pm and 7pm, the estimates from the Ancova model are lower than the estimates calculated using the direct expansion model.

Lighting profiles are projected by adjusting the amount of CFL saturation in households. All else is assumed to remain constant. Furthermore, the adjustment is uniform in the sense that the analysis team assumes all households will experience the same amount of increase in CFL saturation. In reality, we expect different segments to have different changes in saturation. In aggregate, this may not be an issue, but it may warrant more refinement for small cuts of the data.

A more complete analysis could investigate the likelihood of each socket having a CFL as a function of household CFL saturation, socket hours of use, and other factors, with the intent of determining the distribution of CFLs in sockets given an increment in saturation. In other words, assuming that hours of use are determined by the socket application, we will be able to predict what mix of sockets become CFLs as saturation increases.

### **3.6 Comparison to Previous DEER Results**

Table 3-8 compare the hours of use derived based on this analysis with the hours of use developed in the previous version of DEER updated in 2009 for interior and exterior lighting fixtures. Daily hours of interior lighting use at the statewide level have declined by 32 % from 2.18 hours per day to 1.48 hours per day. Estimated daily hour of use for exterior lighting fixtures has actually increased by 10%, from 3.42 hours per day to 3.10 hours per day. The decrease in lighting usage was expected by the DEER team given the increase saturation of CFL in residential dwellings but the explanation for why exterior lighting hours should have increased is not yet clear. The DEER team plans to continue to investigate this issue and may provide an updated estimate at a later date.

**Table 3-8: Estimated Daily Hours of Use for Interior and Exterior Residential Light Fixtures**

INTERIOR				
Year	IOU	Hours of Use		CDF
		Annual	Daily	All
2011	SCE	627	1.72	0.056 - 0.061
2011	SDG&E	421	1.15	0.021 - 0.024
2011	PG&E	493	1.35	0.038 - 0.044
2011	Overall	541	1.48	0.043 - 0.049
2008	Overall	796	2.18	0.087 - 0.092

EXTERIOR				
Year	IOU	Hours of Use		CDF
		Annual	Daily	All
2011	SCE	1342	3.68	0.000
2011	SDG&E	1127	3.09	0.000
2011	PG&E	1195	3.27	0.000
2011	Overall	1249	3.42	0.000
2008	Overall	1132	3.10	0.000

### 3.7 Conclusion

The extensive data collection efforts conducted by the KEMA team in the residential lighting area have allowed the DEER team to develop much more robust estimates of lighting usage. Whether the observed trends toward lower daily hours of usage between 2008 and 2011 are likely to continue depends on a variety of factors including the characteristics and lighting usage habits of the late adopters, new competitors to CFLs stimulated by the new EISA standards, and perhaps even future economic conditions. Comments on the current analysis of adjusted hours of use the key market factors that should be monitored because they may lead to further changes in hours of use.

### 3.8 References

- KEMA. (2010b). *Additional Analysis of 2006-2008 Impact Evaluation Results for DEER Update*.
- KEMA. (2010a). *Final Evaluation Report: Upstream Lighting Program, Vol 1, CALMAC CPU0015.01*.
- KEMA. (2011). *KEMA Retail Energy Outlook, Issue 9, Q2*.

# 4

## Load Impact Updates for Non-Residential Lighting

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### 4.1 Introduction

This section presents the general analysis that the DEER team has conducted to update the load impact estimates for non-residential lighting technologies. In this analysis the DEER team reviewed new information on lighting system characteristics and hours of use gathered as part of the 2006-08 evaluation of non-residential lighting programs. After comparing the revised HOU estimates by building type from this data set with the existing HOU values in the DEER data base, the DEER team decided not to recommend any changes to the HOU values because of uncertainties in the aggregation of data at the site level to DEER building prototypes and other technical issues. However, the DEER team did decide to recommend minor changes to the baseline system inputs used to estimate load impacts for non-residential lighting systems due to changes in building codes and some changes to remaining useful life estimates for the same technologies. These proposed changes to the baseline values discussed in Section 4.5.2. Below we provide an overview of the data sources and methods used for developing the values derived from the 2006-2008 analysis of small commercial and local government programs to illustrate the rationale for not updating the HOU at this time.

#### 4.1.1 Overview of this Section

This section is laid out as follows:

- Overview
  - Includes the Ranked List of Energy Efficiency Measures and other High-Level Background from the Analysis Plan.
- Data Sources
  - Describes the Data Sources for the 2008 DEER and Proposed 2011 DEER inputs.
- Hours of Use, Annual Usage Shapes and Coincident Factors
  - Presents and Compares the 2008 DEER and Proposed 2011 DEER HOU and CFs.
- Delta Watts Calculations
  - Presents and Compares the 2008 DEER and Proposed 2011 DEER HOU and CFs for CFL and linear fluorescents.



- Interactive Effects
- Appendix A-2.1 – Methodology for Calculating HOU and CFs

## 4.2 Background/Overview of the DEER TG1 Analysis Plan

Table 4-1 summarizes the EEM Categories included in this update. The measure groups were selected based upon their historical and perceived future energy savings potential statewide. The EEM Categories listed appear in ranked order as determined by the Technology Group 1 team members. The rankings were derived after consideration of both the available EM&V data to affect an update, and the feasibility of completing the analysis within the study’s allocated timeframe and budget. EEMs ranked “A” are the highest priority updates, “B” are medium priority, and “C” are considered the lowest priority updates. The DEER Update Study may include additional “C” ranked measure parameters in the formal DEER long-term update in 2012 based on data availability from ongoing EM&V studies and stakeholder feedback. The table below summarizes the intended update timeframe for each specific parameter: an “S” indicates the EEM parameter is included in this short-term update and an “L” indicates inclusion in the long-term update (June 2012).

**Table 4-1: Commercial Lighting EEM Categories Parameter Updates**

Energy Efficiency Measure Category	Rank	HOU and CF	Load Shapes	Delta Watts	Interactive Effects
CFL, integral	A	S	S	S	S
Linear Fluorescent, de-lamping	A	S	S	S	S
Linear Fluorescent, lamp + ballast	A	S	S	S	S
Linear Fluorescent, fixture	A	S	S	S	S
HID, Mercury Vapor/HPS/LPS	B		L		S
HID, T5 HO	B		L		S
HID, Metal Halide	B		L		S
HID, LED	B		L*		S
CFL, fixture	C				S
Side Daylighting Controls	C				
Top Daylighting Controls	C				
Exit, LED	C				S
Incandescent Lamp	C				

Note: EEMs flagged with “L” also entail long term coordination efforts with the 2010 – 2012 EM&V studies.

This document provides the updates needed for annual energy savings and peak demand reduction for linear fluorescents and CFLs. There is no data at this time to update savings values

for other types of lighting. High bay HIDs and occupancy sensors are listed as a priority for the IOUs.

#### **4.2.1 Parameter Updates**

The following gross impact parameters were considered for updating for both CFL and linear fluorescent measures:

- **Hours of Use/Operation and Coincidence Factors**

The hours of use (HOU) and coincidence factors (CFs) were analyzed and are presented by building type and/or activity area.

- **Measure Load Shape**

The Technology Group developed load shapes for CFLs and linear fluorescents using a combination of the 0608 Small Commercial data and the 0608 Local Government Partnership data. Load shapes for other measures will be updated during the next round of updates. (Load shapes are available in an MS Excel file as an Appendix A-2.2.)

- **Delta Watts**

Delta watt estimates were developed for this short-term DEER update for linear fluorescents and CFLs. The pre- and post-wattages were collected from the 0608 CPUC data sources for predefined measures.

#### **4.2.2 Interactive Effects Updates**

Interactive effects for CFLs, linear fluorescents and high bay lighting will be updated using building simulation models (DOE-2.2). After the release of the 2008 DEER v2.05 updates, the J.J. Hirsch & Associates simulation modeling team continued to work on significant impact improvements, bug fixes, and corrections collected under the unreleased DEER v3.02 update. For example, the California 2008 Title 24 requirements are reflected in the revisions along with corrections to the Large Office primary lighting schedules. The impacts of the various HVAC control and sizing changes in the unreleased DEER v3.02 have a profound effect on the secondary natural gas impacts. In almost all cases, the heating energy “take-back” associated with commercial lighting measures is likely to decrease dramatically.

### **4.3 Data Sources**

#### **4.3.1 Data Sources – 2008 DEER**

This section provides a brief explanation of the data sources used to estimate lighting hours of use in 2008 including sample sizes. The 2008 DEER relied on a combination of the best

available lighting logger data for non-residential buildings at the time and professional judgment. The known data sources for the 2008 DEER HOU by building type were developed using data from the following sources:

- 2003 Express Efficiency Evaluation (logger study)
- 2004-05 Express Efficiency Evaluation (logger study)
- DOE2 Model using occupancy shapes

The 2003 and 2004-05 Express Efficiency evaluations included lighting logger studies. These loggers were installed for approximately two months under the 2003 Express Study and three to four weeks under the 2004-05 Express Study. The combined sample sizes of these studies are shown below:

- CFLs – Total of 179 sites, 414 loggers
- Linear fluorescents – Total of 111 sites, 234 loggers

In addition to the logger data available from these two studies, data from previous evaluation studies and occupancy shapes found in DOE2 were used to develop the HOU used in the 2008 DEER. The process used to develop analyze this data is summarized below.

*Lighting profiles were updated to consider 2002-2003 and 2004-2005 state-wide express efficiency lighting logger studies. While not an exact process, the DEER team made its best effort to “map” activity areas in each DEER nonresidential prototype to the available lighting profiles. The DEER team started with preliminary shapes developed in April 2008 from the logger data collected for the 2004-2005 Express Efficiency evaluation. For business type and usage area combinations where the sample was large enough (e.g. Office - Office with window), the DEER team developed weekday and weekend load shapes at that level. Within a business type, usage areas with N<6 were collapsed together under the "Other" usage area label (e.g. School - Other). These M&V lighting logger study data sets showed that CFL operating hours and resulting equivalent full load hours (EFLH) were quite different and often lower than linear fluorescent and other general lighting.*

*During the review period for the 2009-2011 DEER program planning cycle, several lighting profiles were revised in response to comments from utilities. In general, these revisions resulted in increased equivalent full load hours for several activity areas. The effort to revise lighting profiles is summarized in the Excel workbook “DEER08\_LightingProfiles\_08101403.xls”. The workbook provides comparison of 2005 lighting profiles, 2008 lighting profiles and reference profiles from lighting logger studies.*

### **4.3.2 Data Sources – Proposed 2011 DEER Update**

This section provides a brief overview of the data sources used to produce the HOU and CF estimates that the DEER Team proposes be used for the 2011 DEER Update. The sample sizes are also presented and compared to those used in the 2008 DEER.

The latest EM&V analysis for non-residential lighting was performed during the 2006-2008 program cycle. The analysis presented below uses data collected by two studies:

- 2006-08 Small Commercial Contract Group Evaluation
  - The results of the evaluation were reported in the 2006-08 Small Commercial Contract Group (SCCG) Direct Impact report prepared for the California Public Utilities Commission.
  - The Study included installation of over 7,000 lighting loggers at over 1,200 non-residential buildings. Loggers were installed on linear fluorescents (including high-bay) and CFLs.
  - The logger effort included an Upstream CFL component, as well as the normal downstream/verification component. For the Upstream effort, the sample was drawn from the entire population of commercial businesses. However, only those businesses that installed a purchased CFL were recruited for the on-site visit.
- 2006-08 Local Government Partnership Contract Group Evaluation
  - The results of the evaluation were reported in the 2006-08 Local Government Partnership Contract Group (LGP) Direct Impact report prepared for the California Public Utilities Commission.
  - This study included two distinct lighting logger studies:
    - Pre-Post Study – Nearly 2,000 lighting loggers were installed at over 100 non-residential participant buildings. Loggers were installed both before and after the rebated linear fluorescents (including high-bay) were installed. For this DEER Update, only the data from the post phase (919 loggers) were used in the analysis. (Note: these results were presented in the 2006-08 Small Commercial report.)
    - University/Community College – Over 550 lighting loggers were installed at over 14 universities and community colleges. Loggers were installed after the rebated linear fluorescents were installed.

### **4.3.3 Data Sources – Comparison of Sample Sizes**

Table 4-2 and Table 4-3 present the number of sites and number of loggers used in the analysis by building type for linear fluorescents and CFLs respectively. As shown, the number of loggers

used in the analysis of the 2006-08 lighting logger studies was significantly higher than the logger measurements used to inform the 2008 DEER HOU estimates.

Data collected at these sites were used to update the HOU, CF, load shape and wattage estimates for the 2011 DEER update.

**Table 4-2: Comparison of Sample Sizes – Linear Fluorescents**

DEER Bldg Type	DEER 2008 <sup>1</sup>	Proposed DEER 2011	
	# Loggers	# Sites	# Loggers
Assembly	21	16	156
Education - Community College		7	261
Education - University		7	294
Grocery		15	74
Health/Medical - Clinic		40	332
Office - Small	37	119	771
Other	125	118	633
Restaurant		25	75
Retail - Small	34	196	948
Warehouse		52	344
<b>Total</b>	<b>234</b>	<b>595</b>	<b>3,888</b>

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<sup>1</sup> As explained above, while data from sources in addition to the Express Efficiency lighting logger studies are believed to have been used for the 2008 DEER, the sample sizes are only available for these two lighting logger studies.

**Table 4-3: Comparison of Sample Sizes – CFLs**

DEER Bldg Type	DEER 2008 <sup>2</sup>	Proposed DEER 2011	
	# Loggers	# Sites	# Loggers
Assembly	79	64	280
Health/Medical - Clinic	29	61	215
Lodging	87	110	880
Office - Small	32	123	287
Other	72	141	437
Restaurant	54	110	381
Retail - Small	61	184	375
<b>Total</b>	<b>414</b>	<b>793</b>	<b>2,855</b>

In sum, these tables demonstrate there are significantly more information on hours of usage available from the loggers utilized in the 2006-08 evaluation relative to the loggers used in the 2004-05 studies. These loggers collected data at more sites for each building type and for longer time periods than the loggers used for the DEER 2008 update. However the team had some concerns about the building type assignments of the specific buildings metered within the 2011 sample for the assembly, small office, and restaurant building types. In addition there may be differences in the activity area weights used in the last DEER update and the weights used by the DEER analysis team. These differences are explored in more detail in subsequent sections.

#### **4.4 Hours of Use, Annual Usage Shapes and Coincident Factors**

This section presents the HOU and CFs currently in the 2008 DEER for commercial lighting systems and compares these to the values that were initially suggested for updates.

##### **4.4.1 2008 DEER HOU and CFs**

As mentioned above, the current DEER HOU and CFs were developed using a combination of logger data, professional judgment, and the DOE2 model. The HOU in the official DEER 2008 documentation available on-line are presented by building type and activity area. These HOU are shown in Table 4-4 through Table 4-6. However, since rebated lighting measures are not tracked at the activity area level (space use) in the program tracking data, these values are needed by building type. The 2008 DEER Update documentation does not include a table of HOU and CFs by building type, however these are available in an Excel file on-line. These HOU and CFs

<sup>2</sup> See Footnote #1.

by building type are presented in Table 4-7. Table 4-7 also identifies the DEER building types that we propose to update in the 2011 DEER for CFLs and linear fluorescents.

**Table 4-4: DEER 2008 – from Documentation (1 of 3)**

Building Type	Space Use	Other Lighting Equivalent Full Load Hours		CFL Equivalent Full Load Hours	
		2005	2008	2005	2008
<b>Assembly</b>	Auditorium	not incl.	2431	not incl.	2291
Assembly	Office (General)	not incl.	3173	not incl.	2338
<b>Education - Primary School</b>	Classroom/Lecture	1440	2445	1440	2660
Education - Primary School	Exercising Centers and Gymnasium	1440	2051	1440	2434
Education - Primary School	Dining Area	1440	1347	1440	1530
Education - Primary School	Kitchen and Food Preparation	1440	1669	1440	1846
<b>Education - Secondary School</b>	Classroom/Lecture	2305	2445	2305	2608
Education - Secondary School	Office (General)	2305	2323	2305	2452
Education - Secondary School	Exercising Centers and Gymnasium	2305	2366	2305	2532
Education - Secondary School	Computer Room (Instructional/PC Lab)	2305	2137	2305	2522
Education - Secondary School	Dining Area	2305	2365	2305	2493
Education - Secondary School	Kitchen and Food Preparation	2305	1168	2305	1354
<b>Education - Community College</b>	Classroom/Lecture	3792	2471	3792	2619
Education - Community College	Office (General)	3792	2629	3792	2568
Education - Community College	Computer Room (Instructional/PC Lab)	3792	2189	3792	2629
Education - Community College	Comm/Ind Work (General, Low Bay)	3792	3078	3792	2740
Education - Community College	Dining Area	3792	2580	3792	2620
Education - Community College	Kitchen and Food Preparation	3792	2957	3792	2602
<b>Education - University</b>	Classroom/Lecture	3073	2522	3073	2716
Education - University	Office (General)	3073	2870	3073	2640
Education - University	Computer Room (Instructional/PC Lab)	3073	2372	3073	2830
Education - University	Comm/Ind Work (General, Low Bay)	3073	3099	3073	2772
Education - University	Dining Area	3073	2963	3073	2713
Education - University	Kitchen and Food Preparation	3073	3072	3073	2823
Education - University	Hotel/Motel Guest Room (incl. toilets)	3073	1196	3073	1196
Education - University	Corridor	3073	2972	3073	2765
<b>Health/Medical - Hospital</b>	Office (General)	8736	4873	8736	4216
Health/Medical - Hospital	Office (General)	8736	4873	8736	4216
Health/Medical - Hospital	Dining Area	8736	5858	8736	4463
Health/Medical - Hospital	Kitchen and Food Preparation	8736	5858	8736	4463
Health/Medical - Hospital	Medical and Clinical Care	8736	5193	8736	4317
Health/Medical - Hospital	Laboratory, Medical	8736	4257	8736	3449
Health/Medical - Hospital	Medical and Clinical Care	8736	5193	8736	4317
Health/Medical - Hospital	Office (General)	8736	4873	8736	4216
<b>Health/Medical - Nursing Home</b>	Hotel/Motel Guest Room (incl. toilets)	8736	4367	8736	3529
Health/Medical - Nursing Home	Office (General)	8736	3723	8736	3468
Health/Medical - Nursing Home	Office (General)	8736	3723	8736	3468
Health/Medical - Nursing Home	Corridor	8736	7884	8736	4709
Health/Medical - Nursing Home	Dining Area	8736	3814	8736	3522
Health/Medical - Nursing Home	Kitchen and Food Preparation	8736	3814	8736	3522
<b>Lodging - Hotel</b>	Hotel/Motel Guest Room (incl. toilets)	8736	799	1145	799
Lodging - Hotel	Corridor	8736	7884	8736	5913
Lodging - Hotel	Dining Area	8736	3485	8736	3108
Lodging - Hotel	Kitchen and Food Preparation	8736	4524	8736	3641
Lodging - Hotel	Bar, Cocktail Lounge	8736	3820	8736	3275
Lodging - Hotel	Lobby (Hotel)	8736	7884	8736	5913
Lodging - Hotel	Laundry	8736	4154	8736	3586
Lodging - Hotel	Office (General)	8736	3317	8736	3006

Table 4-5: DEER 2008 – from Documentation (2 of 3)

Building Type	Space Use	Other Lighting Equivalent Full Load Hours		CFL Equivalent Full Load Hours	
		2005	2008	2005	2008
<b>Lodging - Motel</b>	Hotel/Motel Guest Room (incl. toilets)	8736	755	8736	755
Lodging - Motel	Office (General)	8736	5858	8736	6132
Lodging - Motel	Laundry	8736	4709	8736	4709
Lodging - Motel	Corridor	8736	7474	8736	6132
<b>Manufacturing - Bio/Tech</b>	Laboratory, Medical	not incl.	3177	not incl.	2613
Manufacturing - Bio/Tech	Office (General)	not incl.	3212	not incl.	2613
Manufacturing - Bio/Tech	Corridor	not incl.	7008	not incl.	7008
Manufacturing - Bio/Tech	Computer Room (Mainframe/Server)	not incl.	3068	not incl.	2613
Manufacturing - Bio/Tech	Dining Area	not incl.	3068	not incl.	2847
Manufacturing - Bio/Tech	Kitchen and Food Preparation	not incl.	3068	not incl.	2653
Manufacturing - Bio/Tech	Conference Room	not incl.	3703	not incl.	2676
<b>Manufacturing - Light Industrial</b>	Comm/Ind Work (General, High Bay)	2860	3068	2860	2613
Manufacturing - Light Industrial	Storage (Unconditioned)	2860	3376	2860	2645
<b>Office - Large</b>	Office (Open Plan)	2739	2641	2808	3100
Office - Large	Office (Executive/Private)	2739	2641	2808	3100
Office - Large	Corridor	2739	2641	2808	3860
Office - Large	Lobby (Office Reception/Waiting)	2739	2692	2808	3860
Office - Large	Conference Room	2739	2692	2808	1647
Office - Large	Copy Room (photocopying equipment)	2739	2692	2808	3860
Office - Large	Restrooms	2739	2692	2808	3860
Office - Large	Mechanical/Electrical Room	2739	2692	2808	1647
<b>Office - Small</b>	Office (Executive/Private)	2492	2594	2808	3066
Office - Small	Corridor	2492	2594	2808	3360
Office - Small	Lobby (Office Reception/Waiting)	2492	2594	2808	3957
Office - Small	Conference Room	2492	2594	2808	1556
Office - Small	Copy Room (photocopying equipment)	2492	2594	2808	3957
Office - Small	Restrooms	2492	2594	2808	3957
Office - Small	Mechanical/Electrical Room	2492	2594	2808	1556
<b>Restaurant - Sit-Down</b>	Dining Area	3444	4836	4368	4836
Restaurant - Sit-Down	Lobby (Main Entry and Assembly)	3444	4836	4368	4836
Restaurant - Sit-Down	Kitchen and Food Preparation	3444	4804	4368	4804
Restaurant - Sit-Down	Restrooms	3444	4606	4368	4606
<b>Restaurant - Fast-Food</b>	Dining Area	6188	4850	6188	4850
Restaurant - Fast-Food	Lobby (Main Entry and Assembly)	6188	4850	6188	4850
Restaurant - Fast-Food	Kitchen and Food Preparation	6188	4812	6188	4812
Restaurant - Fast-Food	Restrooms	6188	4677	6188	4677
<b>Retail - 3-Story Large</b>	Retail Sales and Wholesale Showroom	4259	3546	4259	3989
Retail - 3-Story Large	Storage (Conditioned)	4259	2702	4259	2559
Retail - 3-Story Large	Office (General)	4259	2596	4259	2559
<b>Retail - Single-Story Large</b>	Retail Sales and Wholesale Showroom	4368	4454	4368	4512
Retail - Single-Story Large	Storage (Conditioned)	4368	2738	4368	2633
Retail - Single-Story Large	Office (General)	4368	2714	4368	2737
Retail - Single-Story Large	Auto Repair Workshop	4368	3429	4368	4022
Retail - Single-Story Large	Kitchen and Food Preparation	4368	3368	4368	3947
Retail - Single-Story Large	Retail Sales and Wholesale Showroom	4368	4454	4368	4512
<b>Retail - Small</b>	Retail Sales and Wholesale Showroom	3724	3378	4004	4013
Retail - Small	Storage (Conditioned)	3724	2753	4004	2550



Table 4-6: DEER 2008 – from Documentation (3 of 3)

Building Type	Space Use	Other Lighting Equivalent Full Load Hours		CFL Equivalent Full Load Hours	
		2005	2008	2005	2008
<b>Storage - Conditioned</b>	Storage (Conditioned)	2860	3441	2860	2780
Storage - Conditioned	Office (General)	2860	3441	2860	2780
<b>Storage - Unconditioned</b>	Storage (Unconditioned)	2860	3441	2860	2780
Storage - Unconditioned	Office (General)	2860	3441	2860	2780
<b>Grocery</b>	Retail Sales, Grocery	2492	4964	2808	3942
Grocery	Office (General)	2492	4526	2808	3504
Grocery	Comm/Ind Work (Loading Dock)	2492	4964	2808	3942
Grocery	Refrigerated (Food Preparation)	2492	4380	2808	3504
Grocery	Refrigerated (Walk-in Freezer)	2492	4380	2808	3504
Grocery	Refrigerated (Walk-in Cooler)	2492	4380	2808	3504
<b>Warehouse - Refrigerated</b>	Refrigerated (Frozen Storage)	2492	4818	2808	4818
Warehouse - Refrigerated	Refrigerated (Cooled Storage)	2492	4818	2808	4818
Warehouse - Refrigerated	Comm/Ind Work (Loading Dock)	2492	4818	2808	4818
Warehouse - Refrigerated	Office (General)	2492	3522	2808	2719

**Table 4-7: DEER 2008 – HOU and CF by Building Type**

DEER Bldg Type	Linear Fluorescents			CFL		
	HOU	CF	Updating	HOU	CF	Updating
Assembly	2,605	0.53	X	2,302	0.41	X
Education - Community College	2,416	0.81	X	2,509	0.67	
Education - Primary School	2,061	0.58		2,173	0.59	
Education - Relocatable Classroom	2,445	0.70		2,454	0.70	
Education - Secondary School	2,317	0.71		2,339	0.71	
Education - University	2,279	0.72	X	2,281	0.67	
Grocery	4,891	0.69	X	3,879	0.50	
Health/Medical - Hospital	5,182	0.80		4,081	0.68	
Health/Medical - Nursing Home	4,308	0.68		3,616	0.56	
Lodging - Hotel	1,964	0.24	X	1,660	0.20	X
Lodging - Motel	1,588	0.17	X	1,366	0.15	X
Manufacturing - Bio/Tech	3,963	0.85		3,572	0.78	
Manufacturing - Light Industrial	3,227	0.92		2,578	0.78	
Office - Large	2,641	0.71		2,996	0.63	
Office - Small	2,594	0.69	X	2,962	0.67	X
Restaurant - Fast-Food	4,847	0.81	X	4,847	0.81	X
Restaurant - Sit-Down	4,827	0.80	X	4,827	0.80	X
Retail - 3-Story Large	3,372	0.78		3,703	0.64	
Retail - Single-Story Large	4,171	0.85		4,245	0.69	
Retail - Small	3,378	0.88	X	4,013	0.70	X
Storage - Conditioned	3,434	0.70	X	2,780	0.58	
Storage - Unconditioned	3,434	0.70	X	2,780	0.58	
Warehouse - Refrigerated	4,792	0.55		4,776	0.55	

Source: DEER 08\_Lighting-EFLH-DemFactor-v3-kjm.xlsx from Kevin Madison.

As mentioned, although the 2008 DEER relied on more information about usage than just the logger data, the 2003 and 2004-05 Express Efficiency logger data were a primary input for developing HOU estimates. Therefore, the HOU values estimated directly from the 2003 and 2004-05 Express Efficiency logger data are also presented in Table 4-8 and Table 4-9 for comparison purposes.

