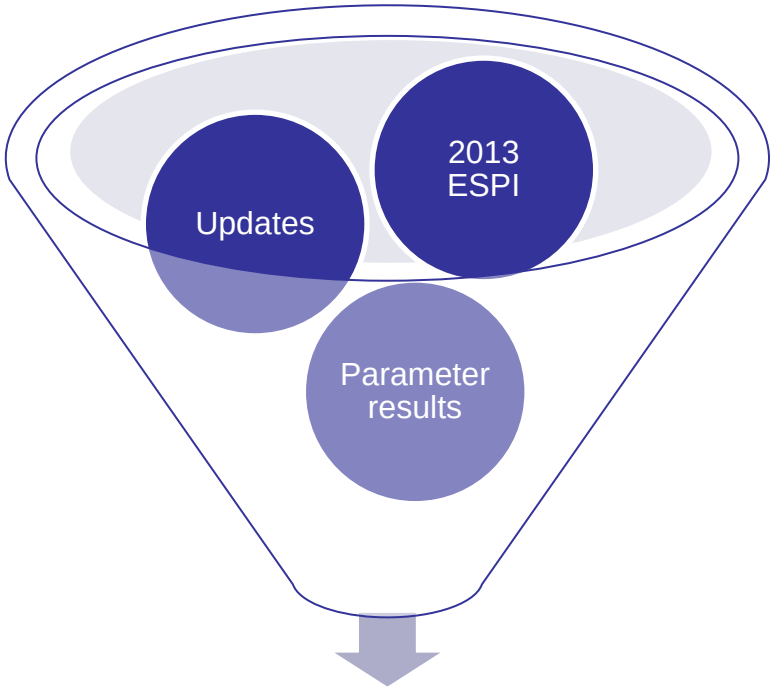
# 2013 Efficiency Savings Performance Incentive (ESPI) Ex-Post Update

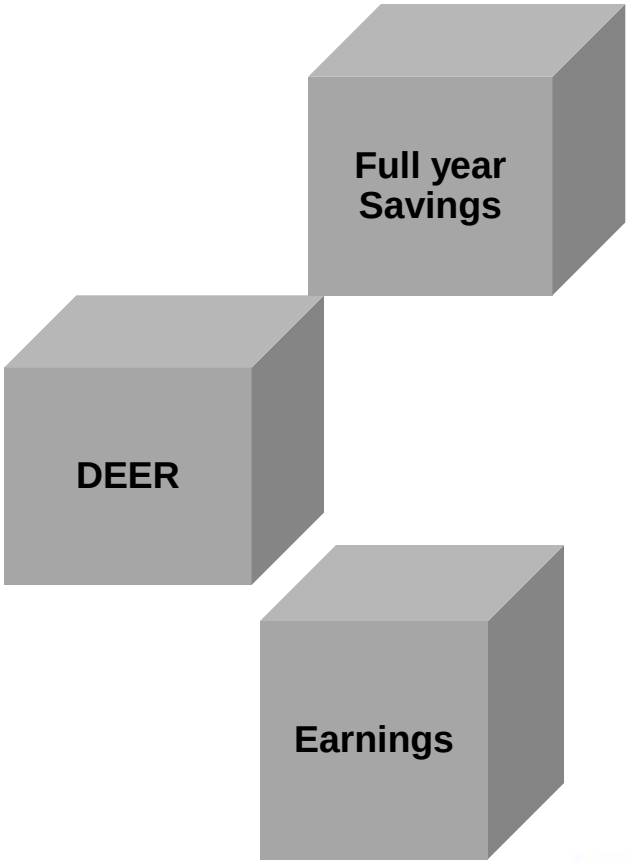
**Energy Division**
**March 25, 2015**

# In Scope




Stakeholder Comments Due 4/6

# Out of Scope



# Agenda

## 90 minutes

- Custom Lighting
- Non-res New Construction
- Industrial and Agricultural

## 50 minutes

- Deemed Non-res Lighting
- Sprinklers
- Pipe Insulation


LUNCH (**60 minutes**)