**Table 4-8: DEER 2008 Analysis of Express Logger Data – Linear Fluorescents**

<b>Bldg Type</b>	<b>Schedule Group</b>	<b># Loggers</b>	<b>HOU</b>
Community Service	Office_NoWindow	7	2,796
Community Service	Office_Window	6	3,920
Community Service	Other	8	2,256
Misc Commercial	Common_Area	12	2,337
Misc Commercial	Office_NoWindow	7	3,498
Misc Commercial	Office_Window	29	2,590
Misc Commercial	Other	28	3,403
Office	Office_Window	21	2,515
Office	Other	16	2,451
Other	Common_Area	13	3,750
Other	Other	36	3,282
Retail	Common_Area	15	3,335
Retail	Office_NoWindow	10	2,530
Retail	Other	9	2,667
School	Classroom	10	2,039
School	Other	7	2,911

**Table 4-9: DEER 2008 Analysis of Express Logger Data – CFLs**

Bldg Type	Schedule Group	# Loggers	HOU
Community Service	Common_Area	52	2,029
Community Service	Other	27	1,762
Health Care	MedExam_Room	10	2,516
Health Care	Other	19	2,595
Lodging	Guest_Room	52	812
Lodging	Other	35	2,868
Office	Common_Area	14	4,013
Office	Office_Window	8	3,047
Office	Other	10	1,361
Other	Common_Area	31	2,894
Other	Other	41	2,639
Restaurant	Common_Area	13	4,868
Restaurant	Other	41	3,069
Retail	Common_Area	47	3,838
Retail	Other	14	2,486

#### 4.4.2 2011 DEER HOU and CFs

This section presents initially suggested updates to hours-of-use (HOU) and coincident factors (CF) for linear fluorescents and CFLs. As described in the Data Sources section above, the suggested values presented below were based on the lighting logger data collected as part of the 2006-08 Small Commercial Contract Group Evaluation and the 2006-08 Local Government Partnership Contract Group Evaluation.

Below is a brief description of the methodology used to estimate HOU and CF values. The detailed methodology can be found in Appendix A-2.1.<sup>3</sup> Further, additional information about the on-site survey activities can be found in the 2006-08 Small Commercial Contract Group Evaluation Report available on CALMAC.

<sup>3</sup> Note: At the time of this draft (10/28/11), the method of calculating the distribution of lighting across activity areas may not be how the final HOU and CF estimates were calculated. Once the proposed values are finalized, this methodology section will likely need to be updated. These updates would likely be minor.

### **Logger Data Collection and QC**

Time-of-use (TOU) loggers were installed to collect lighting usage data on-site.<sup>4</sup> The TOU loggers monitor on/off events. The TOU data went through stringent quality control procedures. Each logger was reviewed in addition to running the data through code to highlight possible problem loggers. As a result of the validation process, logger data were dispositioned as either good or unusable.

The loggers were installed over the period between September 2008 through October 2009 with the majority of loggers installed in the second and third quarters of 2009. The loggers were installed at each site for an extended period in most cases. More than 75% of the loggers recorded lighting usage for more than eight weeks. The bulk of the remaining loggers had between six to eight weeks of monitored data.

### **Logger Data Analysis**

The validated loggers were then used to calculate hourly shapes for each logger and then were weighted to develop hours-of-use and CF estimates.<sup>5</sup> The results of this re-analysis of the Small Commercial and LGP logger data differs from the results presented in the final reports for those two studies. The primary differences include:

- The Small Commercial report presents HOU and CFs by measure group, program delivery mechanism, building type and activity area. The values proposed below aggregate the results across program delivery mechanisms for the DEER 2011. The primary reason for this is to increase the sample sizes.
- The Small Commercial logger analysis used site weights in addition to the lamp count weights to weight up appropriately to the population of the program participants. However, the team did not feel this was appropriate since the weighting can cause some sites to have large weights due only to the fact that they were originally misclassified in the program tracking database.

### **Initially Suggested HOU and CFs**

The results have been calculated in several different formats. The team has prepared results at the following levels of aggregation:

- **Most Aggregated Level:** HOU and CF values by measure group and building type. Presented in Table 4-10 and Table 4-11 for linear fluorescents and CFLs respectively.

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<sup>4</sup> The TOU loggers installed were dominated by two Dent Instruments logger types: the LIGHTINGlogger™ (TOUL-3G) and the CTlogger™ (TOUCT-3G).

<sup>5</sup> The detailed methodology can be found in Appendix A-1.

- **More Detailed Level:** HOU and CF values by measure group, building type, and activity area. These estimates are available on request.
- **Most Detailed Level:** 8-day hourly load shapes by measure group, building type, and activity area. These estimates are available on request.

**Table 4-10: Potential Updates for HOU and CF – Linear Fluorescents**

DEER Bldg Type	# Sites	# Loggers	HOU	CF
Assembly*	16	156	1,213	0.29
Education - Community College	7	261		
Education - University	7	294		
Grocery	15	74	5,292	0.90
Health/Medical - Clinic	40	332	3,501	0.71
Office - Small	119	771	2,545	0.66
Other	118	633	2,773	0.56
Restaurant	25	75	3,682	0.69
Retail - Small	196	948	2,691	0.79
Warehouse	52	344	2,268	0.65
<b>Total</b>	<b>595</b>	<b>3,333</b>		

\* One of the current items being discussed is which specific detailed building from the 2006-08 data set should be included in Assembly. Depending on the outcome of this discussion, the sample sizes could change slightly.

**Table 4-11: Potential Updates for HOU and CF – CFLs**

DEER Bldg Type	# Sites	# Loggers	HOU	CF
Assembly*	64	280	970	0.14
Health/Medical - Clinic	61	215	1,703	0.27
Lodging	110	880	1,177	0.12
Office - Small	123	287	2,285	0.48
Other	141	437	2,060	0.34
Restaurant	110	381	3,803	0.63
Retail - Small	184	375	2,818	0.63
<b>Total</b>	<b>793</b>	<b>2,855</b>		

\* One of the current items being discussed is which detailed building types should be included in Assembly. Depending on the outcome of this discussion, the sample sizes could change slightly.

**Assessment of the Robustness of the revised Hours of Use Estimates compared to Current HOU Estimates**

As discussed above, the substantial increase in data available from the recent EM&V logger studies supports using these results to update the DEER HOU and CF values. These reasons are re-summarized below.

- Sample Sizes are significantly higher in the SmCom/LGP logger studies than the combined 2003 and 04-05 Express studies (used as a basis for DEER 2008).
  - SmCom/LGP logger analysis used data from over 8,000 loggers.
  - Express 03/04-05 logger analysis used data from approximately 650 loggers.
- The loggers installed as part of SmCom were installed for longer periods of time than those installed during the Express Evaluations.
- The DEER 2008 HOU estimates were partially based on assumed occupancy schedules in addition to logger data.
- However the team also identified some concerns with the whole sale substitution of HOU values from the 2006-08 studies which are described below.

**Possible Concerns with the Proposed Updates**

As discussed above, the suggested updates to HOU's for most building types are lower than the 2008 DEER values. The team has investigated several possibilities for the lower HOU and describes these possibilities below. In some cases, data was available to research the issue.

- **Possible Reason:** The Small Commercial participants do not represent the general non-residential population. Are the sites logged during the 2006-08 EM&V Studies smaller than the population? Do larger sites stay open longer and therefore have higher lighting HOU?
  - First, this question is more relevant if DEER is intended to be used for estimating savings for the “general population” as opposed to program participants. If the latter, the question however is still important, but changes slightly to: Are the sites logged during the 2006-08 EM&V Studies smaller than probable future participants.
  - The Small Commercial participant buildings were compared to the 2005 CEUS buildings. (Draft memo on this analysis is available.)
  - High-level results:
    - The Small Commercial sites are, on average, as large as the 2005 CEUS sites except for: Grocery\*, Retail, and Warehouses.
    - The Small Commercial sites are, on average, open as long as the 2005 CEUS sites except for: Lodging (N/A) and Retail.

- According to this preliminary analysis, the only building type that appears to require an HOU adjustment is retail. However, according to a simplistic regression model, the adjustment would be less than 1%.
  - **Possible Reason:** Increased saturation of occupancy sensors has reduced hours of use from the period 1995-2005 to current time period.
    - This is not supported by the Small Commercial logger data. The saturation of occupancy sensors is less than a couple percent of the sites logged.
  - **Possible Reason:** Previous estimates of HOU depended on engineering judgment and were not clearly estimated and then weighted up by different usage areas in buildings.
  - **Possible Reason:** The recession has reduced hours of use from the period 1995-2005 to current time period.
  - **Possible Reason:** The building type designation assigned to select sites as part of the 2006-08 logger study may differ in some cases from the definition of the DEER prototypes. The DEER team is continuing discussions about how to characterize these sites and whether they can be included in the analysis. The result of this conversation may end up proposing additional prototypes or a change in the definition of current prototypes to be more inclusive of similar types of buildings. The concern is that a large percentage of the 2006-08 participant population does not fit into one of the current DEER prototypes.
  - **Possible Reason:** Activity area weightings are also different. The DEER team is working on how to resolve these differences.

## 4.5 Delta Watts Calculations

This section presents the proposed delta watt values for CFLs and linear fluorescents including a comparison to the 2008 DEER values.

### 4.5.1 Delta Watts – CFLs

#### 2008 DEER Delta Watts – CFLs

The 2008 DEER estimated delta watts as a multiplier (or ratio reduction of 2.53) of the installed CFL wattage. Therefore, a 10 watt CFL would have a delta watts of 25.3 (or assumed baseline wattage of 35.3, or 3.53 times the installed wattage).

#### 2011 DEER Delta Watts – CFLs

The proposed delta watts (or ratio reduction) values were calculated using data collected during the 2006-08 Small Commercial Contract Evaluation. For the evaluation, the delta watts were calculated separately for Upstream CFLs and Downstream CFLs. However, for the 2011 DEER



update, the Tech Group proposes to use one set of ratio reductions. This section describes the data collected and the methodology used in the analysis to calculate these estimates.

For CFLs, manufacturer and model information were collected onsite for post-retrofit measures to estimate the wattage of the lamps installed, rather than simply relying on program tracking data. Average wattages were estimated by measure. In addition, self-report data was collected on-site on the wattage of pre-existing equipment. Pre-existing wattages were estimated by post-retrofit wattage (as pre-retrofit wattages were gathered by post-retrofit measure). Because the on-site data was not all encompassing of every possible post-retrofit wattage, regression analysis was used to develop a relationship between the pre- and post-retrofit wattages. These pre- and post-wattages were reviewed for this DEER update. The resulting delta watts and ratio reductions are shown below in Table 4-12.

As shown in Table 4-12, the proposed update would result in the delta watts increasing for some wattage ranges of CFL and decreasing it for others. The CFLs most likely to be included in future programs are the “advanced” CFLs which include:

- Twister CFLs over 30 watts.
  - The proposed delta watts for these CFLs would decrease the overall UES value by approximately 33%.
- Specialty CFLs (globes, reflectors, dimmable, etc.).
  - The team recommends that future research be conducted to better estimate the delta watts for specialty CFLs since that was not the focus of the Small Commercial Evaluation Study.

**Table 4-12: Delta Watts – CFLs**

Post-Wattage/ Ranges	Proposed 2011 Updates			2008 DEER		Delta Watts % Change
	Ratio	Pre-Wattage	Delta Watts	Pre-Wattage	Delta Watts	
3 W - 11 W	5.05	Various	Various	Various	Various	60%
12	4.75	57.0	45.0	30.4	30.4	48%
13	4.46	58.0	45.0	32.9	32.9	37%
14	4.22	59.0	45.0	35.4	35.4	27%
15	4.00	59.9	44.9	38.0	38.0	18%
16	3.80	60.8	44.8	40.5	40.5	11%
17	3.62	61.6	44.6	43.0	43.0	4%
18	3.46	62.4	44.4	45.5	45.5	-3%
19	3.32	63.1	44.1	48.1	48.1	-8%
20	3.19	63.8	43.8	50.6	50.6	-13%
21	3.07	64.4	43.4	53.1	53.1	-18%
22	2.96	65.0	43.0	55.7	55.7	-23%
23	2.85	65.6	42.6	58.2	58.2	-27%
24	2.81	67.4	43.4	60.7	60.7	-29%
25	2.77	69.1	44.1	63.3	63.3	-30%
26	2.73	70.9	44.9	65.8	65.8	-32%
> 26 W	2.70	Various	Various	Various	Various	-33%

#### 4.5.2 Delta Watts – Linear Fluorescents

##### Summary of Ex Ante Value Revisions for T12 Linear Fluorescent Baseline Fixtures

- Baseline Fixture Wattage Revised to Assume Minimum Energy Saving Magnetic Ballasts:** Minimum efficiency requirements for magnetic ballasts were adopted as part of EPACT in 1990. Ballasts covered by these standards are often called “Energy Efficient” or “ES” magnetic ballasts. These minimum efficiency requirements were updated again in 2005. The new requirements essentially prohibited the inclusion of ES magnetic ballasts in any new fixtures. However, the standard did allow the shipment of ES magnetic ballasts for repair or replacement purposes. Most importantly, EPACT 1990 required ES magnetic ballasts for all nonresidential applications. For this reason, the DEER team believes that older (or standard or pre-EPACT) magnetic ballasts cannot reasonably be used as a basis for determining baseline fixture wattage. For this reason, baseline wattages of fixtures in the DEER lighting fixture table that include pre-EPACT

magnetic ballasts have been revised to assume ES magnetic ballasts. Table 4-13 provides a sample of these fixture power revisions for 4 and 8 foot 2-lamp fixtures.

**Table 4-13: Comparison of 2008 and 2005 Fixed input Power for Linear Fluorescents**

Fixture Description	Fixture Input Power	
	DEER 2008	DEER 2011
FL, (2) 48in, ES IS lamp, Mag, W/fixt=82	82	72
FL, (2) 48in, STD IS lamp, Mag, W/fixt=84	84	74
FL, (2) 96in, ES lamp, Mag, W/fixt=128	128	123
FL, (2) 96in, ES HO lamp, Mag, W/fixt=227	227	207

- RUL of T12 Fixture Reduced:** EPACT will prohibit the shipment of most 4 and 8 foot T12 lamps as of July 1, 2012. This means that, at the end of a T12 lamp’s useful life, it will have to be replaced with a T8 lamp. The DEER team has therefore revised the remaining useful life (RUL) to be based on lamp life rather than ballast life for measures with baseline fixtures that include T12 lamps. For these cases, the RUL will be determined from the following equation:

$$RUL = 20,000 \text{ hr lamp life} / \text{bldg EFLH} / 3 - 1$$

20,000 hours is considered a conservative (or long) estimate for T12 lamp life. With this revised approach, as can be seen in the Table 4-14 below, the RUL for T12 fixtures changes from a range of 3.11 to 5.0 years to 0.27 to 3.3 years depending on the DEER building type. The current RUL in the DEER data base is six years.

**Table 4-14: Impact of Proposed Changes on T-12 RUL by Building Type**

Changes to DEER T12 Linear Fluorescent Early Retirement RUL				
Building Type	EFLH	DEER 45K hour Ballast Life Based EUL	DEER 2008 40K Hour Ballast Life Based RUL	DEER 2011 20K Hour Lamp Life Based RUL
Assembly	2610	15.00	5.00	1.55
Primary School	2140	15.00	5.00	2.12
Secondary School	2280	15.00	5.00	1.92
Community College	2420	15.00	5.00	1.75
University	2350	15.00	5.00	1.84
Relocatable Classroom	2480	15.00	5.00	1.69
Grocery	4910	9.16	3.05	0.36
Hospital	5260	8.56	2.85	0.27
Nursing Home	4160	10.82	3.61	0.60
Hotel	1950	15.00	5.00	2.42
Motel	1550	15.00	5.00	3.30
Bio/Tech Manuf.	3530	12.75	4.25	0.89
Light Industrial Manuf.	3220	13.98	4.66	1.07
Large Office	2640	15.00	5.00	1.53
Small Office	2590	15.00	5.00	1.57
Sit-Down Restaurant	4830	9.32	3.11	0.38
Fast-Food Restaurant	4840	9.30	3.10	0.38
Department Store	3380	13.31	4.44	0.97
Big Box Retail	4270	10.54	3.51	0.56
Small Retail	3380	13.31	4.44	0.97
Conditioned Storage	3420	13.16	4.39	0.95
Unconditioned Storage	3420	13.16	4.39	0.95
Refrigerated Warehouse	4770	9.43	3.14	0.40

#### 4.6 Non Residential Lighting – Interactive Effects

The DEER interactive effects of non-residential lighting were updated in 2010. The documentation of these changes can be found in *2006-2008 Energy Efficiency Evaluation Report: Summary of Development of Interactive Effects, May 21, 2010*.

# 5

## Impact Updates for Residential Hot Water Heating

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### 5.1 Introduction

Based on the findings of the Technology Group 3 team's data review effort, the DEER team has revised the EEM impacts for faucet aerators and low-flow showerheads for the 2011 update. For the residential water heater measure that uses simulation approach, the DEER team provides input parameters to the simulation team to update the impacts. The team will revise the remainder of the residential and non-residential hot water heating measures identified in the Technology Group 3 analysis plan and data assessment in 2012 for the long-term update.

### 5.2 Residential Faucet Aerators and Showerheads

Currently, the DEER deemed savings estimates for faucet aerators and low-flow showerheads use a non-weather sensitive engineering calculation method. The estimates use a fixed percent savings, also known as the Energy Savings Fraction (ESF), applied to the residential water heating unit energy consumption (UEC). Based on the data assessment, the DEER team proposed to revise the residential water heating UEC values as part of the short-term update in 2011. The energy savings fractions (ESF), used in the simplified engineering estimates, will be further reviewed and revised as part of the long-term effort in 2012.

The new residential water heating UEC values come from the 2009 Residential Appliance Saturation Study (RASS)<sup>1</sup>. The team compared the new UEC values to the values used in the 2004-2005 DEER updates. The 2008 DEER update did not revise the savings impacts for the faucet aerator and low-flow showerhead measures; hence, the 2005 DEER values are the most current set of deemed values. After comparing the UEC values, the DEER team planned to update the UEC values and propose updated EEM impacts. Table 5-1 compares the proposed UEC values and EEM impacts<sup>2</sup> for faucet aerators and low-flow showerheads with the 2005 DEER values. A Peak Demand factor (kW/kWh-unit) of 0.22 was used in the 2005 DEER to calculate the peak demand impacts. Even though the conversion factor seems to be on the higher side, the same factor is recommended for the short term. For the long term, it is recommended

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<sup>1</sup> 2009 Residential Appliance Saturation Study- <http://websafe.kemainc.com/rass2009/>

<sup>2</sup> These are direct impacts on the energy use of the water heater and do not include any estimate of embedded energy savings from reduced water deliveries or pumping.

that the non-weather sensitive peak demand reduction be aligned with the weather sensitive peak demands.

**Table 5-1: Comparison of 2005 DEER IOU Electricity Impacts and Proposed Impacts for Faucet Aerators and Low-Flow Showerheads**

Utility	Measure Name	Building Type	2005 DEER UEC (kWh)	2009 UEC (kWh)	ESF Electric %	From 2005 DEER		Proposed/ Calculated		% change in impacts
						Electric Impact (kWh/Unit)	Peak Demand <sup>3</sup> (Watts/Unit)	Elec. Impact (kWh/Unit)	Peak Demand (Watts/Unit)	
PG&E	Faucet Aerators	SF	2,301	3,311	3%	99.9	22.0	99.3	21.9	-1%
PG&E	Faucet Aerators	MF	1,896	1,495	3%	52.2	11.5	44.9	9.9	-14%
SCE	Faucet Aerators	SF	2,512	2,868	3%	90.6	19.9	86.0	18.9	-5%
SCE	Faucet Aerators	MF	1,906	1,645	3%	47.3	10.4	49.4	10.9	4%
SDGE	Faucet Aerators	SF	2,340	3,157	3%	83.2	18.3	94.7	20.8	14%
SDGE	Faucet Aerators	MF	1,940	1,690	3%	43.4	9.5	50.7	11.2	17%
PG&E	Low Flow Showerhead	SF	2,301	3,311	4%	133.3	29.3	132.4	29.1	-1%
PG&E	Low Flow Showerhead	MF	1,896	1,495	4%	69.6	15.3	59.8	13.2	-14%
SCE	Low Flow Showerhead	SF	2,512	2,868	4%	120.7	26.6	114.7	25.2	-5%
SCE	Low Flow Showerhead	MF	1,906	1,645	4%	63.0	13.9	65.8	14.5	4%
SDG&E	Low Flow Showerhead	SF	2,340	3,157	4%	110.9	24.4	126.3	27.8	14%
SDG&E	Low Flow Showerhead	MF	1,940	1,690	4%	57.9	12.7	67.6	14.9	17%

The last column in the table provides the percentage difference between the proposed impact and 2005 DEER impact values. Since there is not a significant variation in proposed savings across the utilities, the DEER team recommends that statewide unit energy saving impacts be used for both of the measures. Table 5-2 provides the recommended statewide electric unit energy

<sup>3</sup> Peak demand factor was calculated using a multiplying the energy impacts with peak demand conversion factor of 0.22 in 2005 DEER.

impacts for faucet aerators and low-flow showerheads. The statewide numbers are obtained by performing a straight average of electric impacts for all the utilities.

**Table 5-2: Recommended Statewide Average Electric Unit Energy Impacts for Faucet Aerators and Low-Flow Showerheads**

<b>Measure Name</b>	<b>Building Type</b>	<b>2009 UEC</b>	<b>ESF</b>	<b>Proposed Elec Impact (kWh/Unit)</b>	<b>Proposed Peak Impact (Watts/Unit)</b>
Faucet Aerators	SF	3,112	3%	93.4	21
Faucet Aerators	MF	1,610	3%	48.3	11
Low Flow Showerhead	SF	3,112	4%	124.5	27
Low Flow Showerhead	MF	1,610	4%	64.4	14

Table 5-3 compares the proposed natural gas impacts for the water heating measures. It also compares the proposed UEC values with the UEC values used in the 2005 DEER database.

**Table 5-3: Comparison of Proposed IOU Natural Gas Impacts and 2005 DEER Impacts for Faucet Aerators and Low-Flow Showerheads**

Utility	Measure Name	Bldg. Type	2005 DEER UEC (Therms)	2009 UEC (Therms)	ESF Gas %	2005 DEER Gas Impact (Therms/Unit)	Proposed Gas Impact (Therms/Unit)	% change in impacts
PG&E	Faucet Aerators	SF	111	189	3%	5.6	5.7	2%
PG&E	Faucet Aerators	MF	104	183	3%	11.5	5.5	-52%
SCG	Faucet Aerators	SF	115	196	3%	6.7	5.9	-12%
SCG	Faucet Aerators	MF	104	192	3%	10.4	5.8	-44%
SDGE	Faucet Aerators	SF	103	182	3%	5.6	5.5	-2%
SDGE	Faucet Aerators	MF	97	161	3%	5.0	4.8	-4%
PG&E	Low Flow Showerhead	SF	111	189	4%	7.5	7.6	1%
PG&E	Low Flow Showerhead	MF	104	183	4%	6.7	7.3	9%
SCG	Low Flow Showerhead	SF	115	196	4%	9.0	7.8	-13%
SCG	Low Flow Showerhead	MF	104	192	4%	8.1	7.7	-5%
SDG&E	Low Flow Showerhead	SF	103	182	4%	7.4	7.3	-1%
SDG&E	Low Flow Showerhead	MF	97	161	4%	6.7	6.4	-4%

The last column in the table provides the percentage difference between the proposed impact and 2005 DEER impact values. Since there is not a significant variation in proposed savings across the utilities, the DEER team recommends that statewide unit energy saving numbers should be used for both of the measures. Table 5-4 provides the recommended statewide electric unit energy impacts for faucet aerators and low-flow showerheads. The statewide numbers are obtained by performing a straight average of electric impacts for all the utilities.



**Table 5-4: Recommended Statewide Average Natural Gas Unit Energy Impacts for Faucet Aerators and Low-Flow Showerheads**

Measure Name	Bldg. Type	2009 UEC	ESF	Proposed Gas Impact (Therms/Unit)
Faucet Aerators	SF	189	3%	5.7
Faucet Aerators	MF	179	3%	5.4
Low Flow Showerhead	SF	189	4%	7.6
Low Flow Showerhead	MF	179	4%	7.1

### 5.3 Residential Instantaneous and Storage Water Heater Measures

The 2008 DEER model incorporated the domestic hot water system into the residential simulation prototypes to calculate EEM impacts. As part of the short-term update, the input parameters used in the simulation will be reviewed and updated. The input parameters that are used in the simulations are readily available from the 06-08 evaluation studies<sup>4</sup> and will be compared with the existing values by the simulation team.

The input parameters that are used in the simulation are:

1. Heat Input Ratio,<sup>5</sup>
2. Tank Losses,<sup>6</sup> and
3. Water Heater Part Load Performance Curve

The simulation team will use the Energy Factor (EF) to update the heat input ratio, where as the storage tank size and the water heater temperature setting information will be used to update the tank losses. Energy factor, storage tank size, and water heater temperature setting information are available from the 06-08 evaluation studies. The values from the evaluations will be compared with the input parameters in the simulation model. Table 5-5 shows the number of sites within the utility program for which the energy factor, storage size and temperature setting information are available.

<sup>4</sup> Residential Retrofit – High Impact Measure Evaluation Report, Prepared for the California Public Utilities Commission Energy Division, February 2010

<sup>5</sup> HIR (Heat Input Ratio) = 1/Recovery Efficiency. 2008 DEER developed a table that shows the corresponding recovery efficiency to energy factor.

<sup>6</sup> Formula used for calculating Tank Losses is provided in the 2008 DEER Report Version 2008.2.05.

**Table 5-5: Sample Size by Utility Program**

Utility Program	Number of Sites
PGE2000	75
SDGE3024	75

Table 5-6 through Table 5-8 provide details on the energy factor, storage size and the temperature settings gathered during the site visits. The simulation team will compare the input parameters with the values that are currently being used by the DEER model and update them if there is a significant difference.

**Table 5-6: Energy Factor for Rebated Hot Water Heaters**

Energy Factor (EF) <sup>7</sup>	PGE2000 (n=75)	SDGE3024 (n=75)
Gas EF of 0.59	0	1
Gas EF of 0.62	43	46
Gas EF of 0.63	18	23
Gas EF of 0.64	2	0
NA	12	5
Gas EF – Average	0.623	0.622

**Table 5-7: Average Storage Size for Rebated Hot Water Heaters**

Storage Size (Gallons)	PGE2000 (n=75)	SDGE3024 (n=75)
30 Gallon Tank	3	7
40 Gallon Tank	43	37
50 Gallon Tank	25	31
NA	4	0
Average Size	43.1	43.2

**Table 5-8: Average Temperature Setting for Hot Water Heaters**

Utility	Average Temperature Setting
PGE2000 (n=75)	128
SDGE3024 (n=75)	125

<sup>7</sup> When the EF was not available from site visits, the Evaluation Team conducted a make/model look-up (e.g., the Website: [http://www.nipsco.com/energyprograms/eh/waterheaters\\_prod\\_list.html](http://www.nipsco.com/energyprograms/eh/waterheaters_prod_list.html))

## 5.4 Recommendations for the Short-Term Update

As mentioned earlier in the report, the DEER team recommends statewide impact values for the faucet aerators and low-flow showerhead measures. Table 5-9 and Table 5-10 summarize the recommended impact updates for the faucet aerators and low-flow showerhead measures.

**Table 5-9: Recommended Statewide Electric Unit Energy Impacts for Faucet Aerators and Low-Flow Showerheads**

Measure Name	Bldg. Type	2009 UEC	ESF	Proposed Elec. Impact (kWh/Unit)	Proposed Peak Impact (Watts/Unit)
Faucet Aerators	Single Family	3,112	3%	93.4	21
Faucet Aerators	Multi Family	1,610	3%	48.3	11
Low Flow Showerhead	Single Family	3,112	4%	124.5	27
Low Flow Showerhead	Multi Family	1,610	4%	64.4	14

**Table 5-10: Recommended Statewide Natural Gas Unit Energy Impacts for Faucet Aerators and Low-Flow Showerheads**

Measure Name	Bldg. Type	2009 UEC	ESF	Proposed Gas Impact (Therms/Unit)
Faucet Aerators	Single Family	189	3%	5.7
Faucet Aerators	Multi Family	179	3%	5.4
Low Flow Showerhead	Single Family	189	4%	7.6
Low Flow Showerhead	Multi Family	179	4%	7.1

For the residential water heater measures, the DEER team provides recommended input parameters to the simulation team. The simulation team will compare the input parameters with the values that are currently being used by the DEER model and update the impacts if there is a significant difference.

# 6

## Overall Summary of NTGR Analysis

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This section is designed to provide the reader with a very high level overview of the recommended changes in net to gross ratios (NTGR) as part of the DEER 2011 update. The master table below provides a useful historical perspective on how net to gross ratios for specific measure delivered using a specific program delivery method have evolved over the last five years. For each measure, the table summarizes the NTGR value, source and method used to derive the value for the 2008 DEER v2.05, the most recent evaluations of 2006-08 programs and the recommended NTGR value for the 2011 DEER update. The table provides an overall perspective on how the methods used to derive the NTGR values and the NTGR values themselves have evolved over time.

In addition, the table highlights the magnitude of the proposed changes for 2011 compared to the values in the 2008 version of DEER using a color code described immediately above the table. The color codes identify measures where the proposed NTGR values for 2011 have changed by more than 50% (yellow) or between 20 and 50% (green code) relative to the values in the 2008 DEER data base. Table 6-1 summarizes all of this data grouped by technology and market segment. The table uses a consolidated list of Program Delivery Methods that are defined as follows:

1. **CIDN**: Custom or Calculated Incentive based on site or project related parameters; paid downstream to customer.
2. **CIDI**: Custom or Calculated Incentive based on site or project related parameters; paid to a contractor (Direct Install or Mid-stream).
3. **CI**: Custom or Calculated Incentive based on site or project parameters; paid to either a contractor (Direct Install or Mid-stream) or customer (Indexes 1 & 2).
4. **DI**: Custom or Prescriptive incentive or reimbursement for services; paid to a contractor (Direct Install or Mid-stream) (Indexes 2 & 6).
5. **PRDN**: Prescriptive (fixed) rebate; paid downstream to customer.
6. **PRDI**: Prescriptive (fixed) rebate or reimbursement for services; paid downstream or midstream to contractor (Direct install or midstream).
7. **PR**: Prescriptive (fixed) rebate or reimbursement for services; paid to either a contractor (Direct Install or Mid-stream) or customer (Indexes 5 & 6).
8. **OBF**: Custom or prescriptive incentive in form of financing; paid to customer via on bill financing.
9. **PRUP**: Prescriptive (fixed) rebate; paid upstream to manufacturer or distributor.
10. **DSVC**: Service provided by the implementer at no cost to the participant. Example: free pump tests from SCE Hydraulic Services Group, etc.
11. **ALL**: All program delivery methods (Indexes 1 - 10).
12. **ALLXDI**: All program delivery methods except Direct Install (Indexes 1, 5, 8, 9, & 10).

**Table 6-1: Master Table of NTGR for Specific Measure/Delivery Combinations Over Time**

Key to Highlight Colors for Changes in Values from the 2008 DEER to the Recommended 2011 DEER Updates: <10%, 10% to 20%, >20% to 50%, >50%

EEM	Sector	Program Delivery Methods*	2008 DEER v2.05			2006 – 2008 Evaluation Studies			Recommended 2011 DEER Updates			
			NTGR	Source	Method	Source	NTGR	Method	NTGR	Building Types or Sales Channels	Utility Specific or Statewide	Proposed Adjustments for 2013-2014
<b>Non-Residential Lighting</b>												
CFLs	Non-Res	PRDN or CI	0.81	0405 Express Efficiency	SRA	0608 Small Commercial Contract Group (SCCG)	0.53	SRA	0.53 kWh 0.57 kW	All <sup>1</sup>	Statewide	None
CFLs	Non-Res	DI	0.85	0405 SDG&E Small Business	SRA	0608 SCCG Report	0.80	SRA	0.80	All <sup>1</sup>	Statewide	None
Linear Fluorescents <sup>2</sup>	Non-Res	PRDN or CI	0.78	0405 Express Efficiency	SRA & Discrete Choice	0608 SCCG Report	0.70	SRA & Discrete Choice	0.70	All <sup>1</sup>	Statewide	None
Linear Fluorescents	Non-Res	DI	0.85	0405 SDG&E Small Business	SRA & Discrete Choice	0608 SCCG Report	0.89	SRA & Discrete Choice	0.89	All <sup>1</sup>	Statewide	None
Lighting Controls	Non-Res	PRDN	0.84	0405 Express Evaluation	SRA	0608 SCCG Report	0.60	SRA	0.60 kWh 0.59 kW	All <sup>1</sup>	Statewide	None
Lighting Controls	Non-Res	DI	0.85	0405 SDG&E Small Business	SRA	0608 SCCG Report	0.89	SRA	0.89 kWh 0.74 kW	All <sup>1</sup>	Statewide	None
<b>Residential Lighting</b>												
Basic CFL	Res	PRUP	0.60	Multiple sources	SRA, Discrete Choice, Market Share Forecasts	0608 KEMA	0.54	Multiple Sources, Preponderance of Evidence	0.54	All Sales Channels	Statewide	None
<b>Commercial HVAC Systems</b>												
HVAC Maintenance: Refrigerant Charge Adjustment	Non-Res	PR	0.70	Default	n/a	HVAC HIM and Spec. Commercial	PGE2068 0.54 PGE2080 0.55 SCE 0.94 SDGE 0.70	SRA	0.73	All	Statewide	None

<sup>1</sup> The non-residential lighting NTGR values are available by specific building types in the “Recommended Updates to Net-to-Gross Ratios for Non-residential Lighting Measures” document and can be used to exclude a building type from the weighted NTGR value and a new weighted value estimated.

<sup>2</sup> Consider excluding T-12 and first generation T-8 fixtures as of July 2012 by designating a zero NTGR after new federal standards become effective.

Database for Energy Efficiency Resources: 2011 Update

EEM	Sector	Program Delivery Methods*	2008 DEER v2.05			2006 – 2008 Evaluation Studies			Recommended 2011 DEER Updates				
			NTGR	Source	Method	Source	NTGR	Method	NTGR	Building Types or Sales Channels	Utility Specific or Statewide	Proposed Adjustments for 2013-2014	
RCx Packages	Non-Res	CIDN, PRDN	0.90 Elec., 1.0 Nat. Gas	'04-'05 Bldg. Tune-Up, '04-'05 SD RCx	SRA	RCx Impact Evaluation	<small>kWh kW Therms</small> PGE 0.80 0.76 0.86 SCE 0.86 0.78 0.91 SCG - - 0.92 SDGE 0.75 0.75 0.68	SRA	0.80 0.82	Elec. Nat. Gas	All	Statewide	None
Chiller Replacement	Comm. only	CIDN	0.64	'04-'05 SPC Evaluation + SRA Bias	SRA	Major Customer Evaluation	<small>kWh kW</small> SCE 0.59 0.57 SDGE3010 0.70 0.68 SDGE3025 0.56 0.54	SRA	0.58		All	Statewide	None
Package and Split System AC and HP Replacement	Non-Res	PRUP	0.85	'04-'05 SW Express and Upstream Evaluation, Adjusted	SRA, Discrete Choice	HVAC HIM and Spec. Commercial	<small>kWh kW</small> PGE 0.94 0.94 SCE 0.96 0.96 SDGE0.94 0.94	SRA	0.85		All	Statewide	None
<b>Residential HVAC Systems and Building Envelope</b>													
Room Air Conditioner	Res	PRDN	0.70	Default '04-'05 Res. Retrofit	SRA	Residential Retrofit Evaluation	PGE2000 0.41 SCE2501 0.36 SDGE3024 0.31	SRA	0.36		Single and Multi-Family	Statewide	Increase base NTGR by .10
HVAC Maintenance: Duct Sealing	Res	PR	0.78	'04-'05 Res. Retrofit	SRA	HVAC HIM and Spec. Commercial	PGE2000 0.54 PGE2078 0.85 SCE2501 0.79 SCE2507 0.96 SDGE3035 0.80	SRA	0.78		Single and Multi-Family, Mobile Home	Statewide	None
HVAC Maintenance: Refrigerant Charge Adjustment	Res	PR	0.78	'04-'05 Res. Retrofit	SRA	HVAC HIM and Spec. Commercial	PGE2000 0.63 PGE2078 0.78 SCE2501 0.78 SCE2507 0.97 SDGE3035 0.78	SRA	0.78		Single and Multi-Family, Mobile Home	Statewide	None
Roof and Wall Insulation	Res	PRDN	0.70	'04-'05 Res. Retrofit	SRA	Residential Retrofit Evaluation	<small>kWh kW Therms</small> PGE 0.25 0.28 0.26 SCG 0.30 0.30 0.29 SDGE 0.25 0.26 0.25	SRA	0.28		Single Family	Statewide	None
Air Cooled Packaged and Split System Air Conditioners and Heat Pumps	Res	PRDN	0.67, Central AC >14 SEER; 0.80, Central AC >15 SEER; 0.55, Heat Pump-Energy Star	'04-'05 Res. Retrofit	SRA	HVAC HIM and Spec. Commercial	SCE2507 0.56 SDGE3029 0.53	SRA	0.55		Single Family	Statewide	None

Database for Energy Efficiency Resources: 2011 Update

EEM	Sector	Program Delivery Methods*	2008 DEER v2.05			2006 – 2008 Evaluation Studies			Recommended 2011 DEER Updates			
			NTGR	Source	Method	Source	NTGR	Method	NTGR	Building Types or Sales Channels	Utility Specific or Statewide	Proposed Adjustments for 2013-2014
<b>Commercial and Industrial Custom</b>												
Pump-Off Controllers	Industrial	CIDN	0.54	Itron-KEMA, 2008	SRA	Itron, PG&E 2010 <sup>3</sup> & Itron Memo, 2009 <sup>4</sup>	PGE Major 0.45 PGE/SCE Major 0.42 PGE/SCE Independent 0.74 (Combined since there isn't a simple way to define independents)	SRA	0.45	Oil & Gas Producers	Statewide	None
Pipe Insulation	Industrial	CIDN	0.54	Itron-KEMA, 2008	SRA	Itron, see footnote 2 in document	SCG 0.72 PGE 0.49	SRA	0.71	Industrial	Statewide	None
Steam Traps	Small Comm.	PRDN	0.54	Itron-KEMA, 2008	SRA	Itron, Southern California Industrial and Agricultural	PGE 0.62 SCG 0.70 SDGE 0.72	SRA	0.68	Small Comm.	Statewide	None
Steam Traps, High Pressure	Industrial	CIDN	0.54	Itron-KEMA, 2008	SRA	Itron, Footnote 4 in document	0.52	SRA	0.52	Industrial High Pressure	Statewide	None
Steam Traps, Low Pressure	Industrial	CIDN	0.54	Itron-KEMA, 2008	SRA	Itron, Footnote 4 in document	0.57	SRA	0.52	Industrial Low Pressure	Statewide	None
Custom – Electric	Comm. / Industrial	CIDN	0.54	Itron-KEMA, 2008	SRA	Itron Footnote 1 in document, FN3, SBW (2010) <sup>5</sup> and ADM, 2010 <sup>6</sup>	PGE 0.60 SCE Intgrtd. 0.63 SCE Std Prfrm 0.59 PGE High Tech 0.47 PGE Lg Com 0.60 Based on kWh; kW values not statistically significant	SRA	0.60 (Weighted average based on energy savings from four studies)	Commercial / Industrial	Statewide	None

<sup>3</sup> Itron, PG&E Fabrication, Process and Manufacturing Group, February 2010.

<sup>4</sup> Itron, July 7, 2009 Early Feedback Memo to Support CPUC and IOU Planning Regarding Pump-Off Controller Interventions in 2009-2011.

<sup>5</sup> SBW Major Commercial Contract Group - Final Impact Evaluation Report 2006-2008 Program Years.

<sup>6</sup> ADM, Commercial Facilities Contract Group - 2006-2008 Direct Impact Evaluation, February 2010.

*Database for Energy Efficiency Resources: 2011 Update*

EEM	Sector	Program Delivery Methods*	2008 DEER v2.05			2006 – 2008 Evaluation Studies			Recommended 2011 DEER Updates			
			NTGR	Source	Method	Source	NTGR	Method	NTGR	Building Types or Sales Channels	Utility Specific or Statewide	Proposed Adjustments for 2013-2014
Custom Electric RFP or Bid	Comm. / Industrial	CI	0.54	Itron-KEMA, 2008	SRA	ADM, 2010 <sup>7</sup>	SDGE3010 0.70	SRA	0.70	Commercial / Industrial	Statewide	None
Custom Gas	Comm. / Industrial	CIDN	0.64	Custom Default	SRA	Itron, PG&E 2010; see Footnote 1 in document	PG&E 0.31 SCG 0.54	SRA	0.35	Industrial	Statewide	None
Agricultural Greenhouse Envelope – Heat curtains	Agri	PRDN, CIDN	0.50	kW Engineering / Phil Willems, 2007 <sup>8</sup>	SRA	KEMA, PG&E Agricultural and Food Processing	0.63	SRA	0.63	Agricultural	Statewide	None
Pump Tests	Agri	PRDI, DSVC	0.64	Itron-KEMA, 2008	SRA	Itron, Footnote 2 in document	0.63	SRA	0.63	Agricultural	Statewide	None
Agricultural Greenhouse Envelope – Infrared Film	Agri	PRDN, CIDN	0.50	kW Engineering / Phil Willems, 2007	SRA	KEMA, 2010 <sup>9</sup>	0.46	SRA	0.46	Agricultural	Statewide	None
All Other Agricultural Measures – Electric	Agri	CIDN	0.79	kW Engineering / Phil Willems, 2007	SRA	KEMA, 2010 <sup>10</sup>	0.70	SRA	0.70	Agricultural	Statewide	None
All Other Agricultural Measures - Natural Gas	Agri	CIDN	0.72	kW Engineering / Phil Willems, 2007	SRA	KEMA, 2010	0.69	SRA	0.70	Agricultural	Statewide	None
<b>Residential and Non-Residential Hot Water Heating Systems</b>												
Faucet Aerators	Res	DI	0.85	Default NTGR for direct install for hard to reach	Default	Cadmus, Res Retrofit 2006-08	0.59 Single Family 0.65 Multi family	SRA	0.59 0.65	Single Family Multi Family	Statewide	None
Low Flow Showerheads	Res	DI	0.85	Default NTGR for direct install for hard to reach	Default	Cadmus, Res Retrofit 2006-08	SCG(MF) 0.72 SDGE(MF) 0.68 SDG&E(SF) 0.70	SRA	0.70	All	Statewide	None

<sup>7</sup> Ibid

<sup>8</sup> 2004-2005 Evaluation, Measurement and Verification Report California Multi Measure Farm Program 1354-04 and 1360-04, kW Engineering, March 2007 (CALMAC Study ID: ENS0002.01)

<sup>9</sup> 2006-2008 Evaluation Report: PG&E Agricultural and Food Processing Program; greenhouse Heat Curtain and Infrared Film Measures, KEMA Inc. Feb. 2010 (CALMAC Study ID: CPU0024.01)

<sup>10</sup> 2006-2008 Evaluation Report: PG&E Agricultural and Food Processing Program; Greenhouse Heat Curtain and Infrared Film Measures, KEMA Inc., February 2010 (CALMAC Study ID: CPU0024.01)



*Database for Energy Efficiency Resources: 2011 Update*

EEM	Sector	Program Delivery Methods*	2008 DEER v2.05			2006 – 2008 Evaluation Studies			Recommended 2011 DEER Updates			
			NTGR	Source	Method	Source	NTGR	Method	NTGR	Building Types or Sales Channels	Utility Specific or Statewide	Proposed Adjustments for 2013-2014
Residential Gas Storage Water Heater EF>0.62 <0.65 Cap>30 gallons	Res	PRDN	0.58	Itron, 2004-05 Residential Retrofit <sup>11</sup>	SRA, Discrete Choice	Cadmus, Res Retrofit 2006-08	SDGE 0.23 PGE 0.18	SRA	0.23	All	Statewide	None
<b>Residential Appliances</b>												
Clothes Washers MEF 10% > than Energy Star	Res	PRDN	0.81	Itron, 2007 <sup>12</sup>	SRA	Cadmus, 2010	PGE2000 0.31 SDGE3023 0.31 SCG3517 0.29	SRA	0.31	All	Statewide	None
Refrigerator Recycling	Res	PRDI	0.614	ADM, 2008 <sup>13</sup>	SRA participants and non-participants	Cadmus, 2010	PGE2000 0.51 SCE2500 0.56 SDGE3028 0.58	Self Report and Discrete Choice	0.53	All	Statewide	None
Freezer Recycling	Res	PRDI	0.702	ADM, 2008	SRA participants and non-participants	n/a	Not Evaluated	n/a	0.70	All	Statewide	None
<b>Commercial Refrigeration</b>												
Door Gaskets	Non-Res	ALL	0.46	Itron, December 2008 <sup>14</sup>	SRA	ADM, Feb. 2010 <sup>15</sup>	0.19	SRA	0.19	Supermarkets, Convenience Stores, Restaurants	Statewide	None
Strip Curtains	Non-Res	PRDN	0.76	Itron, Dec. 2008	SRA	ADM, Feb. 2010	0.40	SRA	0.40	Supermarkets, Convenience Stores, Restaurants	Statewide	None

11 Itron Inc, 2004/2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation; CPUC-ID#:1115-04, September 2007.

12 Itron Inc, 2004/2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation; CPUC-ID#:1115-04, September 2007.

13 Evaluation Study of the 2004-2005 Statewide Residential Appliance Recycling Program, ADM, April, 2008

14 2004/2005 Statewide Express Efficiency and Upstream HVAC Program Impact Evaluation, Itron, Inc., December 2008.

15 Commercial Facilities Contract Group 2006-2008 Direct Impact Evaluation Study, Volumes 1 and 3, ADM and Associates, February 2010.

*Database for Energy Efficiency Resources: 2011 Update*

EEM	Sector	Program Delivery Methods*	2008 DEER v2.05			2006 – 2008 Evaluation Studies			Recommended 2011 DEER Updates			
			NTGR	Source	Method	Source	NTGR	Method	NTGR	Building Types or Sales Channels	Utility Specific or Statewide	Proposed Adjustments for 2013-2014
<b>Default NTGR<sup>16</sup></b>												
No Evaluated NTGR – Hard to Reach	Res	DI	0.85	DEER staff	Lit Search	Not Evaluated	See Section 15 for a discussion of how the NTGR values were derived.	n/a	0.85	All	Statewide	None
No Evaluated NTGR - New or emerging technologies in programs <2 years	Res, Comm.	ALLXDI	0.70	DEER staff	Lit Search	Not Evaluated	See Section 15 for a discussion of how these NTGR values were derived.	n/a	0.70	All	Statewide	None
No Evaluated NTGR - Existing Measures with same delivery mechanism for > 2 years	Industrial / Agri/Comm	ALLXDI	0.54	DEER staff	Lit Search	Not Evaluated	See Section 15 for a discussion of how these NTGR values were derived.	n/a	0.60	All	Statewide	None
No Evaluated NTGR - Existing Measures with same delivery mechanism for > 2 years	Res	ALLXDI	n/a	n/a	n/a	Not Evaluated	See Section 15 for a discussion of how these NTGR values were derived.	n/a	0.55	All	Statewide	None

\*The Program Delivery Methods in this table and in the database update use the following convention:

1. **CIDN**: Custom or Calculated Incentive based on site or project related parameters; paid downstream to customer. Database Code: **CustIncentDown**.
2. **CIDI**: Custom or Calculated Incentive based on site or project related parameters; paid to a contractor (Direct Install or Mid-stream). Database Code: **CustIncentDI**.
3. **CI**: Custom or Calculated Incentive based on site or project parameters; paid to either a contractor (Direct Install or Mid-stream) or customer (Indexes 1 & 2). Database Code: **CustIncent**.
4. **DI**: Custom or Prescriptive incentive or reimbursement for services; paid to a contractor (Direct Install or Mid-stream) (Indexes 2 & 6). Database Code: **DirInstall**.
5. **PRDN**: Prescriptive (fixed) rebate; paid downstream to customer. Database Code: **PreRebDown**.
6. **PRDI**: Prescriptive (fixed) rebate or reimbursement for services; paid downstream or midstream to contractor (Direct install or midstream). Database Code: **PreRebDI**.
7. **PR**: Prescriptive (fixed) rebate or reimbursement for services; paid to either a contractor (Direct Install or Mid-stream) or customer (Indexes 5 & 6). Database Code: **PreReb**.
8. **OBF**: Custom or prescriptive incentive in form of financing; paid to customer via on bill financing. Database Code: **OnBill**.
9. **PRUP**: Prescriptive (fixed) rebate; paid upstream to manufacturer or distributor. Database Code: **PreRebUp**.
10. **DSVC**: Service provided by the implementer at no cost to the participant. Example: free pump tests from SCE Hydraulic Services Group, etc. Database Code: **DirectSvc**.
11. **ALL**: All program delivery methods (Indexes 1 - 10). Database Code: **All**.
12. **ALLXDI**: All program delivery methods except Direct Install (Indexes 1, 5, 8, 9, & 10). Database Code: **AllxDI**.

<sup>16</sup> Refer to the analysis paper for the reasoning and criteria used to develop the default NTGR values.

# 7

## Recommended Updates to Net-to-Gross Ratios for Non-Residential Lighting Measures

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### 7.1 Introduction

In this analysis, the most recent NTGR results from the 2006-2008 EM&V studies are compared to the existing values in the 2008 DEER database to derive a recommended value for the measures in this technology group selected for the DEER 2011 update. For each measure, the DEER Team compares the strengths and weaknesses of the latest method used to derive NTGR results and contrast this to the relative strength of the method used to estimate NTGR for the 2008 DEER update. The factors used to make a final NTGR recommendation include:

- The relative merits of the methods and sampling plans used to derive NTGR estimates in for existing DEER data base and those methods used to produce new NTG results in 2006-08 evaluation studies.
- Potential changes in program design or measure minimum qualification levels between the previous evaluation and 2006-08 evaluation.
- Rate of change in the market share of more efficient building systems or measures over time.
- Any available evidence on trends in the incremental cost of specific measures and how these could lead to changes in qualifying rebate levels or estimated NTGR over time.

After making a recommendation for a specific NTGR value to use in 2011 update, the DEER Team identified the program and market factors are likely to lead to changes in NTG results over the next three years (the first year when these new NTGR values might be used). The DEER Team then assessed whether there was sufficient data and or analysis tools to accurately forecast the likely trend in NTGR values over the next three years for this specific measure and program design. If there is sufficient data to make an accurate forecast absent any significant changes in program design and or qualifying levels for rebated measures, the DEER Team produced a forecast of NTGR for use in 2013-2014. Finally, the DEER Team notes that if either the program design or qualifying efficiency level for measures is changed significantly between 2009 and 2013, the forecast of NTGR should not be used in 2013 because it was based on the assumption of no major changes in design or qualifying levels.

## **7.2 Comparison of Current DEER NTGR to Results from Latest EM&V Analyses in 2006-2008**

The latest EM&V analysis for non-residential lighting was performed by Itron during the 2006-2008 program cycle. The results of the evaluation were reported in the 2006-2008 Small Commercial Contract Group (SCCG) Direct Impact report prepared for the California Public Utilities Commission. The objective of this analysis was to develop net-to-gross ratios (NTGR) for all HIMs and non-HIMs. A self-report methodology was utilized. This methodology was developed by the Standard Non-residential NTGR working group, which was comprised of Energy Division and its technical consultants and evaluators. The methodology estimated four separate measurements of free ridership from different inquiry routes and then averaged the values to derive the final free ridership estimate at the measure level.

The SCCG evaluation calculated NTGRs for CFLs, linear fluorescents, high bay fluorescents, and lighting controls. Due to the limited sample size for high bays and similarities in results for the high bay fluorescents and linear fluorescents, these two measures were combined for the DEER recommendations.

Table 7-1 compares NTGR estimates for the leading lighting measures in the current DEER database to the latest results from the 2006-2008 evaluations.

**Table 7-1: Overview of NTGR Results by Measure, Delivery Mechanism and Vintage**

Energy Efficiency Measure	Delivery Mechanism	Existing DEER NTGR Values (Source)	06-08 NTGR Results (Source)
CFLs	Downstream Prescriptive	.81 (0405 Express Efficiency)	0.53 (0608 Small Commercial Report)
CFLs	Direct Install	.85 (0405 SDG&E Small Business)	0.80 (0608 Small Commercial Report)
Linear Fluorescents	Downstream Prescriptive	.78 (0405 Express Efficiency)	0.70 (0608 Small Commercial Report)
Linear Fluorescents	Direct Install	.85 (0405 SDG&E Small Business)	0.89 (0608 Small Commercial Report)
Lighting Controls	Downstream Prescriptive	.84 (0405 Express Evaluation)	0.60 (0608 Small Commercial Report)
Lighting Controls	Direct Install	.85 (0405 SDG&E Small Business)	0.89 (0608 Small Commercial Report)

### 7.3 Comparison of Methods and Sample Sizes Used to Derive NTGR Results

Both the 2004-2005 Express Efficiency evaluation (used to support current NTGR values in DEER) and the SCCG Report used the self-report method to estimate NTG for CFLs, linear fluorescents, and lighting controls. The 2008 DEER and the latest evaluation study also used discrete choice analysis to estimate the NTG for linear fluorescents. The SCCG evaluation included 2,680 participants statewide in the self-report NTG analysis. This greatly exceeds the 862 participants included in the 2004-2005 Express Efficiency Evaluation and the 150 participants included in the Evaluation of the SDG&E 2004-2005 Small Business Energy Efficiency Program.

The recommended NTGR values from the most recent evaluation study are up to 28 percent lower than existing NTGR values because of three factors:

- Diffusion of new product information and success stories over time- e.g. more commercial customers become aware of efficient lighting systems and as a result are willing to buy them as standard business practice.
- More accurate evaluation methods and larger sample sizes.
- Increases in availability and declines in cost of more energy efficient lighting systems over time reinforce likelihood that more efficient lighting systems will become standard business practice for a higher fraction of customers (who will be identified as free rider in NTG analysis.)

Overall, the DEER team finds that the most recent evaluation conducted in 2008 contains better, more precise information than the existing DEER based on a review of the methodologies, sample sizes and applicability. Table 7-2 below shows the methods and sample sizes of the NTG values from the SCCG Report.

**Table 7-2: Methods and Sample Sizes for Non-Residential Lighting**

<b>Measure</b>	<b>Market Segment and Program Year</b>	<b>NTGR Method Used</b>	<b>Sample Size</b>	<b>Delivery Mechanism</b>
CFLs	Non-Residential 2006-2008	Self Report	115	Downstream Prescriptive
CFLs	Non-Residential 2006-2008	Self Report	444	Direct Install
Linear Fluorescents	Non-Residential 2006-2008	Self Report/Discrete Choice	521	Downstream Prescriptive
Linear Fluorescents	Non-Residential 2006-2008	Self Report/Discrete Choice	1,479	Direct Install
Lighting Controls	Non-Residential 2006-2008	Self Report	80	Downstream Prescriptive
Lighting Controls	Non-Residential 2006-2008	Self Report	41	Direct Install

## **7.4 Recommended NTGR by Measure and Applicable Market Segments or Building Types**

Table 7-3 shows the recommended NTGRs to be used to update the DEER database in 2011. It is recommended that the NTGRs are updated by measure and delivery mechanism for use statewide.