# Agenda

## 20 minutes

- Residential Upstream Lighting

## 30 minutes

- HVAC Quality Maintenance
- HVAC Mini-splits

## 20 minutes

- Home Upgrade Program

# Agenda

## 15 minutes

- Water Kits

## 15 minutes

- Pool Pumps

## 20 minutes

- Behavior

# Important Dates

| ESPI Activity | Date |
|---|---|
| PY 2013 Draft Evaluation Results Posted | 3/9/2015 |
| PY 2013 Draft Evaluation Results Webinar | 3/25/2015 |
| Public Comments Due | 4/6/2015 |
| Public Comments Incorporated | 5/27/2015* |
| Draft Savings Performance Statement Posted | 6/17/2015* |
| Draft Savings Performance Statement Webinar | 7/1/2015* |
| Written Comments on Performance Statement | 7/15/2015* |
| Final Savings Performance Statement Posted | 8/15/2015* |

* Activity must be completed ***by*** these dates. Energy Division is currently ahead of this schedule

# Custom Projects

ENERGY

# Industrial, Agricultural and LARGE Commercial-4(IALC4)

## ESPI PUBLIC STAKEHOLDER WORKSHOP PY2013 NRNC WHOLE BUILDING IMPACT EVALUATION

March 25, 2015

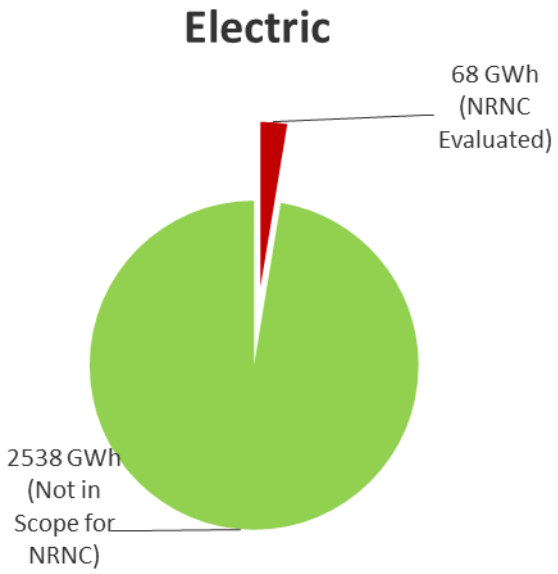
# Topics

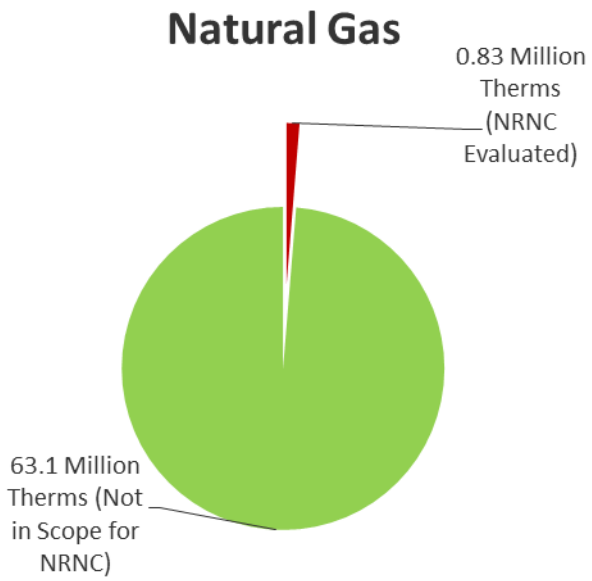
- Overview of NRNC Whole Building Evaluation
- NRNC Whole Building Impact Evaluation Portfolio
- ESPI Performance Parameter Updates
- Data Collection and Approach
- Evaluation Sample Size
- Aggregation of Sample Results
- Gross Evaluation Results
- Net Evaluation Results
- Comparison of Ex ante and Ex post Impact Results
- Questions

# Overview of NRNC Whole Building Evaluation

- NRNC Whole Building projects that received incentives under the statewide Savings By Design (SBD) program
- The scope of work includes an independent estimation of gross and net savings and development of findings and recommendations that can be used to improve program, project, and measure effectiveness
- Three main evaluation activities supported the findings and recommendations:
  - M&V activities for estimating gross impacts
  - Professional telephone survey data collection supporting net to gross (NTG) estimation
  - Engineering reviews of the gross sample points to support the qualitative project practices assessment (PPA)