**Table 7-3: Recommended NTGR by Measure and Delivery Method**

EEM	EEM Characteristics	Delivery Mechanism	Applicable Sector and Building Types	Utility Specific or Statewide NTGR	Recommended NTGR (kWh)	Recommended NTGR (kW)
CFLs	All	Downstream Prescriptive	Non-Residential	Statewide	0.53	0.57
CFLs	All	Direct Install	Non-Residential	Statewide	0.80	0.80
Linear Fluorescents	All	Downstream Prescriptive	Non-Residential	Statewide	0.70	0.70
Linear Fluorescents	All	Direct Install	Non-Residential	Statewide	0.89	0.89
Lighting Controls	All	Downstream Prescriptive	Non-Residential	Statewide	0.60	0.59
Lighting Controls	All	Direct Install	Non-Residential	Statewide	0.89	0.74

## 7.5 Factors Likely to Lead to Changes in NTGR Over Next Three Years

The DEER team reviewed the two most recent NTGR evaluations and the overall literature to identify key factors likely to lead to changes in NTGR over time for non-residential lighting measure programs. The principal factors were:

1. Changes in the code will affect what measures are rebated in the future.
2. Changes in rebate levels.
3. Changes in incremental costs.
4. Changes in Program Design or Sales Channel (Example – Target certain business sectors).

## 7.6 Assessment of Current Data and Tools Available for Adjusting NTGR Over Time

The most likely impact on NTGRs in the future will be the upcoming changes to the codes for non-residential lighting. As the currently rebated measures become standard, these NTGRs will no longer be representative of the new lighting technologies that replace them. At this time, there is not sufficient data available to estimate a change in NTGR based on changes in code, rebate levels, or incremental costs. The DEER team recognizes that future programs designs are likely to target different business sectors than past programs have targeted. As a result, the

DEER team recommends that NTGRs by measure, building type, and delivery mechanism are available for the program planners to customize a net to gross ratio by weighting the results by expected building types.

## 7.7 Recommended NTGRs by Building Type to Assist Predicting NTGs for Future Programs

The DEER team analyzed the sample sizes by measure, building type, and delivery mechanism to determine which combinations have enough sample points to warrant a DEER value. All combinations that did not have enough sample points were combined into the “ALL OTHER” category. Table 7-4 shows the recommendations for CFLs. The only building type with a downstream prescriptive recommendation is lodging. Lodging was a large participant in the 2006-2008 programs. As shown in the table, the lodging NTGR is lower than other business types. Having this data would allow program planners designing a program to that did not include lodging to use a NTGR that was more consistent. Similarly, a program planner that is designing a direct install program could weight these net to gross ratios to determine a more accurate ratio to represent the program. Please note that these NTGRs by building type should only be used to create a customized NTGR with the approval of the Energy Division. The DEER team does not recommend that these be the official DEER values.

**Table 7-4: CFL Sample Sizes and Net to Gross Ratios by Building Type and Delivery Mechanism**

	Direct Install			Downstream Prescriptive		
	Sample Size	NTGR (kWh)	NTGR (kW)	Sample Size	NTGR (kWh)	NTGR (kW)
All Other	96	0.80	0.75	74	0.61	0.63
Assembly	20	0.54	0.53			
Health/Medical - Nursing Home	51	0.83	0.83			
Lodging	32	0.77	0.77	41	0.40	0.40
Office - Small	59	0.89	0.89			
Retail - Single-Story Large	22	0.89	0.88			
Retail - Small	164	0.79	0.79			

Table 7-5 shows the recommendations for net to gross ratios by building type and delivery mechanism for linear fluorescents.



**Table 7-5: Linear Fluorescent Sample Sizes and Net to Gross Ratios by Building Type and Delivery Mechanism**

	Direct Install			Downstream Prescriptive		
	Sample Size	NTGR (kWh)	NTGR (kW)	Sample Size	NTGR (kWh)	NTGR (kW)
All Other	112	0.93	0.93	168	0.75	0.75
Assembly	55	0.89	0.89			
Grocery	43	0.87	0.87			
Health/Medical - Nursing Home	63	0.85	0.85			
Manufacturing - Light Industrial	125	0.91	0.91	127	0.69	0.70
Office - Large	37	0.93	0.93	58	0.70	0.70
Office - Small	330	0.89	0.89	35	0.58	0.58
Restaurant - Fast-Food	37	0.83	0.82			
Retail - Single-Story Large	109	0.88	0.88			
Retail - Small	521	0.88	0.88	44	0.74	0.74
Storage - Unconditioned	47	0.94	0.94	34	0.76	0.77
Storage - Conditioned				55	0.77	0.77

# 8

## Recommended Updates to Net-to-Gross Ratios for Residential Lighting (CFLs)

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This report contains the results of an assessment of net-to-gross ratio (NTGR) estimates for CFLs distributed through upstream retail channels. The goal of this assessment was to:

- Compare current DEER NTGR estimates to CFL NTGR estimates from the 2006-2008 impact evaluation;
- Compare methods and sample sizes used to derive CFL NTGR estimates (current DEER v. 2006-2008 impact evaluation);
- Review CFL NTGR estimates estimated by channel and product type (basic v. specialty, or “advanced”<sup>1</sup>), assess whether changes in market conditions are likely to change these values over time and assess the pros and cons of adopting NTGR estimates at the sales channel, product type or technology level
- Recommend a final NTGR estimate for the 2011 update in the near term
- Identify factors likely to lead to changes in CFL NTGR estimates over next three years; and
- Assess current data and tools available for adjusting CFL NTGR estimates over time.

We begin with a brief summary of the NTGR results from the 2006-2008 impact evaluation<sup>2</sup> followed by a comparison of these results to the current DEER values. We then describe some relevant changes to the Upstream Lighting Program from 2006-2008 to 2010 through Q1 2011 and assess their possible effects on NTGR. After performing some sensitivity analysis on the channel level NTGR estimates, we present our final recommendation for a technology level NTGR of 0.54 for upstream CFL programs in the residential sector. The final two sections describe factors that will lead to changes in CFL NTGR estimates beyond the current program cycle (2013-2014) and our recommended approach to collecting the needed data to adjust CFL NTGR estimates over time.

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<sup>1</sup> “Advanced” refers to the category of CFLs that are not basic bare spirals less than 30 watts. Many of these products are not necessarily *advanced* so, to be more accurate, throughout this report we refer to them as specialty (“advanced”) CFLs.

<sup>2</sup> See Sections 2.3, 3.3 and 6.1.3 in *Final Evaluation Report: Upstream Lighting Program, Volume 1*, February 2010, KEMA.

## **8.1 NTGR Results from 2006-2008 Impact Evaluation**

In the 2006-2008 impact evaluation, NTGR estimates were developed for all CFLs<sup>3</sup> using multiple methods which produced a range of results, as shown in Table 8-1. As part of the evaluation effort, the validity of each method/estimate was considered and assessed, at the channel level where available. The relative strengths and weaknesses of each were presented and discussed in the 2006-2008 impact evaluation report.

The final recommended CFL NTGR estimates for the 2006-2008 Upstream Lighting Program are also presented in Table 8-1 by sales channel. These estimates reflect the evaluators' best judgment based on a preponderance of the evidence found using different methods of estimating the net impact of the program in each sales channel.

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<sup>3</sup> Only the supplier self-report and conjoint methods were designed to produce estimates for specific types of CFLs (i.e., basic v. specialty CFLs). Results from those methods were ultimately not used to inform the final recommended NTGR estimates for the 2006-2008 program.

**Table 8-1: CFL NTGR Estimates by Method and Final Recommended CFL NTGR Estimates from 2006-2008 Upstream Lighting Program Impact Evaluation**

Channel	% of CFL Shipments by Channel	CFL NTGR Estimates by Evaluation Method						Final Recommended CFL NTGR
		Self-Report		Econometric Models			Total Sales (Market-Based) Approach	
		Supplier	Consumer Stated Preference	Conjoint Model	Revealed Preference Purchase Model	Stated Preference Purchaser Elasticity Model		
Discount	16%	1.00	0.18	n/a	n/a	0.52	n/a	<b>0.90</b>
Drug	9%	0.73	0.36		0.33	0.31		<b>0.32</b>
Grocery - chain	15%	0.81	0.14		0.33	0.29		<b>0.33</b>
Grocery - small	21%		0.11		n/a	0.51		<b>0.90</b>
Hardware	5%	0.60	0.06		0.20	0.50		<b>0.35</b>
Home Improvement	8%	0.46	0.20		0.20	0.52		<b>0.36</b>
Lighting and Electronics	1%	0.83	n/a		n/a	n/a		<b>0.36</b>
Mass Merchandise	5%	0.37	0.10		0.33	0.48		<b>0.41</b>
Membership Club	19%	0.63	0.12		0.33	0.32		<b>0.33</b>
<b>All IOUs</b>		0.74	0.15		0.06	n/a		0.42
<b>PG&amp;E</b>		0.71	0.18	0.06	0.40		n/a	<b>0.49</b>
<b>SCE</b>		0.80	0.14	0.06	0.44			<b>0.64</b>
<b>SDG&amp;E</b>		0.71	0.30	0.08	0.41			<b>0.48</b>

In general, the revealed preference results were favored over the other approaches mainly because these were the only methods that used data derived from actual observations of participating retail store environments, average prices for all available, comparable products, and average prices for actual purchased products. In addition, the revealed preference surveys provided the only source of data for actual observations of IOU-discounted CFL purchases as a percent of all CFL purchases. Therefore, the recommended NTGR estimate for most channels was taken as the average of the two revealed preference model results.

There were two important channels for which the revealed preference models did not produce direct NTGR estimates for the 2006-2008 program – that is, discount stores and small,

independent grocery stores. For discount stores we observed mostly IOU-discounted CFLs on the retail shelves and, as a result, the revealed preference models could not be run. In addition, manufacturer, retail buyer and retail store manager survey responses were in agreement that nearly 100% of the CFLs sold through this channel are discounted by the program (i.e., close to zero non-program sales), which was confirmed through the revealed preference surveys (i.e., we observed near 100% stocking of IOU-discounted CFLs and near 100% sales of IOU-discounted CFLs in this channel), and manufacturers and retail buyers were in agreement in terms of their independently-generated estimates of 100% program attribution. Therefore, for this important channel (it accounted for 16% of all CFLs rebated through the program during 2006-2008), we recommended a NTGR estimate of 0.90.

For similar reasons, we also recommended a 0.90 NTGR estimate for small, independent grocery stores. Interviews with manufacturers and retailers attribute a high percentage of the sales through these channels to the program, and the revealed preference surveys indicated that 100% of all CFL purchases were IOU-discounted CFLs. According to 2006-2008 program tracking records, nearly 20 million IOU-discounted CFLs were distributed by less than ten manufacturers to more than 700 small, independent grocery stores located in hard-to-reach segments throughout the state. These suppliers indicated that had it not been for the program incentives, they would not have been able to sell CFL products through these stores in anywhere near the volume they experienced during 2006-2008.

The NTGR estimates presented in Table 8-1 represented the most robust, well-constructed estimates available for attributing net impacts to the 2006-2008 Upstream Lighting Program. The main reason for the difference between the IOUs had to do with variations in distributions by retail channel – i.e., during 2006-2008, SCE shipped a much greater portion of the rebated measures through channels for which the NTGR estimates were highest (e.g., discount stores, small grocery stores).

## **8.2 Comparison of 2006-2008 Evaluation Results to DEER Values**

The last DEER update resulted in recommended NTGR estimates of 0.60 for basic CFLs and 0.85 for specialty CFLs<sup>4</sup>. At that time, the recommended NTGR estimates for basic CFLs were projected to reflect conservative estimates for the 2009-2011 time period. The key driver for these NTGR estimates was increased sales nationwide beginning in 2007 combined with decreasing CFL prices.<sup>5</sup>

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<sup>4</sup> See Table 12 in Itron's "NTFR Res CFLs 050208.doc."

<sup>5</sup> Itron indicated that its recommendation of 0.60 as a forward-looking NTGR estimate for basic CFLs was, at that time, conservative due to the significant reported increase in basic CFL sales in states without active programs and their observation of decreasing/converging basic CFL prices across different states. It should be noted that

The overall NTGR estimate from the 2006-2008 impact evaluation was somewhat lower than the DEER estimate for basic CFLs (0.54 v. 0.60). The 2006-2008 results were significantly lower than 0.60 for PG&E (0.49) and SDG&E (0.48), whereas for SCE the 2006-2008 results were somewhat higher (0.64). As mentioned above, these differences are largely due to differences in shipments by channel, which was not taken into account in the last DEER update.

Separate NTGR estimates for specialty CFLs were not produced as part of the 2006-2008 impact evaluation. Therefore, a comparison to the DEER NTGR estimate of 0.85 for specialty CFLs cannot be made.<sup>6</sup>

### **8.3 Changes to Upstream Lighting Programs Over Time**

As stated in the 2006-2008 Upstream Lighting Program Impact Evaluation final report, it is likely that the final recommended NTGR estimates may not represent the best estimates going forward since the market for energy efficient lighting will continue to change and the effects of ongoing IOU interventions, new standards, and changes in the broader California economic conditions will need to be considered in future analyses.

Through Q1 2011, the 2010-2012 Upstream Lighting Program has changed in two significant ways:

- The distribution of discounted lighting products by channel has shifted slightly toward those channels with higher expected attribution, and
- Specialty (or “advanced”) CFLs make up a more significant percentage of all CFLs discounted through the program.

#### **8.3.1 Changes to Channel Distribution**

According to IOU program tracking data, over 150 million CFLs have been discounted through the upstream programs beginning in 2006 through first quarter 2011<sup>7</sup> Table 8-2 presents the distribution of CFLs discounted through various channels by year.

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there was very little evidence provided in the documentation accompanying the last DEER update to support the recommended NTGR estimate of 0.85 for specialty CFLs.

<sup>6</sup> While NTGR estimates were produced using the supplier self-report and the conjoint methods, these estimates were deemed unreliable and thus not considered as part of the final set of recommended NTGR estimates.

<sup>7</sup> Throughout this report, we refer to program tracking data collected for the following IOU program periods: 2006-2008, and 2010 through Q1 2011. For simplicity, the heading “2010” is often used to represent data reported for the 2010 program year through Q1 2011. Limited information is available from the 2009 program period; we estimate that 30 million CFLs were distributed in 2009 through the IOU upstream programs.

**Table 8-2: Upstream Lighting Program CFL Shipments by Channel and Year**

All CFLs	2006	2007	2008	2010*
Discount	13%	15%	19%	19%
Drug	13%	8%	8%	4%
Grocery	40%	33%	37%	39%
Hardware	4%	5%	6%	8%
Home Improvement	7%	10%	7%	5%
Lighting and Electronics	1%	1%	2%	2%
Mass Merchandise	4%	5%	6%	4%
Membership Club	19%	22%	17%	20%
Other	0%	0%	0%	0%
All Channels	100%	100%	100%	100%

\*2010 refers to the period January 2010 through March 2011.

### **8.3.2 Changes to Product Type Distribution**

Table 8-3 shows the basic CFLs as a percent of all CFLs discounted through the Upstream Lighting Programs by channel and year. In all channels, the percentages have decreased from 2008 to 2010 and, overall, basic CFLs have been scaled back to represent 70% of the all CFL shipments by Q1 2011.

**Table 8-3: Basic CFL as a Percent of All CFL Shipments by Channel and Year**

All CFLs	2006	2007	2008	2010*
Discount	95%	97%	96%	68%
Drug	99%	70%	83%	80%
Grocery	97%	93%	84%	71%
Hardware	95%	98%	94%	78%
Home Improvement	73%	92%	82%	67%
Lighting and Electronics	99%	96%	91%	68%
Mass Merchandise	79%	88%	87%	84%
Membership Club	70%	87%	69%	61%
Other	100%	99%	83%	64%
All Channels	90%	90%	84%	70%

\*2010 refers to the period January 2010 through March 2011.

## 8.4 Recommended NTGR Estimates

### 8.4.1 Basic CFLs

Using the results from the 2006-2008 impact evaluation, the overall NTGR estimate for basic CFLs discounted in 2010 through Q1 2011 would be 0.57, reflecting a shift in CFL shipments toward channels with higher expected program attribution. Estimates for each IOU are as follows: SCE, 0.59; SDG&E, 0.50 and PG&E, 0.55. Table 8-4 presents the distribution of basic CFL shipments by channel for each IOU as well as overall. Applying the 2006-2008 CFL NTGR estimates by channel to these IOU-specific shipment distributions produces the basic CFL NTGR estimates by IOU for the 2010 through Q1 2011 program period.

**Table 8-4: Basic CFL Distributions by Channel and NTGR Estimates (2010 through Q2011)**

Channel	Percent of Basic CFL Shipments (2010-Q1 2011)				NTGR by Channel (2006-2008)
	SCE	SDG&E	PG&E	All IOUs	
Discount	18.9%	16.9%	14.8%	17.1%	0.90
Drug	5.2%	0.8%	3.2%	4.0%	0.32
Grocery	45.7%	19.5%	30.9%	37.3%	0.65
Hardware	8.3%	4.5%	8.6%	8.1%	0.35
Home Improvement	3.3%	1.2%	6.2%	4.3%	0.36
Ltg & Electronics	1.4%	1.2%	1.5%	1.4%	0.36
Mass Merchandise	6.0%	11.1%	2.4%	5.0%	0.41
Membership Club	11.1%	44.3%	16.3%	16.3%	0.33
Other	0.0%	0.5%	0.9%	0.4%	0.54
Missing	0.0%	0.0%	15.2%	6.1%	0.54
<b>Basic CFL NTGR Estimate by IOU (2010-Q1 2011)</b>	<b>0.59</b>	<b>0.50</b>	<b>0.55</b>	<b>0.57</b>	

Recent NTGR research completed in MA (using similar methods to what was used in CA for 2006-2008) produced a NTGR estimate of 0.43 for basic CFLs during 2010. A recent study completed for ComEd (Illinois) using some of these similar methods determined that the NTGR estimate for a similar upstream CFL program implemented from mid-2009 through mid-2010 was 0.58. Table 8-5 compares the NTGR results from the 2006-2008 CA study with these other studies from MA and IL.



**Table 8-5: CFL NTGR Estimates: Comparison Across Recent Studies**

	CA (2006-2008)		MA (2010) <sup>8</sup>		ComEd (2009-2010) <sup>9</sup>	
	Basic	Specialty	Basic	Specialty	Basic	Specialty
<b>Final Recommended NTGR Estimate</b>	<b>0.54</b>		<b>0.43</b>	<b>0.60</b>	<b>0.58</b>	
Conjoint Model	0.06 - 0.44	0.14 - 0.66	n/a	0.59	n/a	
Multistate Model	0.23 - 0.63		0.45		n/a	
Revealed Preference Model	0.20 - 0.33	0.60	0.37	0.31	0.21	
Stated Preference Model	0.42		n/a		n/a	
Consumer Self-Report	0.15		0.49	0.31	0.57 - 0.60	
Supplier Self-Report	0.74	0.72	0.39	0.49	0.44	
<i>Program Discounted CFLs (millions)</i>	<i>105.1</i>	<i>20.5</i>	<i>1.4</i>	<i>1.2</i>	<i>7.4</i>	<i>0.8</i>

**MA Study**

As mentioned above, the MA study used similar methods to determine NTGR estimates but it also included a Delphi panel to integrate the results. The overall result of 0.43 for basic CFLs was generally in line with all of the other individual NTGR results from each specific method.

In MA, the 2010 programs differed from prior programs in that hard-to-reach households were targeted by expanding CFL distributions in dollar stores, discount stores, bargain stores, thrift stores, ethnic markets, and stores of various types located in low-income neighborhoods or market areas. However, the MA study did not produce overall NTGR estimates by channel. However, the MA study did produce NTGR estimates by channel using the supplier self report method. This method produced a NTGR estimate of 0.72 for basic CFLs for the discount/HTR channel, which was much higher than any of the other channel-specific estimates produced using the supplier self report method.

Despite targeting HTR households through expanded distributions in HTR channels (including discount stores), only about 9% of all basic CFLs distributed through MA 2010 program were distributed through HTR/discount channels. In contrast, the CA programs distributed about 17% of all basic CFLs through discount channels.

Given the relatively larger emphasis placed on basic CFLs distributed through discount channels in CA, and the consistently higher NTGR estimate derived from supplier self-reports for this channel, it is reasonable to assume that CA’s overall NTGR estimate for all basic CFLs would be

<sup>8</sup> *Massachusetts Energy Star Lighting Program: 2010 Annual Report, Volume 1*, submitted to Energy Efficiency Advisory Council Consultants, Cape Light Compact, NSTAR, National Grid, Unitil and Western Massachusetts Electric, June 2011, NMR Group, Inc.

<sup>9</sup> *Energy Efficiency / Demand Response Plan: Plan Year 2 (6/1/2009-5/31/2010), Evaluation Report: Residential Energy Star ® Lighting*, prepared for Commonwealth Edison Company, December 2010, Navigant Consulting.

higher than the overall NTGR estimate produced through the MA study. Said another way, the MA 2010 program distributed proportionally more basic CFLs through channels expected to have lower NTGR estimates and as such it is reasonable to expect that the overall NTGR estimate for the MA 2010 program would be lower than an estimate derived for the CA programs.

### **ComEd Study**

The ComEd program in 2009-2010 was similar to the CA IOU programs in 2006-2008 in that it was almost exclusively an upstream buy-down type of program in which specialty CFLs represented less than 10% of total CFLs discounted through the program. However, the ComEd program differed somewhat significantly from CA in that 90% of the CFLs discounted through the program were distributed through the “big box,” “DIY” and membership club channels. In comparison, during a similar time period, the CA programs distributed less than 30% of basic CFLs through these channels.

The overall NTGR estimate of 0.58 was determined by averaging the customer self report methods (0.57 and 0.60, average 0.58). The evaluators rejected the revealed preference results because of instability in the model, as well as other data issues and constraints. The evaluators also rejected the supplier self-report results due to concerns over potential bias from a small sample.

### **Final Recommended NTGR Estimate for Residential CFLs**

The DEER team reviewed the range of NTGR estimates produced for each sales channel in KEMA’s 2006-08 evaluation of the upstream lighting programs. (See Table 8-1) The group identified two specific sales channels, discount stores and small independent grocery stores that had the greatest variance in NTGR estimates within the same channel. For example NTGR estimates from different methods ranged from 1.0 to 0.18 in the discount sales channel. In this case KEMA decided on using a final NTGR estimate of 0.90 in its 200608 evaluation because of the compelling evidence presented by suppliers that CFL bulbs would not have been sold in these stores in the absence of the program. Other analysts on the DEER team gave more weight to the NTGR estimates derived from customer interview in this channel because of the possibility that some small fraction of the customers who purchased CFL in the discount stores would have been free riders if they purchased CFLs in other sales channels. Because all of these approaches contain some uncertainty, the DEER team decided to bound the uncertainty by developing high, medium and low NTGR values for each of the key sales channels.

Table 8-6 shows the impact of selecting different NTGR results for these key sales channels on the overall Program level NTGR. The table shows that small changes in the judgment used to derive a final NTGR by channel led to a range of overall program NTGR from 0.57 to 0.45.

**Table 8-6: Effect of Channel Level NTGR on Overall Program NTGR for Residential CFL's**

Team	NTGR by Channel			Program NTGR
	Discount	Small Grocery	Grocery-Chains	Weighted by 2010 shipments
High	0.9	0.9	0.33	0.57
Medium	0.8	0.7	0.33	0.50
Low	0.6	0.6	0.33	0.45
Final Recommended Value				0.54

The DEER team recommended that the 2011 DEER update only include a program weighted NTGR because of concerns that these channel specific NTGR estimates are likely to change over time as prices and market conditions change. The DEER management team reviewed these results and the supporting evidence used to derive the program weighted NTGR estimates for these sales channels. In the final analysis the DEER team decided there was too much uncertainty in the NTGR estimates developed for this table and in any event there were based on channel shipment weights that are likely to change in the future. The DEER management concluded that any overall NTGR value within this range could be supported by the available data and evaluation evidence

As a result of this sensitivity analysis and consideration of a variety of policy concerns, the DEER management team decided to recommend using the original program level NTGR of 0.54 produced in the 2006-08 study for the 2011 update, This represents a reduction of 10% relative to the current NTGR value of 0.60 contained in the current DEER data base but falls within the range of uncertainty identified by the DEER team. The NTGR of 0.54 was estimated across all types of CFLs, both basic spiral CFL and specialty CFLs and as such would be applied to all upstream programs promoting all types of residential CFL's

## 8.5 Factors Leading to Changes in CFL NTGR Estimates Over Time

There are numerous factors leading to changes in CFL NTGR estimates over time. These include the following listed below.

- Channel Shift.** Channel shift refers to sales through one retail channel that, in the absence of an energy-efficiency program, would have occurred through another channel.

To meet other program objectives – such as trying to increase CFLs sales in “hard-to-reach” market sectors – lighting rebate programs may promote CFL sales in certain retail channels (e.g., discount, ethnic grocery) over others. However, some observers have wondered whether such policies might be simply shifting some CFL sales from traditional lighting channels such as large home improvement or mass merchandise to these presumably more targeted channels.

- **Economic Recession/Recovery.** During 2009, many retailers saw CFL sales decline in comparison to sales during 2008, with some recovery in overall sales during 2010 and 2011. Most suppliers attribute this decline and subsequent recovery to changes in the economy. As the general economic climate changes, so too do consumer spending habits – and likely consumer willingness or ability to pay the incremental cost associated with CFLs and other energy-efficient lamps.
- **Unpredictability of Lighting Market Reaction in Response to New Lighting Standards.** The U.S. Energy Independence and Security Act of 2007 (EISA) establishes increased energy efficiency standards for general service lamps and will effectively phase out traditional medium screw-base incandescent lamps over time, starting with the standard 100-Watt lamp on January 1, 2012. Through California Assembly Bill 1109 (AB1109), the Lighting Efficiency & Toxics Reduction Act of 2007, the state of California has begun implementing the increased efficiency standards of EISA a year ahead of the rest of the country. Neither set of standards prohibits retailers from selling through their existing stock of these products – so conceivably, the 100-Watt incandescent bulb may be available to Californians after January of 2011. Because these changes have just begun, it is difficult to assess their effects on the lighting market in general and their possible resultant effects on NTGR.
- **Increased Presence of Halogen Lamps.** Attributable in part to EISA and AB1109, there is an increased presence of halogen lamps on the market. Each of country’s largest incandescent lamp manufacturers (GE, Philips, and Sylvania) released new EISA-compliant halogen products during 2010. It is unclear how the presence of these products – which are markedly similar to standard incandescent lamps in appearance and price as compared to CFLs – will affect consumer choices in a post-EISA world.
- **Commercialization of LED Lamps.** Again possibly attributable in part to EISA and AB1109, there is an increased presence of LED lamps in the marketplace. These products – as well as the EISA-compliant halogen products described above – may dilute consumer understanding of CFLs as “the energy-efficient alternative” to incandescent lamps, as both of these types become more familiar as energy-efficient alternatives themselves.
- **Increased CFL Penetration of Lighting Sockets.** CFL saturation among CA households has increased from less than 1% in 2000 to more than 20% from by 2009. This increasing saturation of California lighting sockets – along with other related factors

such as the long lifetime of the typical CFL and consumer concerns about the suitability of CFLs for lighting sockets that require quick start-up or dimming capability – could dampen demand for CFL sales going forward.

- **California Policy and Related Changes in IOU Policy.** The lighting chapter of California’s Long-Term Energy Efficiency Strategic Plan was adopted by the commission in late 2010. One of the key strategies in the Plan includes phasing out IOU incentives for CFLs. The Plan, in concert with declining NTGR and other factors, has already lead one IOU (SCE) to stop providing incentives for basic CFLs in late 2011. As the IOUs phase out these incentives, it is unclear whether/how the prices of these products will change.
- **Price of Rare Earth Minerals and Other Raw Materials.** Within the past year, China has taken steps to reduce pollution in the rare earth minerals mining and processing industries. As a result, the country has dramatically reduced supply of these products on the international market. Because China produces the vast majority of the world’s rare earth materials, the resultant shortage has caused prices for CFLs and other lamp types to surge. NEMA reports that the average fluorescent lamp price has increased by 37 percent during 2011,<sup>10</sup> and the price increases likely extend to LED lamps as well. These increased prices widen the incremental price gap between efficient lamp technologies and incandescent lamps, which has implications with regard to the level of the program discount’s influence on energy-efficient lamp purchases and other elements of NTG.