# NRNC Whole Building Impact Evaluation Portfolio



# Claimed Energy Savings by IOU for 2013 Projects in the NRNC Work Order

| Energy Savings Claims by IOU | | | |
|---|---|---|---|
| **IOU** | **Electric Energy (GWh)** | **Electric Demand (MW)** | **Gas Energy (Million Therms)** |
| **NRNC WB Savings Claim** | | | |
| **PG&E** | 35 | 12 | 0.65 |
| **SCE** | 22 | 7 | 0.14 |
| **SDG&E** | 10 | 3 | 0.03 |
| **Total** | **68** | **22** | **0.83** |
| | | | |
| **Portfolio Savings Claim** | | | |
| **PG&E** | 1,490 | 242 | 35 |
| **SCE** | 786 | 142 | 1 |
| **SCG** | 8 | 6 | 26 |
| **SDG&E** | 322 | 47 | 2 |
| **Total** | **2,606** | **436** | **64** |
| | | | |
| **NRNC WB Percentage of Portfolio Claim** | | | |
| **PG&E** | 2% | 5% | 2% |
| **SCE** | 3% | 5% | 14% |
| **SDG&E** | 3% | 6% | 2% |
| **Total** | **2.6%** | **5.0%** | **1.3%** |

# ESPI Performance Parameter Updates

- IALC4 NRNC Whole Building Evaluation addressed each of the following:
  - Verified installed measures and confirmed that they were operating as intended
  - Evaluated project savings- Engineering file review, on-site survey, end-use metering, energy modelling, updated the savings using observed site condition
  - Estimated ex post gross energy and demand savings
  - Estimated ex post NTG ratios and net savings
  - Assessed expected useful life(EUL) and calculated life cycle savings

# Data Collection And Approach

- Gross Impact Evaluation
  - Focused on estimation of gross realization rates for statistically representative samples of NRNC Whole Building projects
  - Utilized project specific measurement verification(M&V) to estimate gross realization rates
  - Analysis involved onsite survey, short-term monitoring, simulation modelling with EnergyPro and eQuest and model adjustments/ calibration with end-use/billing data to calculated ex post impact of the sampled points
- Net Impact Evaluation
  - NTG evaluation consisted of an interview-based evaluation for the same sample points included in the gross impact activities to yield NTG ratio
- 25 gross impact sample points and 25 net points for program year 2013

# Summary of NRNC WB Sample by IOU

- Gross and net impact sampling by IOU
  - Electric and gas savings were collapsed
  - Sampling and analysis used source energy equivalents*

| IOUs | Sample Points | Sampled Source MMBtu | NRNC Source MMBtu | Sample % of Population MMBtu | Sample Points Stratum 1 | Sample Points Stratum 2 | Sample Points Stratum 3 |
|---|---|---|---|---|---|---|---|
| **PG&E** | 15 | 83,081 | 424,316 | 20% | 4 | 5 | 6 |
| **SCE** | 5 | 54,680 | 244,823 | 22% | 3 | 2 | 0 |
| **SDG&E** | 5 | 19,450 | 109,001 | 18% | 1 | 1 | 3 |
| **Total** | **25** | **157,211** | **778,140** | **20%** | **8** | **8** | **9** |

* Conversion rates obtained from "*2001 Energy Efficiency Standards for Residential and Non-residential Buildings, California Energy Commission*," June 2001: 1 kWh = 10,239 Btu source energy; 1 Therm = 100,000 Btu source energy. 1 MMBtu =1,000,000 Btu

# Aggregation of Sample Results

- Sample gross and net results were aggregated by stratum to represent the population of custom claims based on California Evaluation Framework guidelines
  - Within each of 3 strata, case weights were applied to the statewide sample
  - Case Weight Stratum 1 =

    (Stratum 1 Population Quantity)/ (Stratum 1 Sample Quantity)
  - Sample Site 1 Savings =

    Case Weight Strata 1 x Site Savings = Weighted Savings Site 1
- Using the case weights statewide GRR and NTG ratios were calculated and applied to the population results
  - Population GRR =

    sum(weighted ex post gross savings) / sum (weighted ex ante gross savings)
  - Claimed Gross Ex Ante Savings (Population) x GRR = Evaluated Gross Ex Post Savings (Population)