## 8.6 Approach to Adjusting CFL NTGR Estimates Over Time

The planned evaluation and market studies of the 2010-2012 of the California lighting programs have included a number of approaches for adjusting the CFL NTGR estimates over time. Most of this evaluation activity is being done under Work Order 28 (WO28): the *Upstream and Residential Downstream Lighting Impact Evaluation*. The WO28 research team plans to produce a number of interim reports that will provide updated estimates of CFL NTGR estimates at regular intervals. The following is the schedule for the interim and final reports.

1. *2010-2011 Interim Results Report:* This report will cover 2010 through Q2 2011 program activity. The final version of this report is expected in mid-2012.
2. *2010-2012 Interim Results Report:* This report will cover 2010 through Q2 2012 program activity. The final version of this report is expected in March 2013.
3. *2010-2012 Final Results Report:* This report will cover 2010-2012 program activity. The final version of this report is expected in August 2013.

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<sup>10</sup> Bradsher, K., 2011. China Consolidates Grip on Rare Earths. *The New York Times*. New York Edition, Page B1. September 15, 2011.

In addition to these interim and final reports, the WO28 evaluation will also generate early feedback memorandums throughout the process that can provide new/preliminary findings as they become available.

While the WO28 evaluation effort will collect most of the information needed to produce regular revisions of the NTGR estimates, other planned CPUC-sponsored evaluation activities will also provide useful information. The most prominent of these is Work Order 13 (WO13): Lighting Programs Process Evaluation and Market Characterization. The WO13 evaluation will be particularly useful for shedding light on some of the factors such as the EISA legislation and LED market penetration which were discussed in the previous section. The evaluation will achieve this most immediately through a series of three “early feedback” research tasks. These tasks include:

1. *Fast-track lighting retail store shelf surveys:* The WO13 team plans to conduct lighting shelf surveys in 200 California retail stores in the second half of 2011. These surveys will be conducted primarily to provide both time-series and cross-sectional information on lighting product availability, diversity and pricing, as well as to allow for comparisons over time.
2. *LED market characterization study:* This study will provide a high-level/preliminary assessment of LED market characteristics and a snapshot of LED product availability and diversity. The study will also attempt to provide details on screw-base LED lamp and fixture sales in California as well as data on market share and pricing for these technologies. The market characterization will focus on California’s market to the extent that data will allow, and is expected to include data on the national market where California data is not available.
3. *Study to assess the early effects of EISA/AB1109:* The purpose of this study is to assess the possible early effects of EISA and California Assembly Bill 1109 mentioned above. The study will assess the impacts of this legislation on the availability of baseline technologies (i.e., traditional general purpose incandescent lamps) and provide preliminary insights regarding consumer purchasing behaviors in light of possible changes in product availability.

# 9

## Recommended Updates to Net-To-Gross Ratios for Industrial and Agricultural End Uses (Except Lighting)

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### 9.1 Introduction

Net-to-Gross ratio (NTGR) values were last updated in 2008. In late 2010, the CPUC requested that the DEER team develop new NTGR ratios based on more recent research results to increase confidence in their application of NTG ratios to estimate net energy savings for current and future programs. To meet this objective, a comprehensive literature review was recently conducted of recently completed studies relevant to these customer segments. A key data source was the Program Year 2006-2008 EM&V studies covering both Industrial and Agricultural energy efficiency measure (EEM) categories. For certain categories, values were averaged across related studies to obtain the recommended value.

Some of the factors considered in making a final NTGR recommendation may include:

- The relative merits of the methods and sampling plans used to derive NTGR from past and the most current 2006-08 evaluation studies
- Potential changes in either the energy efficiency program's design or the EEM's minimum qualification levels between the previous evaluation and the 2006-08 evaluation, and
- The changing market conditions and saturation levels of the EEMs in the industrial and agricultural sectors. There are two metrics that could serve as indicators of market saturation
  - Rate of change in the market share of efficient technologies over time
  - Any available evidence on trends in the incremental cost of the targeted energy efficiency measures

After recommending specific NTGR values for the 2011 DEER update, the DEER team identified the program and market factors that could most likely lead to changes in the recommended values over the next three years. We then consider whether there is sufficient data and an acceptable analytical approach to reasonably forecast the NTGR trend over the next three years. If both conditions are met absent any significant changes in program design and/or qualifying levels for rebated measures, a NTGR forecast for use in 2013-2014 is presented.

However, if the assessment concludes that there is neither adequate data nor a good understanding of how market changes may affect the NTGR values over time, then no adjustments to the estimated 2011 NTGR update values are recommended to account for market changes between now and 2013.

## **9.2 Comparison of Current DEER NTGR Values to the Results from the 2006 – 2008 EM&V Studies**

Table 9-1 compares NTGR estimates for all industrial and agricultural measure categories. The table is segmented by measure type and fuel.



**Table 9-1: Overview of NTGR Results by Measure and Delivery Approach**

Energy Efficiency Measure(s)	Measure and Program Information		Net-to-Gross Ratio (NTGR) Information		
	Target Market(s)	Program Delivery Mechanism	Existing DEER NTGR Values (Source)	NTGR Values Based on 2006-08 Studies	Data Source
<b>Pump Off Controllers</b>					
Pump-Off Controllers - PGE	Oil & Gas Producers	Custom incentive	0.64 (Itron-KEMA, 2008)	0.45	2006-2008 Evaluation Report for PG&E Fabrication, Process and Manufacturing Contract Group (Itron)
Pump-Off Controllers - PGE & SCE	Oil & Gas Producers - Major Oil companies (large)	Custom incentive	0.64 (Itron-KEMA, 2008)	0.42	July 7, 2009 Early Feedback Memo to Support CPUC and IOU Planning Regarding Pump-Off Controller Interventions in 2009-2011 (Itron)
Pump-Off Controllers - PGE & SCE	Oil & Gas Producers - Independents (small)	Custom incentive	0.64 (Itron-KEMA, 2008)	0.74	July 7, 2009 Early Feedback Memo to Support CPUC and IOU Planning Regarding Pump-Off Controller Interventions in 2009-2011 (Itron)
<b>Large C/I Custom</b>					
PGE2004 - electric - kWh	Large C/I - primarily industrial	Custom incentive	0.64 (Itron-KEMA, 2008)	0.60	2006-2008 Evaluation Report for PG&E Fabrication, Process and Manufacturing Contract Group (Itron)
PGE2004 - gas	Large C/I - primarily industrial	Custom incentive	0.64 (Itron-KEMA, 2008)	0.31	2006-2008 Evaluation Report for PG&E Fabrication, Process and Manufacturing Contract Group (Itron)
SCE - electric (SCE2509, Integrated Industrial program)	Large Industrial	Custom incentive	0.64 (Itron-KEMA, 2008)	0.63	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
SCE2517 (Standard Performance Contracting program) - electric - kWh	Large C/I	Custom incentive	0.64 (Itron-KEMA, 2008)	0.59	MAJOR COMMERCIAL CONTRACT GROUP - FINAL IMPACT EVALUATION REPORT 2006-2008 PROGRAM YEARS (SBW Consulting)
PGE2005 (High Tech applications)	Large C/I	Calculated incentive	0.64 (Itron-KEMA, 2008)	0.47	Commercial Facilities Contract Group - 2006-2008 Direct Impact Evaluation (ADM)
PGE2007 (Large Commercial)	Large Commercial	Calculated incentive	0.64 (Itron-KEMA, 2008)	0.60	Commercial Facilities Contract Group - 2006-2008 Direct Impact Evaluation (ADM)
<b>Pipe Insulation</b>					
SoCal Gas	Large C/I	Calculated incentive	0.64 (Itron-KEMA, 2008)	0.72	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
PG&E	Large C/I	Calculated incentive	0.64 (Itron-KEMA, 2008)	0.49	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)

**Table 9-1 (continued): Overview of NTGR Results by Measure and Delivery Approach**

Energy Efficiency Measure(s)	Measure and Program Information		Net-to-Gross Ratio (NTGR) Information		
	Target Market(s)	Program Delivery Mechanism	Existing DEER NTGR Values (Source)	NTGR Values Based on 2006-08 Studies	Data Source
<b>Steam Traps</b>					
Small Comm - PG&E	Small C/I	Deemed incentive	0.64 (Itron-KEMA, 2008)	0.62	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
Small Comm - SCG	Small C/I	Deemed incentive	0.64 (Itron-KEMA, 2008)	0.70	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
Small Comm - SDG&E	Small C/I	Deemed incentive	0.64 (Itron-KEMA, 2008)	0.72	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
Industrial - High Pressure	Large C/I	Calculated incentive	0.64 (Itron-KEMA, 2008)	0.52	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
Industrial - Low Pressure	Large C/I	Calculated incentive	0.64 (Itron-KEMA, 2008)	0.57	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
<b>Pump Tests</b>					
	Agricultural	Deemed incentive	0.64 (Itron-KEMA, 2008)	0.63	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
<b>Agricultural Measures</b>					
Greenhouse heat curtain	Agricultural	Calculated incentive	0.5 (kW Engineering/Phil Willems, 2007)	0.63	Evaluation Report: PG&E Agricultural and Food Processing Program; Greenhouse Heat Curtain and Infrared Film Measures (KEMA)
Infrared film	Agricultural	Calculated incentive	0.5 (kW Engineering/Phil Willems, 2007)	0.46	Evaluation Report: PG&E Agricultural and Food Processing Program; Greenhouse Heat Curtain and Infrared Film Measures (KEMA)
kWh	Agricultural	Calculated incentive	0.5 (kW Engineering/Phil Willems, 2007)	0.70	Evaluation Report: PG&E Agricultural and Food Processing Program; Greenhouse Heat Curtain and Infrared Film Measures (KEMA)
kW	Agricultural	Calculated incentive	0.5 (kW Engineering/Phil Willems, 2007)	0.78	Evaluation Report: PG&E Agricultural and Food Processing Program; Greenhouse Heat Curtain and Infrared Film Measures (KEMA)
therms	Agricultural	Calculated incentive	0.5 (kW Engineering/Phil Willems, 2007)	0.69	Evaluation Report: PG&E Agricultural and Food Processing Program; Greenhouse Heat Curtain and Infrared Film Measures (KEMA)

**Table 9-1 (continued): Overview of NTGR Results by Measure and Delivery Approach**

Energy Efficiency Measure(s)	Measure and Program Information		Net-to-Gross Ratio (NTGR) Information			
	Target Market(s)	Program Delivery Mechanism	Existing DEER NTGR Values (Source)	NTGR Values Based on 2006-08 Studies	Recommended NTGR Values	Data Source
<b>Steam Traps</b>						
Small Comm - PG&E	Small C/I	Deemed incentive	0.64 (Itron-KEMA, 2008)	0.62	0.68	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
Small Comm - SCG	Small C/I	Deemed incentive	0.64 (Itron-KEMA, 2008)	0.70	0.68	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
Small Comm - SDG&E	Small C/I	Deemed incentive	0.64 (Itron-KEMA, 2008)	0.72	0.68	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
Industrial - High Pressure	Large C/I	Calculated incentive	0.64 (Itron-KEMA, 2008)	0.52	0.52	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
Industrial - Low Pressure	Large C/I	Calculated incentive	0.64 (Itron-KEMA, 2008)	0.57	0.52	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
<b>Pump Tests</b>						
	Agricultural	Deemed incentive	0.64 (Itron-KEMA, 2008)	0.63	0.63	2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group (Itron)
<b>Agricultural Measures</b>						
Greenhouse heat curtain	Agricultural	Calculated incentive	0.5 (kW Engineering/Phil Willems, 2007)	0.63	0.63	Evaluation Report: PG&E Agricultural and Food Processing Program; Greenhouse Heat Curtain and Infrared Film Measures (KEMA)
Infrared film	Agricultural	Calculated incentive	0.5 (kW Engineering/Phil Willems, 2007)	0.46	0.46	Evaluation Report: PG&E Agricultural and Food Processing Program; Greenhouse Heat Curtain and Infrared Film Measures (KEMA)
kWh	Agricultural	Calculated incentive	0.5 (kW Engineering/Phil Willems, 2007)	0.70	0.70	Evaluation Report: PG&E Agricultural and Food Processing Program; Greenhouse Heat Curtain and Infrared Film Measures (KEMA)
kW	Agricultural	Calculated incentive	0.5 (kW Engineering/Phil Willems, 2007)	0.78	0.70	Evaluation Report: PG&E Agricultural and Food Processing Program; Greenhouse Heat Curtain and Infrared Film Measures (KEMA)
therms	Agricultural	Calculated incentive	0.5 (kW Engineering/Phil Willems, 2007)	0.69	0.70	Evaluation Report: PG&E Agricultural and Food Processing Program; Greenhouse Heat Curtain and Infrared Film Measures (KEMA)

### 9.3 Comparison of Methods and Sample Sizes

The studies used to estimate the current DEER values and the latest evaluation studies from 2006-2008 both relied on the Self-Report Approach to derive NTGRs using interviews with participating customers and vendors. The studies underlying the current DEER values were generally those from the PY2004-2005 program evaluations and used a NTG question and scoring rubric that had been in effect for many years. The studies performed for the 2006-2008 program cycle used a newly-developed set of questions and scoring algorithm, as described below.

**Methods.** The self-report methodology used in the 2006-2008 EM&V studies was developed by a nonresidential net-to-gross ratio working group that was composed of experienced evaluation professionals. The main purpose of this group was to develop a standard methodological framework, including decision rules, for integrating, in a systematic and consistent manner, the findings from both quantitative and qualitative information in estimating net-to-gross ratios.

The methodology was developed to address the unique needs of Large Nonresidential customer projects developed through energy efficiency programs offered by the four California investor-owned utilities and third-parties. This method relies exclusively on the Self-Report Approach (SRA) to estimate project and program-level Net-to-Gross Ratios (NTGRs), since other available methods and research designs are generally not feasible for large nonresidential customer programs.

The method introduces a 0 to 10 scoring system for key questions used to estimate the NTGR, rather than using fixed categories that were assigned weights (as was done previously). It asks respondents to jointly consider and rate the importance of the many likely events or factors that may have influenced their energy efficiency decision making, rather than focusing narrowly on only their rating of the program's importance. This question structure more accurately reflects the complex nature of the real-world decision making and helps to ensure that all non-program influences are reflected in the NTGR assessment in addition to program influences.

There are three levels of free-ridership analysis. The most detailed level of analysis, the **Standard – Very Large Project** NTGR, is applied to the largest and most complex projects (representing 10 to 20% of the total) with the greatest expected levels of gross savings<sup>1</sup> The **Standard** NTGR, involving a somewhat less detailed level of analysis, is applied to projects with moderately high levels of gross savings. The least detailed analysis, the **Basic** NTGR, is applied to all remaining projects. Evaluators must exercise their own discretion as to what the appropriate thresholds should be for each of these three levels.

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<sup>1</sup> Note that we do not refer to an Enhanced level of analysis, since this is defined by the Protocols to involve the application of two separate analysis approaches, such as billing analysis or discrete choice modeling.

**Data Sources.** There are five sources of free-ridership information in this study. Each level of analysis relies on information from one or more of these sources. Table 1 below shows the data sources used in each of the three levels of free-ridership analysis. Although more than one level of analysis may share the same source, the amount of information that is utilized in the analysis may vary. For example, all three levels of analysis obtain core question data from the Decision Maker survey.

**Table 9-2: Information Sources for Three Levels of NTGR Analysis**

	Program File	Decision Maker Survey Core Question	Vendor Surveys	Decision Maker Survey Supplemental Questions	Utility & Program Staff Interviews	Other Research Findings
Basic NTGR	√	√	√ <sup>1</sup>		√ <sup>2</sup>	
Standard NTGR	√	√	√ <sup>1</sup>	√	√	
Standard Very Large NTGR	√	√	√ <sup>3</sup>	√	√	√

<sup>1</sup> Only performed for sites that indicate a vendor influence score (N3d) greater than maximum of the other program element scores (N3b, N3c, N3g, N3h, N3i).

<sup>2</sup> Only performed for sites that have a utility account representative

<sup>3</sup> Only performed if significant vendor influence reported or if secondary research indicates the installed measure may be becoming standard practice.

**NTGR Questions and Scoring Algorithm.** The NTGR is calculated as an average of three scores. Each of these scores represents the highest response or the average of several responses given to one or more questions about the decision to install a program measure.

1. A **Timing and Selection** score that reflects the influence of the **most important** of various program and program-related elements in the customer’s decision to select the specific program measure at this time. Program influence through vendor recommendations is also incorporated in this score.
2. A **Program Influence** score that captures the perceived importance of the program (whether rebate, recommendation, training, or other program intervention) relative to non-program factors in the decision to implement the specific measure that was eventually adopted or installed. This score is determined by asking respondents to assign importance values to both the program and most important non-program influences so that the two total 10. The program influence score is adjusted (i.e., divided by 2) if

respondents say they had already made their decision to install the specific program qualifying measure before they learned about the program.

3. A **No-Program** score that captures the likelihood of that the customer might have taken the same program qualifying action at this time and in the future if the program had not been available (the counterfactual). This score also accounts for deferred free ridership by incorporating the likelihood that the customer would have installed the program-qualifying measure at a later date if the program had not been available.

When there are multiple questions that feed into the scoring algorithm, as is the case for the **Timing and Selection** score, the maximum influence rating is used. The rationale for using the maximum value is to capture the most important element in the participant's decision making. Thus, this score is always based on the strongest influence indicated by the respondent. However, high scores that are inconsistent with other previous responses trigger consistency checks and can lead to follow-up questions to clarify and resolve the discrepancy.

The self reported core NTGR is simply the average of the Program Influence, Timing and Selection, and No-Program Scores, divided by 10.

**Sample sizes.** As Table 9-3 summarizes, the 2006-2008 studies reached significantly larger sample sizes and were measure specific. For steam traps and custom measures, interviews with vendors were conducted to support the NTG analysis for those industrial applications where the vendor was an influential factor in the decision to install the measure. In addition, utility account reps were interviewed in all cases to capture any possible influence they may have had on the decision to install the project.

The larger sample sizes, coupled with a more comprehensive battery of questions and a strong focus on measure specific conditions that affect estimates of free ridership resulted in more robust NTGR values in the 2006-08 program evaluations.

**Table 9-3: Methods and Sample Sizes for Agricultural and Industrial Measures**

Measure	Market Segment and Program Year	NTGR Method Used	Sample Sizes		Delivery Mechanism
			DEER	2006-2008	
Agricultural–Heat curtains	Agricultural greenhouse – 2006-08	Self Report	50 <sup>2</sup>	51	Downstream Prescriptive
Agricultural–Infrared Film	Agricultural greenhouse – 2006-08	Self Report		35	Downstream Prescriptive
Industrial Steam Traps	Industrial – 2006-08	Self Report	113 PG&E–34 SCE E–67 SDG&E E–12	126	Customized
Industrial Pump Off Controllers	Industrial - 2006-08	Self Report		250	Customized
Custom Electric Measures	Industrial – 2006-08	Self-Report		408	
Industrial Pipe Insulation	Industrial –2006-08	Self Report		PG&E–35 SCG E–240	Customized

Overall the DEER team finds that the recently completed PY2006-2008 evaluations contain more robust and comprehensive NTGR estimates than the values in the existing DEER database, based on our review of methodologies and sample sizes.

#### 9.4 Industrial/Agricultural NTGR Sensitivity Analysis

For the PY2010-12 evaluation, a dual baseline approach is being implemented, which incorporates the effect of project timing into the gross savings calculation. Previously, this effect has been captured in the deferred free ridership component of the NTG ratio.

The DEER team ran a sensitivity analysis in which the timing effect was removed from the NTG ratio calculation for the Industrial and Agricultural sector studies. The resulting NTGRs are very slightly lower, as shown below.

<sup>2</sup> The kW Engineering study focused on the overall Agricultural program, and did not use a HIM-based approach. Therefore, the NTGR is representative of the program as a whole, not any particular measure.

**Table 9-4: Industrial/Agricultural NTGR Sensitivity Analysis Results**

<b>Evaluation Study</b>	<b>Sampling Domain</b>	<b>2008-2008 NTGR</b>	<b>Sensitivity Analysis with Timing Effect Eliminated</b>
PG&E Fabrication, Process and Manufacturing Contract Group	Pump-Off Controllers (POCs)	kWh =0.45, kW=0.44	kWh =0.45, kW=0.44
PG&E Fabrication, Process and Manufacturing Contract Group	Non-POCs	kWh =0.60, kW=0.59	kWh =0.58, kW=0.57
PG&E Fabrication, Process and Manufacturing Contract Group	Overall electric	kWh=0.53, kW=0.52	kWh=0.51, kW=0.51
PG&E Fabrication, Process and Manufacturing Contract Group	Gas	0.31	0.30
Southern California Industrial and Agricultural Contract Group	Agricultural measures	kWh=0.59, kW=0.63	kWh=0.56, kW=0.59
Southern California Industrial and Agricultural Contract Group	Industrial measures	kWh=0.63, kW=0.65	kWh=0.60, kW=0.61

### 9.5 Recommended 2011 DEER Updates to NTGR Values

Table 9-5 shows the recommended NTGRs to be used to update the DEER database in 2011 for use in ex ante values in 2013 programs and beyond. Because of the large sample sizes and multi-tiered approach used to estimate free ridership, the DEER team recommends use of the 2006-2008 study results shown in Table 9-3 for the reviewed measures.



**Table 9-5: Recommended NTGR by Measure and Delivery Method**

<b>EEM</b>	<b>EEM Characteristics</b>	<b>Delivery Mechanism</b>	<b>Applicable Sector and Building Types</b>	<b>Utility Specific or Statewide NTGR</b>	<b>Recommended NTGR Values</b>
Pump off controllers		Downstream, Custom	Major oil companies	SW	0.42
Pump off controllers		Downstream, Custom	Independent oil companies	SW	0.74
Custom Electric Measures		Downstream, Custom	Large Commercial and Industrial	SW	0.60
Custom Gas Measures		Downstream, Custom	Large Commercial and Industrial	SW	0.35
Pipe Insulation	Various diameters and pressures	Downstream, Custom	Industrial	SW	0.71
Steam Traps	Pressure levels: High and Low	Customized	Industrial	SW	0.52
Greenhouse Heat Curtain		Downstream Prescriptive,	Agricultural greenhouse	SW	0.63
Infrared Film		Downstream Prescriptive	Agricultural greenhouse	SW	0.46
kWh, kW and therms		Downstream, Custom	Agricultural	SW	0.70

## 9.6 Factors Likely to Lead to Changes in NTGR Over Next Three Years

The DEER team reviewed the three most recent NTGR evaluations and the overall literature to identify key factors likely to lead to changes in NTGR over time for the two Agricultural and four Industrial measure programs.

- Changes in qualifying and rebate levels for measures that have an effect on payback periods
- Changes in Program design and delivery as it pertains to vendors
  - e.g., the installation of commercial steam traps involves a more sophisticated approach to program delivery and setting of rebate levels.
- Changes in industry standard practice
  - e.g., for particular measures suspected of becoming standard practice such as pump-off controllers and injection molding machines
- Non-energy factors (e.g., regulatory mandates)
  - e.g., As applicable to projects involving pollution control equipment
- Business trends in the vendor/contractor program volume.

## 9.7 Assessment of Current Data and Tools Available to Prepare a Forecast of NTGR Values

The most recent study and previous evaluations of the SPC and industrial programs not only have derived similar NTGRs over the past several years, but have consistently raised concerns regarding the relatively high levels of free-ridership among customers who installed the four industrial measures. These evaluations have also recommended changes in program design to reduce these high free-ridership levels. Following the PY2004-2005 evaluation, these recommendations were not implemented and it is unclear the extent to which they have been implemented in this program cycle. In addition, the only difference in rebate levels has been the addition of a per-kW incentive on top of the traditional per-kWh incentive. However, this was largely done to help meet kW goals, not to cut back on free ridership. On the other hand, for pump-off controller measures, the IOUs did in fact suspend rebates on POCs for new well applications starting in 2009 based on the 2006-2008 Early Feedback Memo.

The trends in NTGRs have been relatively flat over the past several evaluation cycles. The 2006-2008 Study NTGRs are virtually identical to the estimate of corresponding net-to-gross ratios for the statewide Standard Performance Contracting (SPC) program in the PY2004-2005 evaluation. In addition, they are very similar to the NTG estimates made in prior SPC evaluations conducted for each program year since the program's inception in 1998, as shown in Table 9-6. This implies it is appropriate to apply current NTGRs in future cycles.

**Table 9-6: Statewide Custom Electric Measures Net to Gross Ratios for the Period 1998-2008**

(1-FR)	1998	1999	2000	2001	2002	2003	2004-2005	2006-2008
Weighted	0.53*	0.51	0.41	0.65	0.45	0.59	0.57	.059
Unweighted	0.49	0.48	0.46	0.55	0.45	0.60	0.54	

\* Weighted by incentives rather than by kWh savings.

## 9.8 Recommended NTGR Values for Future Programs

Given the stability of NTGR values over the past several evaluation cycles, and the fact that many of the recommendation for program improvements have not been implemented, the DEER team advises using the recommended NTGR values (based on the 2006-08 EM&V studies) for future program years. Thus we recommend no adjustment be made to the NTGR values presented in Table 9-5.

# 10

## Recommended Updates to the Net-to-Gross Ratios for Commercial HVAC Systems and Building Envelopes

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### 10.1 Introduction

In this analysis, the Net-to-Gross Ratio (NTGR) results from the 2006 – 2008 EM&V studies covering a selection of Commercial HVAC energy efficiency measure (EEM) categories, are compared to the values in the 2008 DEER database, Version 2.05. The objective is to arrive at a recommended set of NTGR values for the measures selected for the 2011 DEER update. For each measure, we compared the strengths and weaknesses of the methods and datasets used to derive the latest NTGR results to the relative strengths and weaknesses of the methods and datasets used to estimate the values for the 2008 DEER update. Some of the factors considered in recommending a revised NTGR value include:

- **Methods and Sample Sizes.** The relative merits of the methods and sample sizes used to derive the NTGR estimates in the existing DEER database and new evaluation studies,
- **Program Design Changes.** The potential changes in either the energy efficiency program's design or the EEM's minimum qualification levels.
- **Market Changes.** The changing market conditions and saturation levels of the EEM in the specific market segments. There are two metrics that serve as indicators:
  - The rate of change in the measure's market share over time, and
  - The trend in the measure's incremental cost over time.

After recommending specific NTGR values for the 2011 DEER update, the DEER team identified possible program and market factors that could change the recommended values over the next three years. We then consider whether there is sufficient data and an acceptable analytical approach to forecast the NTGR trend over the next three years. If both conditions are met satisfactorily and absent any significant changes in either program design or qualifying levels for rebated measures, an NTGR forecast is prepared and presented for use in 2013 – 2014. However, if the assessment concludes that there is neither adequate data nor a good understanding of how market changes may affect the NTGR values over time, then no adjustments to the estimated 2011 NTGR update values are recommended to account for market changes between now and 2013.

## 10.2 Comparison of the Current DEER NTGR Values to the Results from the 2006 - 2008 EM&V Studies

Table 10-1 lists the Commercial HVAC EEMs that the team selected for the 2011 DEER updates based upon the 2006-2008 evaluation reports. The table summarizes the NTGR values from the 2008 DEER v2.05 database and the results from the final impact evaluation reports.