# Gross Impact Results

## Statewide Life Cycle Weighted Gross Realization Rates

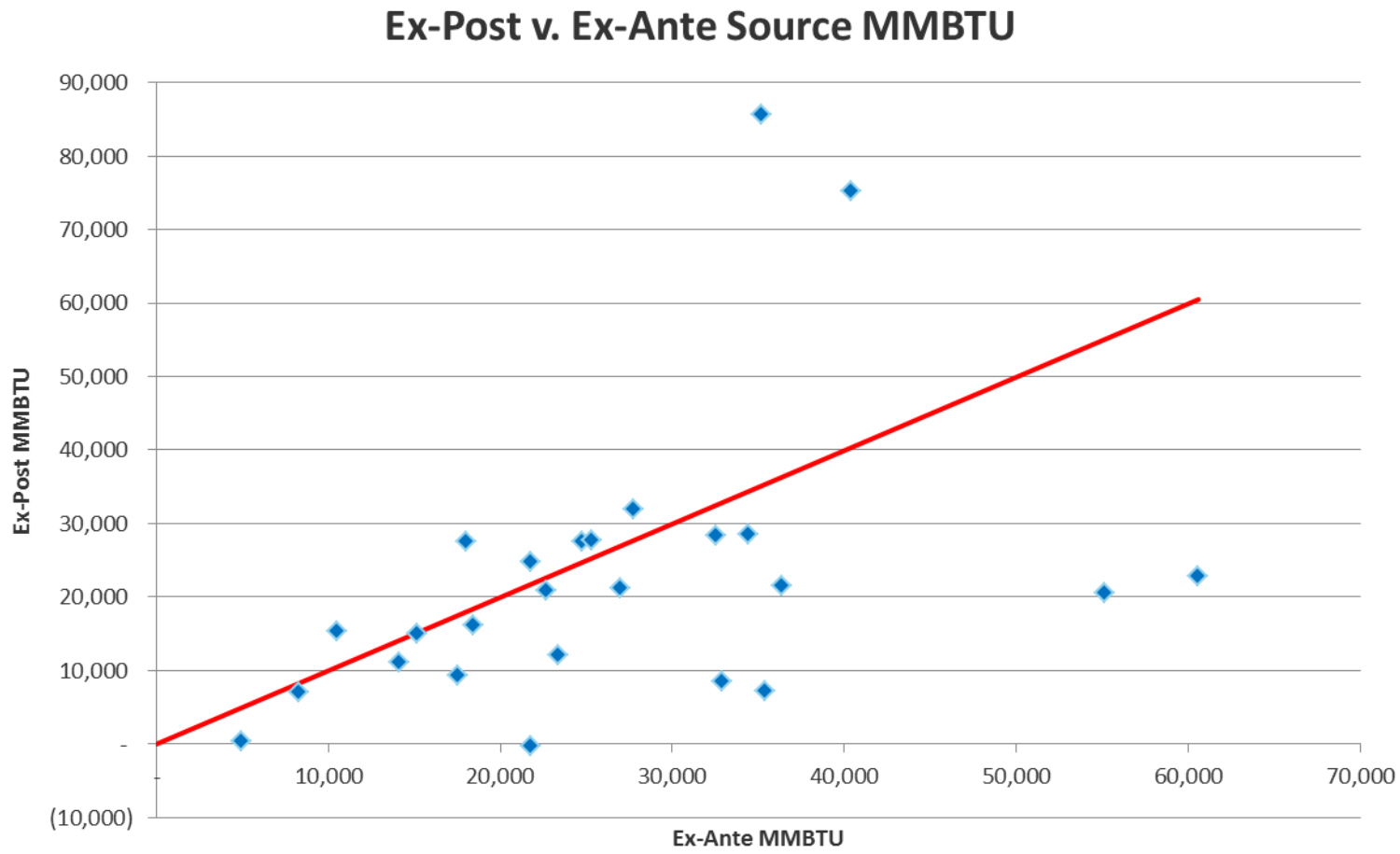
| Energy Metric | Sample Size (n) | LC Gross Realization Rate | Population (N) | Error Ratio* | 90% Confidence Interval | RR > 1.5 | RR = 0 | RR < 0 |
|---|---|---|---|---|---|---|---|---|
| **IOU Statewide** | | | | | | | | |
| kWh | 25 | 0.92 | 239 | 0.79 | 0.88 - 0.97 | 3 | 0 | 1 |
| kW | 25 | 0.79 | 239 | 0.91 | 0.75 - 0.84 | 3 | 0 | 2 |
| Therms | 25 | 0.57 | 239 | 1.44 | 0.52 - 0.62 | 3 | 5 | 5 |