**Table 10-1: Overview of NTGR Results by Measure and Delivery Approach**

Energy Efficiency Measure	Delivery Mechanism	Existing DEER NTGR Values (Source)	'06-'08 NTGR Results (Source)																												
HVAC Maintenance: Refrigerant Charge Adjustment	Midstream	0.70, Default value for new EEM not otherwise addressed and delivery method with no convincing strategies to discourage free-ridership or measures with moderate market share (Source: Default)	<table border="0"> <tr> <td><b>Program</b></td> <td><b>NTGR</b></td> <td colspan="2"></td> </tr> <tr> <td>PGE2068</td> <td>0.54</td> <td colspan="2"></td> </tr> <tr> <td>PGE2080</td> <td>0.55</td> <td colspan="2"></td> </tr> <tr> <td>SCE2507</td> <td>0.94</td> <td colspan="2"></td> </tr> <tr> <td>SDGE3043</td> <td>0.70</td> <td colspan="2"></td> </tr> <tr> <td colspan="4">(Source: HVAC HIM and Specialized Commercial)<sup>1</sup></td> </tr> </table>	<b>Program</b>	<b>NTGR</b>			PGE2068	0.54			PGE2080	0.55			SCE2507	0.94			SDGE3043	0.70			(Source: HVAC HIM and Specialized Commercial) <sup>1</sup>							
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(Source: HVAC HIM and Specialized Commercial) <sup>1</sup>																															
RCx Packages	Customized Incentives, Downstream	0.90 for electric EEM, 1.0 for Natural Gas EEM (Source: Impact and Process Evaluation for QuEST's '04-'05 Building Tune-up Program, and '04-'05 PECI San Diego RCx Program Evaluation) <sup>2,3</sup>	<table border="0"> <tr> <td colspan="4"><b>NTGR</b></td> </tr> <tr> <td></td> <td><b>kWh</b></td> <td><b>kW</b></td> <td><b>Therms</b></td> </tr> <tr> <td>PGE</td> <td>0.80</td> <td>0.76</td> <td>0.86 73</td> </tr> <tr> <td>SCE</td> <td>0.86</td> <td>0.78</td> <td>0.91 29</td> </tr> <tr> <td>SCG</td> <td>-</td> <td>-</td> <td>0.92 15</td> </tr> <tr> <td>SDGE</td> <td>0.75</td> <td>0.75</td> <td>0.68</td> </tr> <tr> <td colspan="4">(Source: RCx Impact Evaluation)<sup>4</sup></td> </tr> </table>	<b>NTGR</b>					<b>kWh</b>	<b>kW</b>	<b>Therms</b>	PGE	0.80	0.76	0.86 73	SCE	0.86	0.78	0.91 29	SCG	-	-	0.92 15	SDGE	0.75	0.75	0.68	(Source: RCx Impact Evaluation) <sup>4</sup>			
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SDGE	0.75	0.75	0.68																												
(Source: RCx Impact Evaluation) <sup>4</sup>																															
Chiller Replacements	Customized Incentives	0.64, All HVAC for Non-Residential Customized Incentives (Source: '04-'05 SPC Program Impact Evaluation; adjusted) <sup>5</sup>	<table border="0"> <tr> <td colspan="4"><b>NTGR</b></td> </tr> <tr> <td></td> <td><b>kWh</b></td> <td><b>kW</b></td> <td></td> </tr> <tr> <td>SCE2517</td> <td>0.59</td> <td>0.57</td> <td></td> </tr> <tr> <td>SDGE3010</td> <td>0.70</td> <td>0.68</td> <td></td> </tr> <tr> <td>SDGE3025</td> <td>0.56</td> <td>0.54</td> <td>(Source: Major Customer Impact Evaluation)<sup>6</sup></td> </tr> </table>	<b>NTGR</b>					<b>kWh</b>	<b>kW</b>		SCE2517	0.59	0.57		SDGE3010	0.70	0.68		SDGE3025	0.56	0.54	(Source: Major Customer Impact Evaluation) <sup>6</sup>								
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Package and Split System Air Conditioner and Heat Pump Replacements	Upstream	0.85, Upstream Prescriptive Rebates for Packaged AC Systems (65-135 kBTU/hr) (Source: '04-'05 California Statewide Express and Upstream Programs Evaluation) <sup>7</sup>	<table border="0"> <tr> <td colspan="4"><b>NTGR</b></td> </tr> <tr> <td></td> <td><b>kWh</b></td> <td><b>kW</b></td> <td></td> </tr> <tr> <td>PGE2080</td> <td>0.94</td> <td>0.94</td> <td></td> </tr> <tr> <td>SCE2507</td> <td>0.96</td> <td>0.96</td> <td></td> </tr> <tr> <td>SDGE3029</td> <td>0.94</td> <td>0.94</td> <td></td> </tr> <tr> <td colspan="4">(Source: HVAC HIM and Specialized Commercial)<sup>1</sup></td> </tr> </table>	<b>NTGR</b>					<b>kWh</b>	<b>kW</b>		PGE2080	0.94	0.94		SCE2507	0.96	0.96		SDGE3029	0.94	0.94		(Source: HVAC HIM and Specialized Commercial) <sup>1</sup>							
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<sup>1</sup> Evaluation Measurement and Verification of the California Public Utilities Commission HVAC High Impact Measures and Specialized Commercial Contract Group Programs, 2006 – 2008 Program Year, Final Consultant Report, Volumes 1 and 2, KEMA, February 10, 2010.

<sup>2</sup> Impact and Process Evaluation Final Report for QuEST's 2004-05 Building Tune-Up Program, SBW Consulting, Inc.; March 22, 2007.

<sup>3</sup> San Diego Gas and Electric Retrocommissioning Program, Final Report; Submitted to Portland Energy Conservation, Inc.; Submitted by Itron, Inc.; December 8, 2008.

<sup>4</sup> 2006 – 08 Retro-Commissioning Impact Evaluation, Final Report, SBW Consulting, Inc., February 8, 2010.

<sup>5</sup> 2004 – 2005 Statewide Nonresidential Standard Performance Contract Program Measurement and Evaluation Study; Impact, Process, and Market Evaluation – Final Report; Submitted to Southern California Edison Company, Submitted by Itron, Inc.; September 30, 2008.

<sup>6</sup> Major Commercial Contract Group, Volume I, Final Impact Evaluation Report, 2006 – 2008 Program Years, SBW Consulting, Inc.; February 10, 2010.

<sup>7</sup> 2004/2005 Statewide Express Efficiency and Upstream HVAC Program Impact Evaluation, Prepared for the California Public Utilities Commission and California's Investor Owned Utilities, Submitted by Itron, Inc.; December 31, 2008.

### 10.3 Comparison of Methods and Sample Sizes

The RCx Packages NTGR value adopted in the current DEER database was arrived at based on the results from two specific EM&V studies: (1) the SBW study<sup>8</sup> of the 2004 - 2005 QuEST Building Tune-Up Program, and (2) the Itron study<sup>9</sup> of the PECI 2004 – 2005 SDG&E Retro-commissioning Program. The SBW study used a Self Report method and a customer survey to estimate the level of free-ridership. The estimates were based on the analysis of 17 customer projects, and arrived at NTGR estimates of 0.87 for electric projects and 1.0 for natural gas projects. The Itron study used a Self Report method, and used the responses from only three participants to derive an NTGR value of 1.0. In past discussions, Itron has stated that the study's under-funding, small sample size, and methods render the NTGR result inadequate for use in either the DEER or any other regulatory application.

The 2008 DEER does not provide an explicit NTGR value for the Chiller Replacements EEM Category. Since all IOU chiller replacement projects appear as part of the Customized Incentives programs, the only applicable NTGR that the EEM may fall under would be the general "All HVAC" grouping for Large Non-Residential Customized Incentives. This measure category uses the same NTGR value that was derived for the custom electric measures in the Itron evaluation of the 2004 – 2005 Standard Performance Contract Program. The study used a Self Report customer survey methodology with 113 participants and derived a 0.54 NTGR value for all Customized Incentive projects. The 0.64 NTGR value adopted in the 2008 DEER resulted from the CPUC's decision to include a self-report bias adder (+0.10) from a 2001 study.<sup>10</sup> The 2008 DEER team advised against continuing the practice since the basis and need for the adder had diminished since its inception. Nonetheless, the decision was made to include it in the 2008 DEER and to revisit the adder's basis during the following DEER update. A further review and discussion may be found in the Custom NTGR section for the Industrial EEM updates.

For Packaged and Split System Air Conditioners and Heat Pumps, upstream delivery, the 2008 DEER does not list a specific NTGR value to cover the entire category at this time and limits its entry to Packaged Air Conditioners within the capacity range of 65-135 kBTU/hour. The NTGR

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<sup>8</sup> Impact and Process Evaluation Final Report for QuEST's 2004-05 Building Tune-Up Program, SBW Consulting, Inc.; March 22, 2007.

<sup>9</sup> San Diego Gas and Electric Retrocommissioning Program, Final Report; Submitted to Portland Energy Conservation, Inc.; Submitted by Itron, Inc.; December 8, 2008.

<sup>10</sup> The self report bias adder originated from a 2001 study entitled "Improving the Standard Performance Contracting [sic] Program: An Examination of historical Evidence and Directions for the Future," Xenergy, Inc. The draft 2008 NTFR summary report indicates that this adjustment was intended to be temporary. According to the 2001 Xenergy Study, the adjustment arises from applying different NTG methodologies, Self-Report, Discrete Choice, etc., to the same population with the result that the Self-Report Approach is typically 0.10 or more, lower than other methods.

estimate originates from the Itron evaluation study<sup>11</sup> of the 2004 – 2005 Upstream HVAC programs. The study produced a Self Report free-ridership set of estimates based on telephone interviews with 19 distributors, and a set of estimates using Discrete Choice methodology based on a total sample size of 2,460 participants and non-participants. The 19 distributors interviewed for the self-reported estimates accounted for about 77% of the total cooling tonnage rebated through the upstream program during the 2004 through 2005 timeframe.

Table 10-2 shows the free-ridership and NTGR estimates the study determined through the self-report estimates from the distributor interviews. The study did not recommend using the “by size” reported results.

**Table 10-2: '04-'05 Upstream HVAC Study Free-Ridership Estimates and NTFR Ratios**

Estimate	CAC Size/Efficiency					Overall (All Motor Sizes)
	<65 kBtuh Tier 1	<65 kBtuh Tier 2	<65 kBtuh Tier 3	65-135 kBtuh	>135 kBtuh	
Total rebated CAC tonnage (2004/2005) represented by distributors in sample	22,072	36,596	997	27,641	14,895	102,200
"Free rider" tonnage represented by distributors in sample (n=19)*	7,816	5,309	349	8,697	6,456	28,627
<b>Free ridership rate</b>	35% <sup>†</sup>	15% <sup>†</sup>	35% <sup>†</sup>	31% <sup>†</sup>	43% <sup>†</sup>	<b>28%</b>
<b>NTFR Ratio (inverse of free ridership)</b>						<b>72%</b>
<b>n (number of distributors)</b>	16	13	11	14	17	19

\* Nineteen of the 21 distributors in the sample could provide estimates of free ridership.

† Free-ridership estimates at the motor size level are not statistically valid and are shown for illustrative purposes only.

The study also presented the self-reported free-ridership estimates by utility service area, shown in Table 10-3, and noted that the estimates by utility were not statistically valid.

<sup>11</sup> 2004/2005 Statewide Express Efficiency and Upstream HVAC Program Impact Evaluation, Prepared for the California Public Utilities Commission and California’s Investor Owned Utilities, Submitted by Itron, Inc.; December 31, 2008.

**Table 10-3: '04-'05 Upstream HVAC Study Free-Ridership Estimates by IOU**

IOU	Free-Ridership Estimate	n
PG&E	31% <sup>†</sup>	15
SCE	27% <sup>†</sup>	11
SDG&E	20% <sup>†</sup>	8
<b>Overall</b>	<b>28%</b>	<b>19*</b>

\* Nineteen of the 21 distributors in the sample could provide estimates of free ridership.

† Free-ridership estimates at the IOU level are not statistically valid and are shown for illustrative purposes only.

The study's Discrete Choice modeling yielded a NTGR value of 0.58 for Packaged and Split System Air Conditioners as shown Table 10-4. The study describes a number of problems with the Discrete Choice analysis and concluded that its resultant value for the air conditioner analysis may be biased downwards. Further problems may have existed with the self-reporting of non-participants air conditioners and their ability to report on the efficiency level of the equipment they purchased.

**Table 10-4: '04-'05 Express and Upstream Study NTGR Results**

Measure Type	Self-Report Express Participants	Self-Report Upstream	Discrete Choice Express Participants
<b>Lighting</b>			
CFLs	81%		77%
T8_T5s	78%		76%
LED Exit Signs	77%		
Occupancy Sensors	78%		
<b>HVAC</b>			
Programmable Thermostats	76%		
PTACs	74%		
Reflective Window Film	59%		
Split/Packgd A/C Systems	N/A	72%	58%
<b>Refrigeration</b>			
Curtains	46%		
Door Gaskets	76%		
<b>Motors</b>	N/A	46%	

If nonparticipants over-reported the efficiency level of their purchase, the effect could result in an over-stated free-ridership value. Due to these issues, the study recommended using the upstream self-report result of 0.72 for Packaged and Split System Air Conditioners. The Technology Group 2 team did not find in the available 2008 DEER documentation how and why the 0.85 NTGR value was adopted and it appears to be a consensus judgment value.

**Table 10-5: Methods and Sample Sizes for Commercial HVAC EEMs in the '06-'08 EM&V Studies**

<b>EEM</b>	<b>Market Segment and Program Year</b>	<b>NTGR Method Used</b>	<b>Sample Sizes</b>	<b>Delivery Mechanism</b>
HVAC Maintenance: Refrigerant Charge Adjustment	Non-Residential 2006 – 2008	Self Report Approach	PG&E2068 122 PG&E2080 92 SCE2507 23 SDG&E3043 23 Total: 260	Midstream
RCx Packages	Non-Residential 2006 – 2008	Self Report Approach	PG&E 73 SCE 29 SCG 15 SDG&E 3 Total: 120	Customized Incentives, Downstream
Chiller Replacements	Non-Residential 2006 – 2008	Self Report Approach	SCE2517 47 SDGE3010 33 SDGE3025 27 Total: 107	Customized Incentives
Package and Split System Air Conditioner and Heat Pump Replacements	Non-Residential 2006 – 2008	Self Report Approach	PGE2080 10 SCE2507 10 SDGE3029 10 Total: 30	Upstream

## 10.4 Recommended 2011 DEER Updates to the NTGR Values

Overall, the DEER team found that the most recent evaluations had larger sample sizes and improved evaluation methods over the 2004 – 2005 studies that were used in the 2008 DEER updates. Accordingly, we recommend using the statewide weighted average NTGR values the team has derived and summarized in Table 10-6. The values were derived through weight averaging the utility level estimates, using ex post energy savings and peak demand reduction, to arrive at statewide recommended values. The analyst’s data collection notes are in Appendix A-3.1 for each recommendation and Appendix A-3.2 provides the embedded spreadsheet calculations that derived the recommended statewide averages.<sup>12</sup>

<sup>12</sup> From within Microsoft Word, you may double-click on a table in Appendix B to launch the spreadsheet application on your computer to examine the underlying formulas and calculations.



**Table 10-6: Recommended NTGR by Measure and Delivery Method**

<b>EEM</b>	<b>EEM Characteristics</b>	<b>Delivery Mechanism</b>	<b>Applicable Sector and Building Types</b>	<b>Utility Specific or Statewide NTGR</b>	<b>Recommended NTGR Values</b>
HVAC Maintenance: Refrigerant Charge Adjustment	n/a	Midstream	Commercial, All Building Types	Statewide	0.73
RCx Packages	n/a	Customized Incentives, Downstream	Commercial, All Building Types	Statewide	0.80 for Electric, 0.82 for Nat. Gas
Chiller Replacements	Water or air cooled, all compressor types with and without variable speed capability	Customized Incentives	Commercial, All Building Types	Statewide	0.58
Package and Split System Air Conditioner and Heat Pump Replacements	All sizes	Upstream	Commercial, All Building Types	Statewide	No update. Retain current value of 0.85.

For the standalone Refrigerant Charge Adjustment HVAC Maintenance measure, the update team considers the sample sizes for two of the evaluated utility programs too low to recommend standalone utility values. Therefore, the NTGR results for the four evaluated programs in the 2006 – 2008 study were used to derive a statewide weighted average NTGR value as shown in Appendix A-3.2. The team expects that future utility programs are unlikely to offer this measure in a standalone fashion. The launch of the HVAC Quality Maintenance programs this year already bundles all the HVAC maintenance measures into a single diagnostic service offering. Ongoing 2010 – 2012 EM&V efforts will better inform the long term DEER update in this area than what can be further derived from the prior measurement efforts. Hence, despite the two opposite extreme NTGR results for the PG&E and SCE programs, the team considers the resulting average value of 0.73 adequate for the 2011 DEER update due to the ongoing program changes.

Likewise, the RCx study results had small sample sizes for individually evaluated programs, requiring that the NTGR results be combined into statewide electric and natural gas values to maintain statistical significance. The large number of potential measures in this category and the custom projects through which they are mostly implemented through does not allow us to make any reliable predictions for this measure category. In addition, with the launch of the HVAC Quality Maintenance offerings, potential overlaps need to be more closely examined as the program evolves and the Ex Ante and Custom Project review process begin to take place. The

derivation of the recommended RCx packages EEM statewide weighted average NTGR values for electric and natural gas is shown in Appendix B.

The Chiller Replacements EEM is typically implemented and rebated through custom projects. Thus, a recommended NTGR value was derived from the 2006 – 2008 evaluation study NTGR results for customized incentive programs. The evaluation study did not produce a standalone result for chiller replacements. Hence, the team used a combination of program level results and individual chiller project results and selected the rounded-up midpoint of the range to arrive at an overall statewide recommended NTGR value. The approach is shown in Appendix B. Finally, the team's detailed review of the 2006 – 2008 evaluation study for the HVAC Upstream programs for the Packaged and Split Systems Air Conditioner replacement measure concluded that the sample size was not much better than the 2004 – 2005 evaluation. Therefore, no change to the adopted 2008 DEER NTGR value for this measure is recommended.

## **10.5 Factors Likely to Lead to Changes in the Next Three Years**

The DEER team reviewed the two most recent NTGR evaluations and the overall literature to identify key factors that may lead to changes in the next three years for the commercial HVAC EEMs and the programs that promote them. The principal factors that were identified include:

- Potential changes in the level of rebates and qualification tiers for commercial HVAC equipment,
- Significant changes in EEM incremental costs,
- Potential federal and state code updates including the time lag from the previous set of code updates (effective date requirements in EISA and Title 20/24 for code changes that are already approved),
- Business trends in the contractor market, and customer disposable income and attitude towards major purchases (effect on program volumes and market share), and
- Changes in either Program Design or Sales Channels, e.g., target a narrow market sector.

## **10.6 Assessment of Current Data and Tools Available to Prepare a Forecast of NTGR Values**

The NTGR values for certain general commercial HVAC EEM Categories such as “Other HVAC” have declined, falling from 0.96 used in the Express Efficiency Program through 2005, to 0.50 established in the 2004 – 2005 Express Efficiency Program Evaluation Study and adopted for the 2008 DEER Update. Likewise, the general “All HVAC” EEM Category for large non-residential projects through the Customized Incentives approach declined from 0.70 to a value of 0.54 determined through the '04-'05 SPC evaluation study, and settling on the consensus value of 0.64 for all Customized Incentive EEMs adopted in the 2008 DEER Update.

Equipment specific commercial HVAC EEM categories and delivery approaches have stayed fairly constant over the years. Three examples are “HVAC Motors” targeted at New Construction through Building Design Incentives, “Window Film” aimed at small hard-to-reach commercial through Direct Install, and “HVAC/Economizer Controls” also intended for small hard-to-reach commercial through Direct Install. The two direct install EEMs were assigned an NTGR of 0.80 prior to the '04-'05 studies. The '04-'05 studies determined a 0.85 NTGR value for the direct install approach and the 2008 DEER Update adopted it for these EEMs. The “HVAC Motors” new construction EEM NTGR value has remained within a very narrow band of 0.82, prior to the '04-'05 studies, to 0.84 determined through the '04-'05 evaluations and adopted in the 2008 DEER Update. These trends appear to indicate that the general, “catch-all” non-residential HVAC EEM categories associated with either Prescriptive Incentives or Customized Incentives have declined over time while the equipment specific EEMs have remained nearly constant. In large part, the most dramatic NTGR declines are due to a shift away from the earlier approach of assigning an NTGR value to a program as a whole with no regard to the underlying EEMs to determining measure specific NTGR values per delivery method and market segments since the '04-'05 evaluation studies.

## **10.7 Recommended NTGR Values for Future Programs**

Once the effect of shifting from program centric NTGR values to measure and delivery method NTGR values is discounted, the NTGR values for HVAC measures have remained within a narrow range. The DEER team believes that there is inadequate information to make any significant adjustments to the recommended NTGR values we have derived from the 2006 - 2008 evaluations. Thus, the Team recommends that no adjustments be made to the NTGR values presented in Table 10-6 to account for potential market changes from now to 2013.

# 11

## Recommended Updates to Net-To-Gross Ratios for Commercial Refrigeration

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### 11.1 Introduction

In this analysis, the Net-to-Gross ratio (NTGR) analysis results from the 2006 – 2008 impact evaluation studies that reviewed commercial refrigeration measures are compared to the matched NTGR values for similar energy efficiency measures in the current DEER data base. The goal of this comparison is to decide if an update to the existing NTGR values is warranted for the 2011 update. The 2011 updates could serve as part of the bases for programs implemented after January 1, 2013. For each measure, the DEER team compares the strengths and weaknesses of the latest evaluation methods used to derive the NTGR results with the prior studies' evaluation methods used for the 2008 DEER update. Some of the factors that may be considered in recommending a revised NTGR value include:

- The relative merits of the methods and sampling plans used to derive the NTGR estimates in the existing DEER database and in the 2006 – 2008 evaluation studies,
- The potential changes in either the program's design or measure's minimum qualification levels between the previous evaluation efforts and the 2006 - 2008 evaluation, and
- The changing market conditions and measure's saturation levels in the specific market segments. There are two metrics that could serve as indicators of market saturation:
  - The rate of change in the measure's market share over time, i.e., the measure's adoption rate – very high rates, along with dramatic changes in the rate, may be indicative that the measure has reached commercial maturity and market acceptance with the expectation that the NTGR value will decline over time in mature markets, and
  - The trend in the measure's incremental cost over time – the NTGR is expected to decrease as the incremental cost declines.

After recommending specific NTGR values for the 2011 DEER update, the DEER team identified possible program and market factors that could change the recommended values over the next three years. We then consider whether there is sufficient data and an acceptable analytical approach to forecast the NTGR trend over the next three years. If both conditions are met satisfactorily and absent any significant changes in either program design or qualifying levels for the rebated measures, an NTGR forecast is prepared and presented for use in 2013 -

2014. However, if the assessment concludes that neither adequate data nor a good understanding of how market changes may affect the NTGR values over time, then no adjustments to the recommended 2011 NTGR estimates are made to account for market changes between now and 2013.

## 11.2 Comparison of Current DEER NTGR Values to the Results from the 2006 – 2008 EM&V Studies

Table 11-1 lists the Commercial Refrigeration measures that the DEER team selected for the 2011 DEER update based upon the readily available data from the 2006-2008 evaluation reports. The table summarizes and compares the NTGR values from the 2008 DEER v2.05 database and the results from the final 2006 – 2008 impact evaluation reports. The recent evaluations found much higher levels of free-ridership for both measures, and consequently much lower NTGR values compared to those values in the 2008 DEER. The evaluation report offered no explanations and possible reasons for the large increase in free-ridership between the two sets of evaluations. One potential reason may be the low ex ante baseline issues identified in the recent study, in particular for the strip curtains measure.

**Table 11-1: Overview of NTGR results by Measure and Delivery Mechanism**

Energy Efficiency Measure	Delivery Mechanism	Existing DEER NTGR Values (Source)	06-08 NTGR Results (Source)
Door Gaskets	Downstream Prescriptive	0.46 (Itron, December 2008 <sup>1</sup> )	0.19 (ADM, February 2010 <sup>2</sup> )
Strip Curtains	Downstream Prescriptive	0.76 (Itron, December 2008)	0.40 (ADM, February 2010)

## 11.3 Comparison of Methods and Sample Sizes

Both the 2004-05 and 2006-08 studies used the Self-Report Approach to derive their NTGR results using interviews with participating customers. The 2006-08 evaluation study used a modified version of the standard net-to-gross battery especially for the door gaskets and strip curtains measures to eliminate obvious free-riders: participants with maintenance contracts for door gasket replacements (measure already adopted), and those that have an internal replacement schedule that is less than the measure’s estimate effective useful life (EUL) of four years. The latest evaluation achieved larger sample sizes relative to the 2004-05 evaluation, as summarized

<sup>1</sup> 2004/2005 Statewide Express Efficiency and Upstream HVAC Program Impact Evaluation, Itron, Inc., December 2008.

<sup>2</sup> Commercial Facilities Contract Group 2006-2008 Direct Impact Evaluation Study, Volumes 1 and 3, ADM and Associates, February 2010.

in Table 11-2. More detailed information on the sources and methods used are provided in Appendix A-4.

Due to the larger sample sizes, along with the improved, modified battery of questions specifically designed for the door gaskets and strip curtain measures, the recent evaluation appears to provide more precise information than the prior bases of the 2008 DEER based on our assessment of the sampling and analyses methodologies used. Hence, the DEER Update Technology Group 5 team recommends the 2006-08 NTGR estimates summarized in Table 11-3 for use in the 2011 update.

**Table 11-2: Methods and Sample Sizes for Commercial Refrigeration Measures**

Measure	Market Segment and Program Year	NTGR Method Used	Sample Sizes		Delivery Mechanism
			DEER	2006-2008	
Door gaskets	All Nonresidential 2006-08	Self Report	24	71	Downstream Prescriptive
Strip curtains	All Nonresidential 2006-08	Self Report	47	101	Downstream Prescriptive

## 11.4 Recommended 2011 DEER Updates to the NTGR Values

Table 11-3 summarizes the recommended NTGR values for the 2011 DEER database update.

**Table 11-3: Recommended NTGR by Measure and Delivery Method**

EEM	EEM Characteristics	Delivery Methods	Applicable Sector and Building Types	Utility Specific or Statewide	Recommended NTGR Value
Door Gaskets	Applied to either walk-in cooler or freezer doors, Refrigerated Reach-in Display Cases	Downstream Prescriptive, Direct Install	Non-Residential: Supermarkets, Convenience Stores, Restaurants	Statewide	0.19
Strip Curtains	Walk-in coolers or freezers	Downstream Prescriptive, Direct Install	Nonresidential: Supermarkets, Convenience Stores, Restaurants, Refrigerated Warehouses	Statewide	0.40

## **11.5 Factors Likely to Lead to Changes in the Next Three Years**

The DEER team reviewed the two most recent NTGR evaluations and the overall literature to identify key factors that may lead to changes in the next three years for the commercial refrigeration measures and the programs that promote them. The principal factors that were identified for the commercial refrigeration measures include:

- Changes in the measures qualifying for the programs and their respective rebate levels,
- Potential federal and state minimum performance requirements for walk-in coolers and freezers,
- Changes in Program design, especially changes to the measure baselines, and
- Business trends in the Vendor/Contractor markets and their impacts on program volume.

## **11.6 Assessment of Current Data and Tools Available to Prepare a Forecast of NTGR Values**

There is insufficient data on the market share of door gaskets and strip curtains to make adjustments to the 2008 NTGRs for use in program years 2013 and beyond.

## **11.7 Recommended NTGR Values for Future Programs**

Given the lack of data on price and limited incremental costs, and the percentage of customers with either maintenance contracts or with internal maintenance schedules for the two refrigeration measures reviewed, the DEER team finds that it cannot produce reliable adjustments to account for potential market conditions in 2013 - 2014. Thus, we recommend no adjustments be made to the NTGR values presented in Table 11-3.