# Net Impact Results

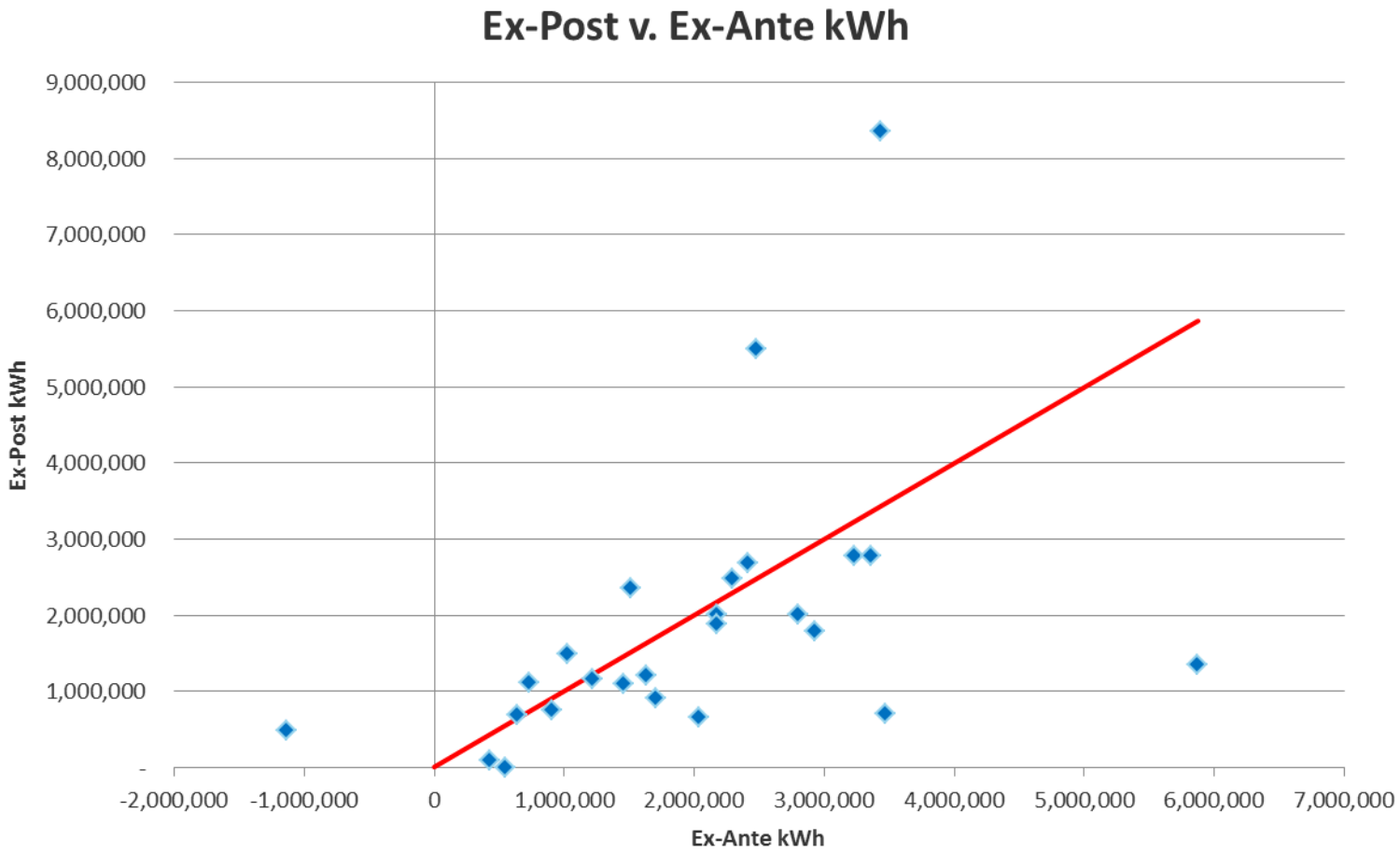
## Net-to-Gross Ratios by Fuel Type

| Results | Electric NTGR | Gas NTGR | MMBTU NTGR |
|---|---|---|---|
| | Statewide | Statewide | Statewide |
| Weighted NTGR | 0.53 | 0.51 | 0.53 |
| 90 Percent Confidence Interval | 0.51 - 0.56 | 0.49 - 0.54 | 0.51 - 0.55 |
| Net Savings Relative Precision | 24% | 25% | 20% |
| n Survey Completes | 25 | 25 | 25 |
| N Sampling Units | 239 | 239 | 239 |
| **Final NTGR** | **0.53** | **0.51** | **0.53** |

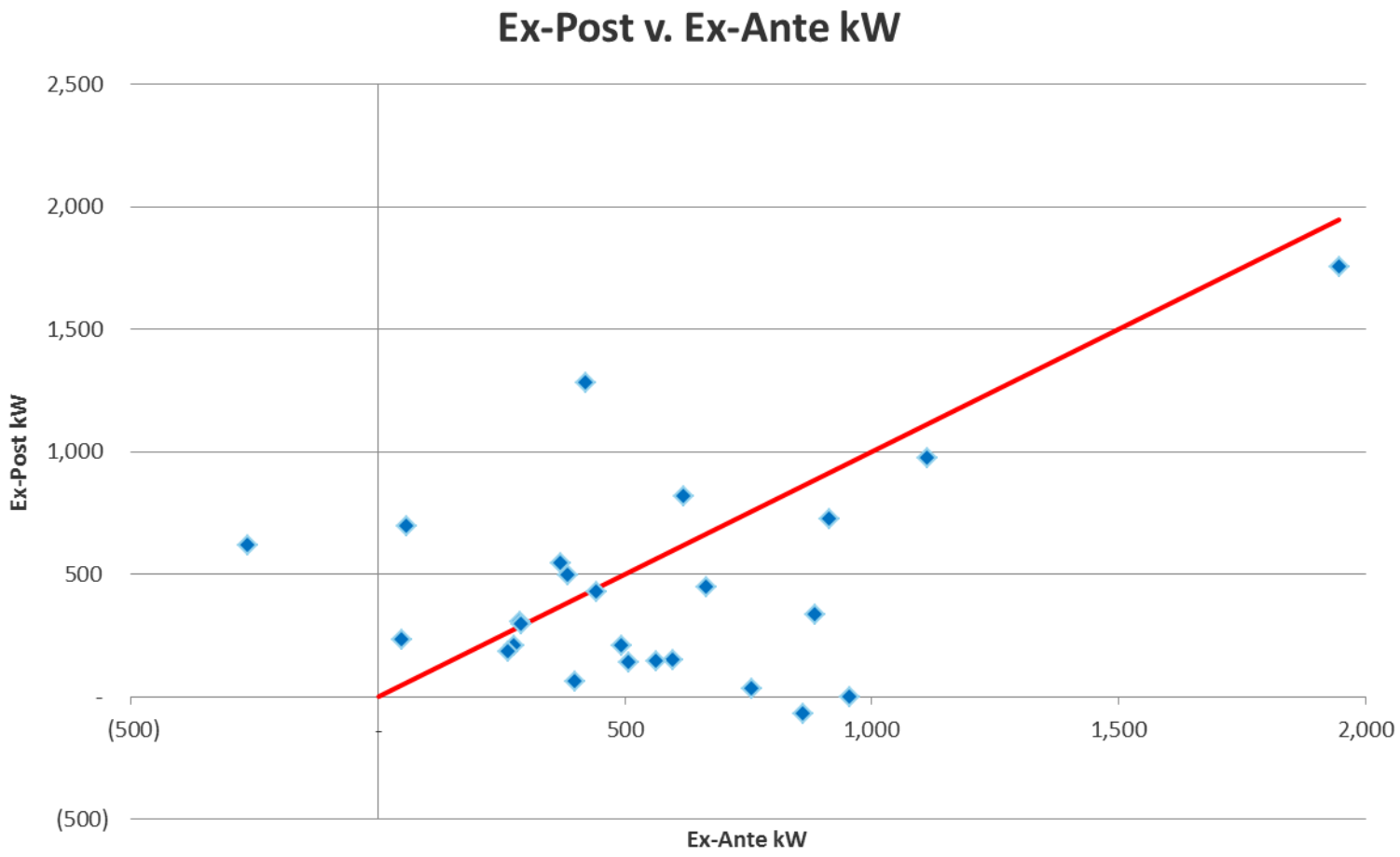
# First Year Weighted Ex-Ante and Ex-Post Source MMBTU Savings for Sampled Projects