# 12

## Recommended Updates to the Net-to-Gross Ratios for Residential HVAC Systems and Building Envelopes

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### 12.1 Introduction

The DEER team reviewed the Net-to-Gross Ratio (NTGR) results from the 2006 – 2008 EM&V studies for a select group of Residential HVAC energy efficiency measure (EEM) categories and compared them the California Public Utilities Commission’s (CPUC) adopted values in the 2008 DEER database, Version 2.05. The objective was to arrive at a recommended set of NTGR values for the 2011 DEER update. For each measure, we compared the strengths and weaknesses of the methods and datasets used to derive the NTGR results and contrasted them to the relative strength of the methods and datasets used to establish the values for the 2008 DEER update. Some of the factors that may be considered in recommending a revised NTGR value include:

- **Methods and Sample Sizes.** The relative merits of the methods and sample sizes used to derive the NTGR estimates in the existing DEER database and new evaluation studies.
- **Program Design Changes.** The potential changes in either the energy efficiency program’s design or the EEM’s minimum qualification levels.
- **Market Changes.** The changing market conditions and saturation levels of the EEM in the specific market segments. There are two metrics that serve as indicators:
  - The rate of change in the measure’s market share over time, and
  - The trend in the measure’s incremental cost over time.

After recommending specific NTGR values for the 2011 DEER update, the DEER team identified possible program and market factors that could change the recommended values over the next three years. We then consider whether there is sufficient data and an acceptable analytical approach to forecast the NTGR trend over the next three years. If both conditions are met satisfactorily and absent any significant changes in either program design or measure qualifying levels, an NTGR forecast is prepared and presented for use in 2013 – 2014. However, if the assessment concludes that there is neither adequate data nor a good understanding of how market changes may affect the NTGR values over time, then no adjustments to the estimated 2011 NTGR update values are recommended to account for market changes between now and 2013.



## **12.2 Comparison of the Current DEER NTGR Values to the Results from the 2006 - 2008 EM&V Studies**

Table 12-1 lists the Residential HVAC measure categories that were selected for the 2011 DEER updates based upon the 2006-2008 impact evaluation reports. The table summarizes the NTGR values from the 2008 DEER v2.05 database and the results from the final evaluation reports.

**Table 12-1: Overview of NTGR Results by Measure and Delivery Method**

Energy Efficiency Measure	Delivery Method in 2008 DEER	NTGR Values in 2008 DEER (Source)	'06-'08 NTGR Results (Source)																				
Room Air Conditioners	Downstream Prescriptive Rebate	0.70, Default (Source: '04-'05 Res. Retrofit) <sup>1</sup>	<table border="0"> <tr> <td><b>Program</b></td> <td><b>NTGR</b></td> </tr> <tr> <td>PGE2000</td> <td>0.41</td> </tr> <tr> <td>SCE2501</td> <td>0.36</td> </tr> <tr> <td>SDGE3024</td> <td>0.31</td> </tr> <tr> <td colspan="2">(Source: Res. Retrofit)<sup>2</sup></td> </tr> </table>	<b>Program</b>	<b>NTGR</b>	PGE2000	0.41	SCE2501	0.36	SDGE3024	0.31	(Source: Res. Retrofit) <sup>2</sup>											
<b>Program</b>	<b>NTGR</b>																						
PGE2000	0.41																						
SCE2501	0.36																						
SDGE3024	0.31																						
(Source: Res. Retrofit) <sup>2</sup>																							
HVAC Maintenance: Duct Sealing	Free Tune-up/Repair	0.78, HVAC Diagnostic (Source: Unknown)	<table border="0"> <tr> <td><b>Program</b></td> <td><b>NTGR</b></td> </tr> <tr> <td>PGE2000</td> <td>0.54</td> </tr> <tr> <td>PGE2078</td> <td>0.85</td> </tr> <tr> <td>SCE2501</td> <td>0.79</td> </tr> <tr> <td>SCE2507</td> <td>0.96</td> </tr> <tr> <td>SDGE3035</td> <td>0.80</td> </tr> <tr> <td colspan="2">(Source: HVAC HIM and Specialized Commercial)<sup>3</sup></td> </tr> </table>	<b>Program</b>	<b>NTGR</b>	PGE2000	0.54	PGE2078	0.85	SCE2501	0.79	SCE2507	0.96	SDGE3035	0.80	(Source: HVAC HIM and Specialized Commercial) <sup>3</sup>							
<b>Program</b>	<b>NTGR</b>																						
PGE2000	0.54																						
PGE2078	0.85																						
SCE2501	0.79																						
SCE2507	0.96																						
SDGE3035	0.80																						
(Source: HVAC HIM and Specialized Commercial) <sup>3</sup>																							
HVAC Maintenance: Refrigerant Charge Adjustment	Free Tune-up/Repair	0.78, HVAC Diagnostic (Source: Unknown)	<table border="0"> <tr> <td><b>Program</b></td> <td><b>NTGR</b></td> </tr> <tr> <td>PGE2000</td> <td>0.63</td> </tr> <tr> <td>PGE2078</td> <td>0.78</td> </tr> <tr> <td>SCE2501</td> <td>0.78</td> </tr> <tr> <td>SCE2507</td> <td>0.97</td> </tr> <tr> <td>SDGE3035</td> <td>0.78</td> </tr> <tr> <td colspan="2">(Source: HVAC HIM and Specialized Commercial)<sup>3</sup></td> </tr> </table>	<b>Program</b>	<b>NTGR</b>	PGE2000	0.63	PGE2078	0.78	SCE2501	0.78	SCE2507	0.97	SDGE3035	0.78	(Source: HVAC HIM and Specialized Commercial) <sup>3</sup>							
<b>Program</b>	<b>NTGR</b>																						
PGE2000	0.63																						
PGE2078	0.78																						
SCE2501	0.78																						
SCE2507	0.97																						
SDGE3035	0.78																						
(Source: HVAC HIM and Specialized Commercial) <sup>3</sup>																							
Roof and Wall Insulation	Downstream Prescriptive Rebate	0.70, Wall and Ceiling Insulation (Source: '04-'05 Res. Retrofit)	<table border="0"> <tr> <td><b>Prgm</b></td> <td><b>kWh</b></td> <td><b>kW</b></td> <td><b>Therms</b></td> </tr> <tr> <td>PGE</td> <td>0.25</td> <td>0.28</td> <td>0.26</td> </tr> <tr> <td>SCG</td> <td>0.30</td> <td>0.30</td> <td>0.29</td> </tr> <tr> <td>SDGE</td> <td>0.25</td> <td>0.26</td> <td>0.25</td> </tr> <tr> <td colspan="4">(Source: Res. Retrofit)<sup>2</sup></td> </tr> </table>	<b>Prgm</b>	<b>kWh</b>	<b>kW</b>	<b>Therms</b>	PGE	0.25	0.28	0.26	SCG	0.30	0.30	0.29	SDGE	0.25	0.26	0.25	(Source: Res. Retrofit) <sup>2</sup>			
<b>Prgm</b>	<b>kWh</b>	<b>kW</b>	<b>Therms</b>																				
PGE	0.25	0.28	0.26																				
SCG	0.30	0.30	0.29																				
SDGE	0.25	0.26	0.25																				
(Source: Res. Retrofit) <sup>2</sup>																							
Air Cooled Packaged and Split System Air Conditioners and Heat Pumps	Downstream Prescriptive Rebates	0.67, Central AC >14 SEER (Source: '04-'05 Res. Retrofit )  0.80, Central AC >15 SEER (Source: Unknown)  0.55, Heat Pump – Energy Star (Source: '04-'05 Res. Retrofit)	<table border="0"> <tr> <td><b>Program</b></td> <td><b>NTGR</b></td> </tr> <tr> <td>SCE2507</td> <td>0.56</td> </tr> <tr> <td>SDGE3029</td> <td>0.53</td> </tr> <tr> <td colspan="2">(Source: HVAC HIM and Specialized Commercial)<sup>3</sup></td> </tr> </table>	<b>Program</b>	<b>NTGR</b>	SCE2507	0.56	SDGE3029	0.53	(Source: HVAC HIM and Specialized Commercial) <sup>3</sup>													
<b>Program</b>	<b>NTGR</b>																						
SCE2507	0.56																						
SDGE3029	0.53																						
(Source: HVAC HIM and Specialized Commercial) <sup>3</sup>																							

### 12.3 Comparison of Methods and Sample Sizes

The sample sizes and methods used to determine the free-ridership and NTGR estimates in the 2006 – 2008 impact evaluation studies are summarized in Table 12-2.

<sup>1</sup> 2004/2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation, Final Report, Itron/KEMA, October 2, 2007.

<sup>2</sup> Residential Retrofit High Impact Measure Evaluation Report, prepared for the California Public Utilities Commission Energy Division, The Cadmus Group, Inc., February 8, 2010.

<sup>3</sup> Evaluation Measurement and Verification of the California Public Utilities Commission HVAC High Impact Measures and Specialized Commercial Contract Group Programs, 2006 – 2008 Program Year, Final Consultant Report, Volumes 1 and 2, KEMA, February 10, 2010.

**Table 12-2: Methods and Sample Sizes for Residential HVAC in the '06-'08 EM&V Studies**

<b>EEM</b>	<b>Market Segment and Program Year</b>	<b>NTGR Method Used</b>	<b>Sample Sizes</b>	<b>Delivery Methods in Studies</b>
Room Air Conditioners	Residential 2006 – 2008	Self Report Approach	PGE2000 91 SCE2501 629 SDGE3024 377 Total: 1,097	Downstream
HVAC Maintenance: Duct Sealing	Residential 2006 – 2008	Self Report Approach	PGE2000 211 PGE2078 103 SCE2502 102 SCE2507 112 SDGE3035 102 Total: 630	Midstream
HVAC Maintenance: Refrigerant Charge Adjustment	Residential 2006 – 2008	Self Report Approach	PGE2000R 135 SCE2507 94 CMMHP <sup>4</sup> 309 Total: 538	Midstream
Roof and Wall Insulation	Residential 2006 – 2008	Self Report Approach	PGE2000 448 SCG3517 779 SDGE3024 530 Total: 1,797	Downstream
Air Cooled Packaged and Split System Air Conditioners and Heat Pumps	Residential 2006 – 2008	Self Report Approach	SCE2507 204 SDGE3029 <sup>5</sup> 153 Total: 357	Upstream, Downstream

The 2008 DEER does not list a specific NTGR value for Energy Star qualified Room Air Conditioners (RAC). Hence, the default value of 0.70 applies to this measure. For the 2006 – 2008 programs, the investor owned utilities (IOUs) used a default NTGR value of 0.80 for their ex ante claimed results. However, the 2004 – 2005 Residential Retrofit impact evaluation study estimated an NTGR value of 0.69, listed in the report’s Table 9-47, based on a Self Report evaluation of 50 surveys.

The HVAC Maintenance Duct Sealing measure, also referred to as Duct Test and Seal (DTS) in some instances, is categorized as an HVAC Diagnostic measure in the 2008 DEER update. The 2004 – 2005 Statewide Residential Retrofit Study did not evaluate this measure. Likewise the HVAC Maintenance Refrigerant Charge Adjustment measure was not evaluated as part of the 2004 – 2005 Statewide Residential Retrofit Study. A search of the available reports on the CALMAC website did not find an impact evaluation with NTGR values that approximate the

<sup>4</sup> The Comprehensive Manufactured & Mobile Home Program (CMMHP) includes the following utility programs: PGE2078, SCE2502 and SDGE3035.

<sup>5</sup> The HVAC HIM report indicates that for the “...SDG&E 3029 Residential AC Replacement, there were 322 survey sample completes, but only 153 were used to calculate the savings weighted NTG ratio.”

values adopted in the 2008 DEER updates, and the available DEER update documentation does not describe how the adopted values were established.

The Roof and Wall Insulation measures were evaluated in the 2004 – 2005 Residential Retrofit Study and recommended an NTGR value of 0.70, listed in the report's Table 9-47. The study evaluated the insulation measure's free-ridership using both the Self Report and Discrete Choice approaches. The study's Self Report approach estimated the NTGR at 0.53 based on 253 observations. The report's recommended NTGR for this measure used the Discrete Choice method based on 243 observations. The report states that "...the final NTG ratios used to calculate the net Program impacts are based on the discrete choice results since they are generally thought to be more robust than the self-report methods." The insulation Discrete Choice approach was a one-stage model used to determine the probability of installing insulation.

There are two NTGR values listed in the 2008 DEER for Air Cooled Packaged and Split System Air Conditioners and one for Heat Pumps. Both the 0.67, for Central AC > 14 SEER, and the 0.55 for Heat Pumps, may be found among the recommended values in Table 9-47 in the 2004 – 2005 Residential Retrofit Study. The recommended Central AC estimate was derived from a two-stage Discrete Choice model using 248 participant surveys. The Heat Pump NTGR estimate was derived from a Self Report evaluation based on 55 observations as listed in Table 9-35 in the '04-'05 Residential Retrofit Study report. The 2008 DEER adopted NTGR value of 0.80 for Central AC > 15 SEER is not found in the '04-'05 Residential Retrofit Study. The 2008 DEER update documentation does not specify how the adopted value was established.

## **12.4 Recommended 2011 DEER Updates to the NTGR Values**

Overall, the DEER team found that the most recent evaluations had larger sample sizes and improved Self Report evaluation methods over the Self Report methods used in the 2004 – 2005 Residential Retrofit Study. The 2006 – 2008 impact evaluation studies did not use Discrete Choice models to estimate free-ridership for the measures selected for the 2011 DEER Updates. Hence, we cannot conclude unequivocally that the current set of Self Report Approach NTGR estimates would be close in value to a set of values derived using updated Discrete Choice models and the same dataset of surveys. The expectation is that the changed market conditions and baselines for the evaluated measures from the prior evaluation to the circumstances for the 2006 – 2008 timeframe would lead to similar results. It is important to point out that at least one Discrete Choice analysis performed for non-residential packaged and split system air conditioners encountered a number of problems and resulted in a lower value than the

corresponding Self Report Approach.<sup>6</sup> With this limitation in mind for Central Air Conditioner and Insulation measures, we recommend using the NTGR values the team has derived and summarized in Table 12-3 for the 2011 DEER update. The values were derived through weight averaging the utility level estimates from the '06-'08 evaluations to arrive at statewide recommended values. The analyst's summaries and data collection notes are found in the Appendices A-5.1 and Appendix A-5.2 provides the embedded spreadsheet calculations that derived the recommended statewide averages.<sup>7</sup>

**Table 12-3: Recommended NTGR by Measure and Delivery Method**

<b>EEM</b>	<b>EEM Characteristics</b>	<b>Delivery Methods</b>	<b>Applicable Sector and Building Types</b>	<b>Utility Specific or Statewide NTGR</b>	<b>Recommended NTGR Values for 2011 Update</b>
Room Air Conditioners	Energy Star Qualified	Downstream	Residential: All Building Types	Statewide	0.36
HVAC Maintenance: Duct Sealing	n/a	Midstream	Residential: All Building Types	Statewide	0.78
HVAC Maintenance: Refrigerant Charge Adjustment	n/a	Midstream	Residential: All Building Types	Statewide	0.78
Roof and Wall Insulation	Existing Roof Insulation Level $\leq$ R-11 and EEM Level $\geq$ R-30 if 24" of space available or $\geq$ R-19 if less than 24" available  No Existing Wall Insulation	Downstream	Residential: Single Family	Statewide	0.28
Air Cooled Packaged and Split System Air Conditioners and Heat Pumps	SEER $\geq$ 14	Upstream, Downstream	Residential: All Building Types	Statewide	0.55

The Room Air Conditioner NTGR value is intended for Energy Star Qualified units rebated through a downstream program delivery approach. The 2011 NTGR value is an interim recommendation only. As stated in the '06-'08 Residential Retrofit report "...In 2006-2008 the

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<sup>6</sup> 2004/2005 Statewide Express Efficiency and Upstream HVAC Program Impact Evaluation, Prepared for the California Public Utilities Commission and California's Investor Owned Utilities, Submitted by Itron, Inc.; December 31, 2008.

<sup>7</sup> From within Microsoft Word, you may double-click on a table in Appendix A-5.2 to launch the spreadsheet application on your computer to examine the underlying formulas and calculations.

National ENERGY STAR retailer partners reported the national market share data for ENERGY STAR room air conditioners was 36%, 50%, and 43%, respectively. While this is not an estimate of free-ridership, it is an indication that sales of ENERGY STAR room air conditioners were in the 36%-50% range throughout the U.S., substantially lower than the self-reported estimate of free-ridership in this study.” In 2006, the reported California share of sales of Energy Star RACs stood at 21%, well below the national average. In 2007, the reported California sales of Energy Star units went up to 51%, slightly higher than the national level. In 2008, the reported California Energy Star share of sales had dropped to 38%, below the levels reported at the national level by five percentage points. In the last available Energy Star sales dataset for 2009, the California and national share of sales of Energy Star RACs both stood at 36%. In addition, a small survey conducted as part of the process evaluation of the SCE 2006 – 2008 Home Energy Efficiency Rebate program found for room air conditioners that “...Fifty-six percent of those who received a rebate on their recent air conditioner purchase said they would have been very unlikely to have bought the same model without this rebate. A third (33%) said they would have been somewhat likely to make the same decision without the rebate, and only 11 percent said they would have been very likely to buy the same model without rebates. Once again, the handful of respondents who reported knowingly buying a non-rebated model could not provide a reason for their decision.”<sup>8</sup> The Technology Group 8 team believes that a further time-series trend review of incremental costs, adoption rates and market conditions, along with a comparative analysis of retailer stocking practices by capacity and efficiency levels is necessary to adjust the final recommendation for the 2013 – 2014 time periods.

For both the Duct Sealing and Refrigerant Charge Adjustment HVAC Maintenance measures, the team considers that the future of these measures as standalone offerings in IOU programs will be limited due to unresolved uncertainties surrounding the field measurements and the launch of the Quality Maintenance HVAC program in June 2011 that bundles these and other measures into a single service offering. Also, these measures were the only ones among the examined residential HVAC measures whose NTGR values failed to cluster about a central value across IOU programs in the '06-'08 evaluation studies. The studies failed to satisfactorily explain the occurrence of extreme high and low NTGR results for very similar programs across California. Therefore, the team recommends no adjustments to the 2008 DEER NTGR values for both of these HVAC maintenance measures based on the '06-'08 evaluation results.

The residential Roof and Wall Insulation measure is a long standing conservation option within the IOU programs that has been offered on an on-again/off-again basis for close to 30 years. The mature markets for these measures are reflected in the increasing free-ridership observed in successive evaluations using different evaluation methodologies. The team considers that the measures will continue to be part of programs that encourage Whole Building retrofits and take

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<sup>8</sup> Process Evaluation of Southern California Edison's 2006-2008 Home Energy Efficiency Rebate (HEER) Program, Final Report, Report ID SCE0278, KEMA, Inc.; November 30, 2009; page 5-56.

advantage of home renovation opportunities. The recommended value of 0.28 should not be applied to these insulation measures when they are bundled as part of a whole building retrofit but are appropriate if rebates are offered directly for these measures on a standalone basis. The team considers the recommended statewide value for the stand alone insulation measures a reasonable reflection of the mature laggard market and stringent Building Energy Code requirements the measures face in California.

Lastly, the team recommends the adoption of the Air Cooled Package and Split System Air Conditioner and Heat Pump NTGR value listed in Table 12-3 with two exceptions. First, it appears that only one IOU portfolio continues to offer rebates for central air conditioner and heat pump replacements through the newly launched Quality Installation HVAC Program. Given the undisputed problems associated with the operating performance of many newly installed residential central air conditioning systems, the team does not recommend applying the statewide value derived from prior AC replacement programs to the Quality Installation HVAC Program due to the significant program changes. This program should be subjected to early EM&V to evaluate its effectiveness and potential free-ridership. Second, the 2008 DEER adopted a high NTGR value for systems with efficiency levels above SEER 15. The team considers that very high performance systems may still warrant a high default NTGR value. The team recommends continuing the policy and that the SEER level be raised to 16 with a corresponding EER greater or equal to 13 for split system AC units (2009 CEE Tier 3) for the 2013 – 2014 time periods.

## **12.5 Factors Likely to Lead to Changes in the Next Three Years**

The DEER team reviewed the two most recent NTGR evaluations and the overall literature to identify key factors that may lead to changes in the next three years for the residential HVAC EEMs and the programs that promote them. The principal factors that were identified include:

- Potential changes in the level of rebates and qualification tiers for residential HVAC equipment,
- Significant changes in EEM incremental costs,
- Potential federal and state code updates including the time lag from the previous set of code updates (effective date requirements in EISA and Title 20/24 for code changes that are already approved),
- Significant changes in HVAC equipment, controls and system designs not common in the California residential market,
- Business trends in the contractor market, and customer disposable income and attitude towards major purchases (effect on program volumes and market share), and
- Changes in either Program Design or Sales Channels, e.g., target a narrow market sector.

## **12.6 Assessment of Current Data and Tools Available to Prepare a Forecast of NTGR Values**

The NTGR values for the residential HVAC EEM Categories underwent significant declines at the time when policy and practice shifted away from applying an NTGR value wholesale to an energy efficiency program to determining measure specific values per program delivery method and market segment that began with the 2004 – 2005 impact evaluation studies. The IOU residential programs as a whole tended to use 0.80 as their default NTGR value. Thus, central air conditioners declined from an NTGR of 0.80 to values that range from 0.63 to 0.67 depending on the equipment's performance rating and delivery approach in the '04-'05 evaluation studies.

There are no published analyses focused on either free-ridership or NTGR trends as a function of market adoption rates, equipment sales, incremental costs, efficiency levels, or program incentives, etc. Data to inform such analysis will have to be gathered from a broad range of sources and compared. For example, annual Energy Star qualified equipment market share data is available and covers several years as well as current lists of qualified equipment. However, the Energy Star sales share information may only be useful as a comparative source of sales data. The team recognizes that it is problematic to use the Energy Star collected information for anything beyond a general gauge of sales trends of energy efficient equipment. Nonetheless, the information should be informative when compared to data and projections from other commercial data sources on equipment sales and shipments. The California Energy Commission's appliance database may also be a useful resource. Other common residential data sources in California such as the Residential Appliance Saturation Studies (RASS) and the California Statewide Lighting and Appliance Efficiency Saturation Study (CLASS) focus on existing residential equipment and may contribute little to the proposed analysis. Further review and consultation with analysts familiar with the detailed data fields in both the RASS and CLASS are needed to judge the usefulness of the datasets. The Residential Market Share Tracking (RMST) studies may serve as a resource, but further consultation with the RMST analysts is needed. Lastly, several Measure Cost studies have been conducted in California and they should provide adequate information for trending incremental costs against a number of different equipment characteristics. Also, the program information on rebates over the years is possible to retrieve. A number of statistical analysis and forecasting methods are readily available that can be used to determine whether there are any significant correlations between estimated free-ridership levels and the available data the team may gather and compare.

## **12.7 Recommended NTGR Values for Future Programs**

The majority of the 2011 NTGR values listed in Table 12-3 should not be adjusted to account for changed market conditions in 2013. The one adjustment that is necessary is for the Energy Star



Room Air Conditioner measure. The team believes that the result from the 2006 – 2008 impact study may not accurately portray the present and future free-ridership levels because of recent data that suggest the market share of Room air conditioners is declining in recent years. Unfortunately, there is insufficient time to complete a full analysis before the end of 2011. Hence, we recommend increasing the NTGR rate from the 2006-08 studies from 0.36 to 0.46 to reflect the recent decline in the observed market adoption rate of Energy Star qualifying Room AC unit.

# 13

## Recommended Updates to Net-to-Gross Ratios for Residential Water Heating Systems and Energy Efficiency Measures

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### 13.1 Introduction – Residential Hot Water Systems and Water Flow Restriction Measures

In this analysis, the most recent net-to-gross ratio (NTGR) results for more efficient water heating systems and low flow energy efficiency measures are compared to the existing NTGR values in the current DEER data base. These NTGR estimates were part of a larger evaluation of residential retrofit energy efficiency programs conducted by various contractors for the Energy Division of the California PUC for the 2006-08 program cycle. Based on these comparisons, the DEER Team derived a recommended NTGR value for the three measures in this technology group; residential aerators, low flow showerheads, and more efficient residential gas water heater systems. For each measure, the Team compared the strengths and weaknesses of the methods used to derive NTGR results in the previous DEER and contrasted this to the methods used to estimate NTGR in previous evaluations of utility programs in California. The factors considered by the DEER Team in making a final NTGR recommendation are the following:

- The relative merits of the methods and sampling plans used to derive NTGR for existing DEER values and results from new studies;
- Potential changes in program design or measure minimum qualification levels between the previous evaluation and 2006-08 evaluation;
- Rate of change in the market share of efficient measures or products over time; and
- Any available evidence on trends in rebates offered as a fraction of the incremental cost of the measures or more efficient hot water systems.

After making a recommendation for a specific NTGR value to use in this DEER 2011 update, the DEER Team identified the program and market factors that are likely to lead to changes in NTGR results between now and the first potential ex ante application of these values in 2013. The Team then assess whether there is sufficient data and or analysis tools to accurately forecast the likely trend in NTGR values between 2008 and post-2012 for this specific measure and program design. If there is sufficient data to make an accurate forecast absent any significant changes in program design and or qualifying levels for rebated measures, the Team produced a

forecast of NTGR for use in program fielded post-2012. These forecasts are based on the assumption that program design or qualifying efficiency level are not likely to significantly change between programs deployed in 2008 and those in post-2012. If there are significant changes to these factors, the Team recommends the use of our unadjusted NTGR values based on the most recent evaluation research.

### 13.2 Comparison of Current DEER NTGR to Results from Latest EM&V Analyses in 2006-2008

Table 13-1 compares the NTGR estimates in the existing DEER database to recent NTGR results from the 2006-2008 Cadmus study for similar measures and programs designs.<sup>1</sup> The Current DEER data base contains default values for faucet aerators and low flow showerheads and values from the 2004-05 evaluation studies for residential gas water heaters. These differences in NTGR for each of the three major measures are significant (greater than a 10% change) and could reflect changes in program design, evaluation methods, or the underlying market structure between 2005 and 2008. Each potential cause is explored below.

**Table 13-1: Overview of NTGR Results by Measure, Delivery Mechanism and Source**

Energy Efficiency Measure	Delivery Mechanism	Existing DEER NTGR (Source)	06-08 NTGR (Source)
Faucet Aerators	Direct Install	0.85 (Default NTGR for direct install in hard to reach, See 2008 DEER report )	0.59 SF, 0.65 MF (Cadmus, Res Retrofit 2006-08)
Low Flow Showerheads	Direct Install	0.85 (Default NTGR for direct install)	SCG (MF) 0.72 SDGE (MF) 0.68 SDG&E (SF) 0.70 (Cadmus, Res Retrofit 2006-08)
Residential Gas Storage /Instantaneous Water Heater EF >0.62 >30 gallons	Downstream Rebate- Prescriptive	0.58 (all res bldg types) Itron, 2004-5 Single Family Impact Evaluation <sup>2</sup> )	0.23 SDGE 0.18 PGE (Cadmus, Ibid)

### 13.3 Differences in Program Design

The Direct Install Program delivery method was used to promote low flow measures (faucet aerators and low flow showerheads) in both the 2004-05 and 2006-08 programs. Similarly, the

<sup>1</sup> The Cadmus Group, *Residential Retrofit High Impact Measure Evaluation Report* and Appendices, (Prepared for the Energy Division of the CPUC, February 8, 2010).

<sup>2</sup> Itron Inc, *2004/2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation*; CPUC-ID#:1115-04, September 2007.

Prescriptive Rebate Program design used to promote more efficient gas water heaters from 2004-05 has not changed significantly relative to the design used and evaluated in 2006-08 programs. Thus, the differences in NTGR estimates in this table are not likely related to changes in program design between the two program vintages.

### **13.4 Comparison of Methods and Sample Sizes Used to Derive NTGR Results**

Table 13-2 and Table 13-3 compare the methods and sample sizes used to estimate NTGRs for 2004-05 programs compared to 2006-08 programs. Table 13-2 provides information on low flow showerheads and aerators. Table 13-3 provides the corresponding information for residential gas water heater systems. We discuss the potential impact of changes in method and different sample sizes before making a final conclusion on the final NTGR for each measures.

### **13.5 Differences in Evaluation Methods**

The 2006-08 evaluation for these water heating measures used the standardized set of self report questions adopted by the CPUC to estimate NTGR. The 2006-08 evaluation survey batteries are relatively comprehensive relative to the shorter set of questions used in the 2004-05 evaluation of the same measures. The more comprehensive set of questions was designed to tease out different types of impacts that the rebate offer might have on customer decisions including the potential to accelerate customer purchases of more efficient systems and influence customers to choose slightly levels of efficiency than they would have done in the absence of the program. The large drop in NTGRs observed for these measures from 2005 to 2008 may be related to the use of these different survey batteries to determine NTGR in the 2006-08 survey. Alternatively, the observed drop could be simply due to changes in market share of more efficient products over time.

### **13.6 Differences in Sample Size**

Table 13-2 and Table 13-3 show that a significantly larger sample was used to estimate NTGR in the 2006-08 program evaluations compared to the sample sizes used for the 2004-05 program evaluations. Higher sample sizes should lead to more robust estimates of NTGR assuming an efficient sampling plan was used in each study. This fact coupled with the earlier observation that the NTGR batteries used in 2008 were more comprehensive than the survey batteries from 2005 suggest that the NTGR ratios estimated for the 2006-08 programs should be used to replace the values currently in the DEER data base.

**Table 13-2: Methods and Sample Sizes for Aerators and Low-Flow Showerheads**

Measure	Market Segment and Program Year	NTGR Method Used	Sample Size and Precision if Known	Delivery Mechanism
Aerators	All-2004-05	Self Report or Default	25	Direct Install
Aerators	MF-2006-08	Self Report	43	Direct Install
Aerators	SF- 2006-08	Self Report	150	Direct Install
Low Flow Showerheads	All-2004-05	Self Report	25	Direct Install
Low Flow Showerheads	MF-2006-08	Self Report	379	Direct Install
Low Flow Showerheads	SF-2006-08	Self Report	15	Direct Install
Low Flow Showerheads	MF-2006-08	Self Report	160	Direct Install

**Table 13-3: Methods and Sample Sizes for Residential Gas Water Heating Systems**

Measure	Market Segment and Program Year	NTGR Method Used	Sample Size and Precision if Known	Delivery Mechanism
Gas Water Heaters	SF/MF- 2004-05	Self report-simple	53- no confidence interval reported	Downstream Customer Rebates
Residential Gas Storage Instantaneous Water Heater	SF/MF-PG&E- 2006-08	Self Report-comprehensive	392—“ exceeded 90% confidence &10 precision”	Downstream Customer Rebates
Residential Gas Storage Instantaneous Water Heater	SF/MF-SDG&E- 2006-08	Self Report-Comprehensive	456-- , “exceeded 90% confidence &10 %precision”	Downstream Customer Rebates

### 13.7 Recommended NTGR by Measure, Applicable Market Segments, and Building Types

Table 13-4 presents the recommended NTGR values for each measure and compares them to the NTGR values in the current DEER data base. The DEER team finds that the most recent evaluation conducted for 2006-08 programs are likely to contain better, more precise information than the existing DEER based on the aforementioned review of methods, sample sizes, and changes in program delivery mechanisms. Accordingly, the Team recommends use of the 2006-08 NTGR values as shown in Table 13-4 below.

**Table 13-4: Recommended NTGR by Measure and Delivery Method**

<b>EEM</b>	<b>EEM Characteristics</b>	<b>Delivery Mechanism</b>	<b>Applicable Sector and Building Types</b>	<b>Utility Specific or Statewide NTGR</b>	<b>Recommended NTGR Value</b>	<b>Current DEER NTGR Value</b>
Faucet Aerators	NA	Direct Install	Single Family	Statewide	0.59	0.85 (default for HTR)
Faucet Aerators	NA	Direct Install	Multifamily	Statewide	0.65	0.85 (default for HTR)
Low Flow Showerheads	Flow less than 1.5 gallons per minute	Direct Install	Multifamily	SDGE	0.72	0.85 (default for HTR)
Low Flow Showerheads	Flow less than 1.5 gallons per minute	Direct Install	Multifamily	SCG	0.70	0.85 (default for HTR)
Low Flow Showerheads	Flow less than 1.5 gallons per minute	Direct Install	Single Family	SDGE	0.68	0.85 (default for HTR)
Low Flow Showerheads	Flow less than 1.5 gallons per minute	Direct Install	All Re All Residential building types	Statewide	0.70	0.85
Residential Gas Storage Instantaneous Water Heater	Energy factor > 0.62	Downstream Prescriptive Rebate	All Residential building types	SDG&E	0.23	0.58
Residential Gas Storage Instantaneous Water Heater	Energy factor > 0.62	Downstream Prescriptive Rebate	All Residential building types	PG&E	0.18	0.58

The most significant changes in NTGR values between the current DEER and the evaluation findings were for the residential gas water heaters. For these water heating systems, NTGR values decreased by more than 50% for both utilities (from 0.59 to 0.23/0.18 for PGE and SDGE respectively). The Team reviewed the survey design for 2006-08 to determine if there were any anomalies in design or weighting that could help explain this large and unexplained drop. No obvious flaws in the survey design or questionnaires were discovered. More details on the methods used and recommendations from these evaluations can be found in Appendix A-6.

The changes in NTGR observed for faucet aerators and low flow showerheads were primarily because the current DEER estimate of 0.85 was a default value while the 2006-08 values are based on a self report analysis. The differences in estimated NTGR for low flow showerheads of 0/72, 0.70, and 0.68 for Multifamily and Single family units are not statistically significant. Thus

the Team recommends the use of a statewide “average” NTGR value of 0.70 for all residential building types where low flow showerheads are installed.

The 2006-08 study for water heating systems contained NTGR estimates for each of the three program years that gradually declined from 2006 to 2008 by roughly 1% per year. This slow decline suggests a stable market where a gradually larger percentage of customers were adopting efficient gas water heating systems with Energy Factors above 0.62 in the absence of the program. The most obvious potential explanation for a significant drop in the NTGR value between 2004 and 2008 would be the introduction of a new efficiency standard for these systems in the period right before the program was launched in 2005. Another possible explanation would be if the rebate level had been kept the same at 0.62 Energy factor level for many years.

### **13.8 Factors Likely to Lead to Changes in NTGR Over the Next Three Years**

The DEER team reviewed the two most recent evaluations in California and the overall NTGR literature to identify key factors likely to lead to changes in NTGR over time for water heating measures. In the previous DEER update factors 1&2 below were identified as having a significant impact on NTG; efficiency market share and rebates as a fraction of incremental cost. In this update we identify and discuss two more factors (3 and 4 below). The four principal factors are:

1. Rate of growth in the market share of more efficient hot water systems or specific measures such as low flow showerheads,
2. Trend in rebates as a share of incremental costs of efficient measures,
3. Changes in the structure of the contractor service offerings, and
4. Changes in Program Design or Sales Channel – example: move from downstream to upstream for HVAC system rebates.

### **13.9 Assessment of Current Data and Tools Available for Adjusting NTGR Over Time**

There is insufficient data on the market share of low flow showerheads or the saturation of aerators to make adjustments to the 2008 NTGRs for use in post 2012 program years. Thus, the discussion focuses on potential changes for NTGR for efficient gas water heaters below.

### **13.10 Efficient Market Share of Gas Water Heating Systems**

Table 13-5 provides data on changes in market share of more efficient gas water heaters is available for in California from 2000 to 2005 and at the national level from 2000 to 2010.

**Table 13-5: Trends in Efficient Market Share for Gas Water Heater Systems**

Measure	2000	2005	2010	Source
Gas Water Heater- Average Energy Factor Mkt Share >.64 EF	23.1%	26.8%	NA	California Data
Electric Water Heaters Market share >.92 EF	6.3%	12.6%	NA	None

These historical trends in market share suggest the market share of more efficient gas water heaters will continue to increase at a slow but stable rate over the next three to five years. Holding all other factors constant, we would expect that the NTGR for this program is likely to continue to fall in correlation with increases in market share for more efficient product if qualifying levels for rebated equipment are not adjusted upward. However the observed drop in NTGR from 0.58 in 2005 to 0.23 in 2008 suggests that NTGR are not strongly correlated with the relatively small increases in market share for efficient water heaters with an EF above 0.64 in this table. Hence we would not recommend making an adjustment to NTGR for the 2013 program year and beyond based on forecast of market share alone.

### 13.11 Trends in Rebate Levels as a Fraction of Incremental Cost

Rebate levels were decreased from \$40 to unit in the 2005 program to \$30/ unit for the 2008 program. At the same time the incremental cost of more efficient water heaters has declined from \$175/unit in 2005 to \$ 150/unit in 2008. Thus, the fraction of rebates compared to incremental cost has remained relatively constant, from 23% to 20% over four years. This small change is not likely to cause significant changes in NTGR over time and there is insufficient data available to project future trends in the ratio or rebates to incremental costs. As a result no adjustment in NTGR is recommended.

### 13.12 Contractor Market

Contractor market for water heater installation has fallen to record low levels of replacement sales and sales in the new construction market are also quite low. In addition, customer disposable income has been falling for four years in California. There have been no significant changes in the methods used by contractors to sell water heaters. Given these facts, no adjustments to NTGR are recommended based on this factor.



### **13.13 Program Design or Sales Channel**

No significant changes in program design were observed between 2005 and 2008 programs. Review of the commission's strategic plan for 2011 and beyond suggest that some changes in program design may be on the way but there is insufficient data to forecast the timing of any changes in program design with certainty. As a result we recommend no adjustment to the NTGR based on potential changes in the program channel used to promote these water heating systems.

On the other hand there is a plethora of new types of water heating systems coming to market over the last three years which could reduce the incremental costs of these more efficient gas water heaters because of increased competition. A recent study from ACEEE lists 16 different types of water heating systems more efficient than the water heating systems promoted in the utility programs and reports incremental costs ranging from \$200 to \$3000 per system at a cost of conserved gas ranging from \$ 0.75 to \$3.26 per therm. The study claims that seven of these sixteen water heating systems are cost effective at current prices.<sup>3</sup> If even a few of these new systems are able to achieve market share over 5%, it is likely that the new products will induce changes in program design or qualifying requirement for efficient gas systems. We lack confidence in how these two competing factors (competition from new technologies and declining incremental costs will interact over time to influence net NTGR's. As a result we recommend no adjustment to the NTGR based on this factor.

### **13.14 Synthesis of NTGR Forecasting and Adjustment Analysis**

Given the lack of data on trends in the market share of more efficient gas systems and rebates as a function of incremental costs, and the overall decline in the sales volume contractor market, the DEER team finds there is insufficient data or forecasting tools available to reliably adjust the latest NTGR from 2008 values for program years in 2013 and beyond. Thus, the Team recommends no adjustments be made to the NTGR values presented in Table 13-4 for use in residential water heater programs fielded after 2013.

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<sup>3</sup> Harvey Sachs, Jacob Talbot and Nate Kaufman, **Emerging Hot Water Technologies and Practices as of 2011** (ACEEE, Research Report A112, October, 2011) see Table 1.

# 14

## Recommended Updates to Net-To-Gross Ratios for Residential Appliances

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### 14.1 Introduction

In this analysis, the most recent net to gross ratio (NTGR) results for more energy efficient appliances are compared to the existing NTGR values in the current DEER data base. These NTGR estimates were part of the 2006-08 evaluation of residential retrofit energy efficiency programs conducted by various contractors for the Energy Division of the California PUC. Based on these comparisons, the DEER team derives a recommended NTGR value for the three measures in this technology group: residential clothes washers, refrigerators and freezers. For each measure, we compare the strengths and weaknesses of the methods used to derive NTGR results in the previous DEER and contrast this to the methods used to estimate NTGR in previous evaluations of utility programs in California. The factors considered by the DEER team in making a final NTGR recommendation are:

- The relative merits of the methods and sampling plans used to derive NTGR for existing DEER values and results from new studies.
- Potential changes in program design or measure minimum qualification levels between the previous evaluation and 2006-08 evaluation.
- Rate of change in the market share of efficient measures or products over time. Faster rates of change are likely to lead to reduced NTGRs over time.
- Any available evidence on trends in rebates offered as a fraction of the incremental cost of the measures. NTGRs are expected to decrease as the ratio of rebates to incremental cost increase.

After making a recommendation for a specific NTGR value to use in this DEER 2011 update, the DEER team identified the program and market factors are likely to lead to changes in NTG results between now and the first potential ex ante application of these values in 2013. The team then assesses whether there is sufficient data and or analysis tools to accurately forecast the likely trend in NTGR values between 2008 and 2013 for this specific measure and program design. If there is sufficient data to make an accurate forecast absent any significant changes in program design and or qualifying levels for rebated measures, we produce a forecast of NTGR for use in program fielded in 2013-2014. These forecasts are based on the assumption that program design or qualifying efficiency level are not likely to significantly change between

programs deployed in 2008 and those in 2013. If there are significant changes to these factors, we recommend the use of our unadjusted NTGR values based on the most recent evaluation research.

## 14.2 Comparison of Current DEER NTGR Values to Results 2006-2008 EM&V Analyses

Table 14-1 compares the NTGR estimates in the existing DEER database to recent NTGR results from the 2006-2008 Cadmus study for similar measures and programs designs.<sup>1</sup> These differences in NTGR for each of the three major appliance measures are significant (greater than a 10% change) and could reflect changes in program design, evaluation methods, or the underlying market structure between 2005 and 2008. Each potential cause is explored below.

**Table 14-1: Overview of NTGR Results by Measure and Delivery Mechanism**

Energy Efficiency Measure	Delivery Mechanism	Existing DEER NTGR Values (Source)	06-08 NTGR Results (Source)
Clothes Washers >1.72 MEF	Downstream prescriptive	0.81 (Itron, 2007 <sup>2</sup> )	PGE2000 = 0.31 SDGE3023 = 0.31 SCG3517 = 0.29 (CADMUC, 2010)
Clothes Washers 15% Above Standard	Downstream prescriptive	0.85 (Itron, 2007, <i>ibid</i> )	
Refrigerator, efficiency characteristics of recycled unit	Downstream prescriptive	0.614 (ADM, 2008 <sup>3</sup> )	PGE2000 0.51 SCE2500 0.56 SDGE3028 0.58 (CADMUC, <i>ibid</i> )

\*2006-08 evaluation is limited to only the refrigerators recycled through each utility's ARP.

### 14.2.1 Differences in Program Design

The prescriptive rebate program design used to promote more energy efficient clothes washers and to prevent the continued operation of older, inefficient refrigerators and freezers from 2004-05 has not changed significantly relative to the design used and evaluated in 2006-08 programs. The only program change, beginning in 2006, involved expanding eligibility to include small commercial businesses, including office complexes, industrial customers, schools, and

<sup>1</sup> The Cadmus Group, Residential Retrofit High Impact Measure Evaluation Report and Appendices, (Prepared for the Energy Division of the CPUC, February 8, 2010.)

<sup>2</sup> Itron Inc, 2004/2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation; CPUC-ID#:1115-04, September 2007.

<sup>3</sup> Evaluation Study of the 2004-2005 Statewide Residential Appliance Recycling Program, ADM, April, 2008

municipalities. Consequently the differences in NTGR estimates in Table 14-1 are not likely related to changes in program design between the two evaluation periods.

### **14.2.2 Differences in Evaluation Methods**

Table 14-2 compares the methods and sample sizes used to estimate NTGRs for 2004-05 programs compared to 2006-08 programs. Table 14-2 provides information on clothes washers, refrigerators and freezers. The potential impact of changes in method and different sample sizes are discussed here before making a final conclusion on the final NTGR for each measure.

The 2006-08 evaluation for the measures reviewed used the standardized set of self report questions adopted by the CPUC to estimate NTGR. The 2004-05 evaluation interviewed participants and nonparticipants and also used discrete choice analyses to determine NTGRs while the 2006-08 evaluation interviewed only participants. However, the 2006-08 survey batteries are comprehensive relative to the shorter set of questions used in the 2004-05 evaluation of the same measures. The more comprehensive set of questions was designed to tease out different types of impacts that the rebate offer might have on customers to discard inefficient refrigerator/freezers and influence customers to choose slightly higher levels of clothes washer efficiency than they would have done in the absence of the program. The large drop (50%-52%) in NTGRs observed for clothes washers from 2005 to 2008 may be related to the use of these different survey batteries to determine NTGR in the 2006-08 survey. Alternatively the observed drop could be simply due to changes in market share of more efficient products over time.

### **14.2.3 Differences in Sample Sizes**

For clothes washers, all ENERGY STAR / CEE Tier 1-3 machines were grouped together in the evaluation analysis. For refrigerators and freezers, only recycled units were included in the evaluation analysis. A significantly larger sample was used to estimate NTGR in the 2008 program evaluations compared to the sample sizes used for the 2004-05 program evaluations. Higher sample sizes should lead to more robust estimates of NTGR assuming an efficient sampling plan was used in each study. This fact coupled with the earlier observation that the NTGR batteries used in 2008 were more comprehensive than the survey batteries from 2005 suggest that the NTGR ratios estimated for the 2006-08 programs should be used to replace the values currently in the DEER data base.

**Table 14-2: Methods and Sample Sizes for Residential Appliances EEMs in the 2006-2008 EM&V Studies**

Measure	Market Segment and Program Year	NTGR Method Used	Sample Size	Delivery Mechanism
Clothes Washers >1.72 MEF	Residential – 2006-08	Self Report and Discrete Choice	PGE2000 551 SCG3517 323 SDGE3023 116 Total: 990	Downstream Prescriptive
Clothes Washers 15% Above Standard	Residential – 2006-08	Not evaluated		Downstream prescriptive
Refrigerator, efficiency characteristics of recycled unit	Residential – 2006-08	Self Report	1,173 non-participants PG&E – 505 SCE – 248 SDGE – 420 1857 participants PG&E – 712 SCE – 573 SDG&E – 572 81 Market actors	Downstream Prescriptive
Freezer, efficiency characteristics of recycled unit	Not evaluated Of the three appliances (refrigerators, freezers, and room air conditioners), only the recycling of refrigerators was identified as a high impact measure (HIM) by the California Public Utilities Commission (CPUC). As a result, the evaluation is limited to only the refrigerators recycled through each utility’s ARP.			
Refrigerator/Freezer*, 15% >current standard				

### 14.3 Recommended NTGR by Measure and Applicable Market Segments or Building Types

Table 14-3 presents the recommended NTGR values for each measure and compares them to the NTGR values in the current DEER data base. The most significant changes in NTGR values between the current DEER and the evaluation findings were for the residential clothes washers. For clothes washers, NTGR values decreased by more than 50% for both utilities (from 0.81 to 0.31/0.29 for PG&E, SDG&E, and SCG respectively). The Team reviewed the survey design for 2006-08 to determine if there were any anomalies in design or weighting that could help explain this large and unexplained drop. No obvious flaws in the survey design or questionnaires were discovered. The most obvious potential explanation for a significant decline in the NTGR value between 2004 and 2008 would be the introduction of a new efficiency standard for these systems

in the period right before the program was launched in 200. More details on the methods used and recommendations from these evaluations can be found in Appendix A-7.

**Table 14-3: Recommended NTGR by Measure and Delivery Method**

EEM	EEM Characteristics	Delivery Mechanism	Applicable Sector and Building Types	Utility Specific or Statewide NTGR	Recommended NTGR Value	Current DEER NTGR Value
Clothes Washers	CW >1.72 MEF	Downstream Prescriptive	All residential	Utility specific	PGE2000 - 0.31 SDGE3023 - 0.31 SCG3517- 0.29	0.81
Clothes Washers	15% > DOE Standard	Downstream Prescriptive	All residential	Statewide	Current DEER value	0.85
Refrigerator	Recycled unit	Downstream Turn-in Recycling	All residential	Utility specific	PGE2000 -0.51 SCE2500 - 0.56 SDGE3028 - 0.58	0.614
Freezer	Recycled unit	Turn-in Recycling	All Residential	Statewide	Current DEER Value (not evaluated in the 0608 study)	0.702
Refrigerator /Freezer	15% > current standard	Downstream Prescriptive	All residential	Statewide	Current DEER Value (not evaluated in the 0608 study)	0.75

#### 14.4 Factors Likely to Lead to Changes in NTGR Over Next Three Years

The DEER team reviewed the three most recent NTGR evaluations and the overall literature to identify key factors likely to lead to changes in NTGR over time for Residential appliance measures. The four principal factors were:

- Program-qualifying efficiency levels
- Program design, (including incentive levels)
- Trends in market share of Clothes Washers
- Share of the incremental equipment cost being paid for by the program rebate

#### 14.5 Assessment of Current Data and Tools Available for Adjusting NTGR Over Time

The DEER team finds that the most recent evaluation conducted in 2006-08 are likely to contain better, more precise information than the existing DEER based on the aforementioned review of methods, sample sizes and changes in program delivery mechanisms. Accordingly the Team

recommends use of the 2006-08 NTGR values, where a 0608 evaluation was conducted, as shown in Table 3 below, with no adjustment to NTGRs over time.

## **14.6 Synthesis of NTGR Adjustment Analysis**

The DEER team believes that there is inadequate information to make any significant adjustments to the recommended NTGR values derived from the 2006 - 2008 evaluations. Thus, the DEER team recommends that no adjustments be made to the NTGR values presented in Table 14-3.

# 15

## Default NTGRs

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This section develops recommended NTGR values for use in the event that there are no available evaluated NTGR estimates to use for a particular combination of energy efficiency measures and program designs in future program applications. In the previous DEER update, the DEER team had recommended a similar set of default NTGR values for specific types of programs which were partially adopted by the CPUC. In this cycle, we provide similar recommendations and expanded support for the importance of adopting three specific default values for use in future program years.

A goal of the current DEER NTFR update is to expand the list of measures and program delivery strategies with relevant NTFR estimates so that the use of default NTFRs decreases. In the previous chapters, we have provided additional NTGR values for the high impact measures (that represent at least one percent of forecasted savings at the portfolio level but we recognize there are still quite a large number of measures and program delivery methods where no applicable DEER NTG value is present in the data base. Thus the need for default NTGR's.

In previous DEER updates, default NTGR values ranging from 0.54 to 0.85 had been recommended based on compilations of NTG results across a broad array of market sectors and programs. In this cycle we recommend three specific DEER default NTGR values be used that vary as a function of market segment and the number of years that energy efficiency measures have been offered by programs. This approach is designed to increase the probability that evaluations of net savings are conducted within the first two years that new energy efficiency measures are introduced into utility efficiency programs.

Specifically we are recommending a three prong default approach that sets the actual NTGR value based on the number of years that a measure has been promoted using a specific program delivery approach and the targeted market segment. The recommended approach for setting default NTFR values is as follows

- For energy efficiency measures targeted to hard-to-reach populations using direct installation delivery methods, the recommended default NTFR value is 0.85.



- For energy efficiency measures that have been offered for two years or less using all other delivery methods and targeted to market segments besides the hard to reach populations) a default NTFR value of 0.70 is recommended.
- Finally for energy efficiency measures that have been offered by programs for more than two years using the same delivery mechanism and no changes in qualifying levels, a default NTGR value of 0.55 for residential programs and 0.60 for commercial and industrial programs is recommended.

## **15.1 Rationale for Default Values**

### ***15.1.1 Default Values for the Hard to Reach Population***

The DEER NTG Team reviewed 4 evaluations of NTGR ratios for residential and nonresidential direct install programs targeted to hard to reach populations in 2008. The average NTGR value from the two studies for Residential Direct Install measures was 83%, the average for two studies for the Nonresidential NTGRs was 91.5%.

Using a value of 85% NTGR for direct install measure targeted at hard to reach customers provides a relatively high value, while still leaving some symmetry in the associated risk (that is, an even higher default value would leave little room for upward ex post adjustments and would increase the probability of downward ex post adjustments).

### ***15.1.2 Rationale for the Use of .70 NTG Value***

Ideally, the NTFR default value should represent the average NTFR value one could expect to be estimated for any given measure and delivery strategy over an entire portfolio of programs and measures. One proxy for this value could be the average weighted or un-weighted NTG values estimated for the most recently set of evaluated programs. In 2008 we performed this analysis for the evaluations conducted on the 2004-2005 programs. In the 2011 update we have also calculated the average NTGR for all programs evaluated in 2006-08 studies weighted by the estimated energy savings for each program evaluated. We present both calculations below.

#### ***NTGR Estimate for all Evaluated 2004-2005 Programs***

The DEER team calculated both the un-weighted NTG average based on all measure- delivery combinations in the summary NTG table and the energy savings weighted NTG ratio for the same programs for 2005 and 2006-08.

The DEER Team's initial estimate was that the average estimated NTFR across all measures had declined by about 10 percentage points (from 80% to 70%) when comparing the historical NTFRs to the recommended NTFR values for 2009-2011 and taking into account that spillover

was included in some of the values that were averaged in the previous value of 0.8. The DEER Team calculated the mean and median NTFR values for the utility historic and recommended NTFR cases for each sector and for the portfolio as a whole. The results of this calculation for the residential and nonresidential sector are shown in Table 15-1.

**Table 15-1: Comparison of Previous NTGs to DEER 2009-2011 Planning NTGs**

<b>Sector</b>	<b>Average NTG Based on Values Generally Used by Utilities for Programs from 2002-2007</b>	<b>Average DEER NTG Based on the Recommended NTG Values for 2004-05</b>
<i>Residential Measures</i>		
Unweighted Average NTFR	0.78	0.73
Median NTFR	0.80	0.75
Number of cases	N=41	N=41
<i>Nonresidential Measures</i>		
Unweighted Average NTFR	0.82	0.69
Median NTFR	0.80	0.70
Number of cases	N=50	N=50

where N is the number of discrete NTFRs recommended by the DEER Team for each measure/delivery strategy in the DEER NTG tables.

**Savings Weighted Average NTGR from the 2006-08 Evaluation Studies**

Itron used the NTGR results from the 2006 Evaluation to develop an energy savings weighted average NTGR statewide and by sector. These average NTGR represent the expected NTGR value one might expect if a measure that has not been part of a recent evaluation was conducted. Table 15-2 shows the average NTGR results at the statewide, utility level and sector level.

**Table 15-2: Weighted Average NTGR Across All Evaluated Programs in 2006-08**

<b>NTGR Aggregation Level</b>	<b>Savings Weighted NTGR</b>
Statewide across all programs	0.58
Residential Sector Programs	0.56
Commercial Sector Programs	0.61
Industrial Programs	0.59
Agricultural Programs	0.61

The table shows there is remarkably little variation in savings weighted NTGRs across sectors with the statewide savings weighted average of 0.58. The DEER team developed two default NTGR options based on these figures; one based on the statewide average of 0.58 across all programs and another proposing different default values at the sector level. Ultimately we decided it was better to specify default NTGR's at the sector level and round up to the nearest five percent due to the significant uncertainties that surround these aggregate estimates. Table 15-3 provides the recommended default values for measures that have been promoted by programs for two years or more.

**Table 15-3: Proposed Net to Gross Ratio Defaults for Measures**

<b>Measure Type</b>	<b>Residential Sector</b>	<b>Commercial, Industrial and Agricultural Sector</b>
Energy Efficiency Measures targeted at Hard to Reach Market Segments via Direct Install Delivery Methods	0.85	0.85
New Measures promoted by programs for 2 years or less	0.70	0.70
Energy Efficiency Measures promoted by programs for more than two years	0.55	0.60