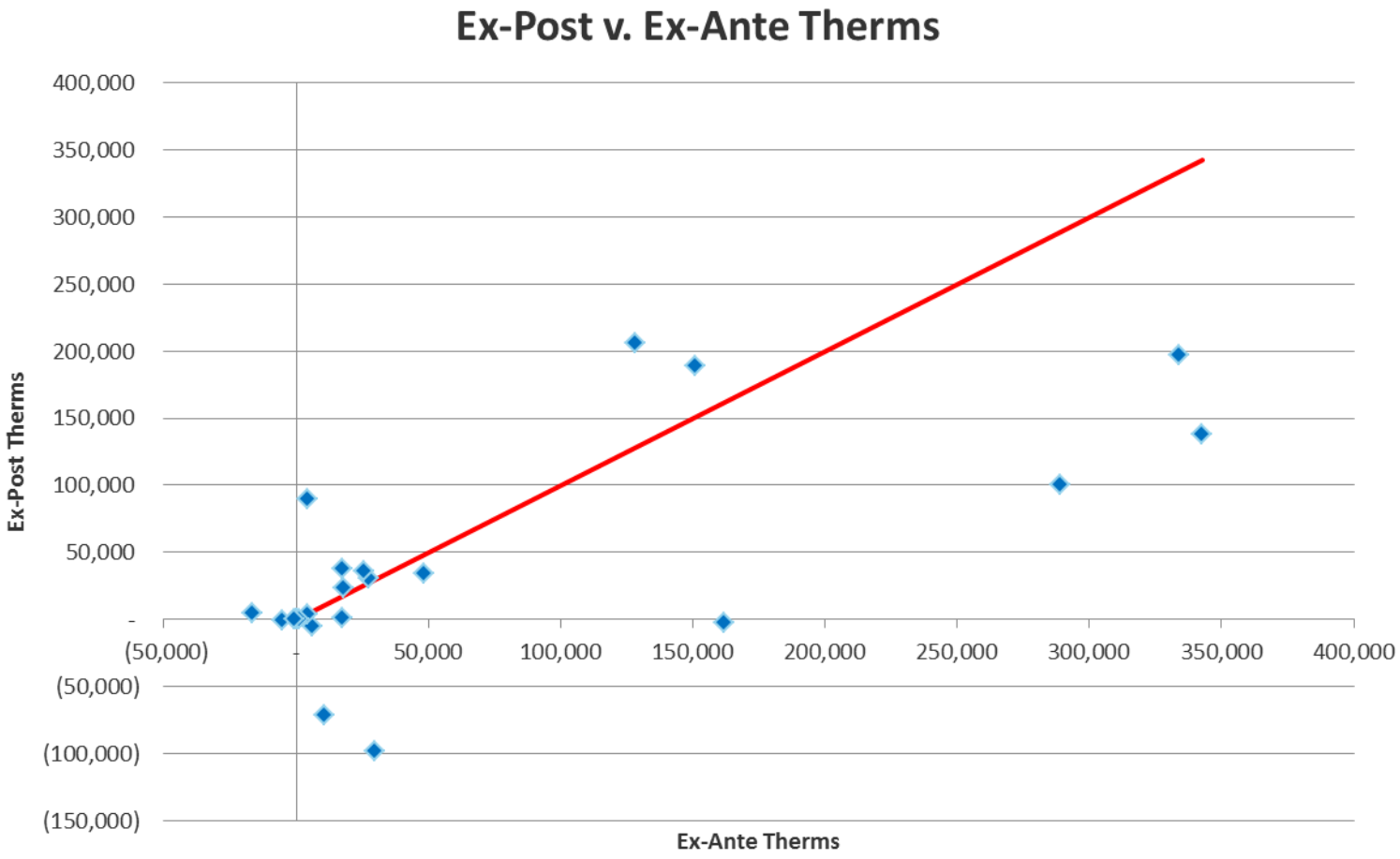
# First Year Weighted Ex-Ante and Ex-Post Electric Savings (kWh) for Sampled Projects



# First Year Weighted Ex-Ante and Ex-Post Electric Demand Savings (kW) for Sampled Projects



# First Year Weighted Ex-Ante and Ex-Post Gas Savings (Therms) for Sampled Projects



# IOU Statewide First Year Gross and Net Realization Rate Estimates and Comparisons

| | Electric Savings | | Gas Savings | Source Energy Savings |
|---|---|---|---|---|
| **Impact Element** | **kWh/year** | **Average Peak kW** | **Therms/year** | **MMBTU/year** |
| **Tracking** | | | | |
| a. Claimed Gross Savings | 67,909,049 | 21,886 | 828,183 | 778,139 |
| b. Claimed GRR* | 0.9 | 0.9 | 0.9 | 0.9 |
| c. Claimed Adjusted Gross Savings | 61,183,615 | 19,710 | 745,328 | 700,992 |
| d. Claimed NTGR | 0.65 | 0.65 | 0.64 | 0.65 |
| e. Claimed Net Savings (e = c x d) | 39,564,196 | 12,746 | 476,312 | 453,116 |
| f. Claimed Net Realization Rate (f = b x d) | 0.58 | 0.58 | 0.58 | 0.58 |
| **Evaluation** | | | | |
| g. Evaluation GRR | 0.94 | 0.79 | 0.57 | 0.85 |
| h. Evaluated Gross Results (h = a x g) | 63,903,109 | 17,397 | 474,104 | 663,454 |
| i. Evaluation NTG Ratio | 0.53 | 0.50 | 0.51 | 0.53 |
| k. Evaluated Net Results (k = h x i ) | 33,986,798 | 8,765 | 242,122 | 353,595 |
| **l. Evaluation Net Realization Rate (l = g x i )** | 0.50 | 0.40 | 0.29 | 0.45 |
| **m. Evaluated Net Savings as a Fraction of Claimed Net Savings (m = k / e)** | 0.86 | 0.69 | 0.51 | 0.78 |

# IOU Statewide Lifecycle Gross and Net Realization Rate Estimates and Comparisons

| | Electric Savings | | Gas Savings | Source Energy Savings |
|---|---|---|---|---|
| **Impact Element** | **kWh** | **Average Peak kW** | **Therms** | **MMBTU/year** |
| **Tracking** | | | | |
| a. Claimed Gross Savings | 1,072,032,790 | 346,431 | 13,026,360 | 12,279,180 |
| b. Claimed GRR* | 0.9 | 0.9 | 0.9 | 0.9 |
| c. Claimed Adjusted Gross Savings | 965,863,066 | 312,000 | 11,723,152 | 11,061,783 |
| d. Claimed NTGR | 0.65 | 0.65 | 0.64 | 0.65 |
| e. Claimed Net Savings (e = c x d) | 624,572,367 | 201,754 | 7,491,835 | 7,150,258 |
| f. Claimed Net Realization Rate (f = b x d) | 0.58 | 0.58 | 0.58 | 0.58 |
| **Evaluation** | | | | |
| g. Evaluation GRR | 0.92 | 0.79 | 0.57 | 0.84 |
| h. Evaluated Gross Results (h = a x g) | 987,494,279 | 274,327 | 7,428,262 | 10,266,156 |
| i. Evaluation NTG Ratio | 0.53 | 0.50 | 0.51 | 0.53 |
| k. Evaluated Net Results (k = h x i ) | 525,197,744 | 138,216 | 3,793,576 | 5,471,463 |
| **l. Evaluation Net Realization Rate (l = g x i )** | 0.49 | 0.40 | 0.29 | 0.45 |
| **m. Evaluated Net Savings as a Fraction of Claimed Net Savings (m = k/e)** | 0.84 | 0.69 | 0.51 | 0.77 |

# Thank you. Questions?

**Name: Amit Kanungo**
Email: amit.kanungo@dnvgl.com
Phone:510-891-0446

**www.dnvgl.com**

**SAFER, SMARTER, GREENER**

# 2013-14 INDUSTRIAL, AGRICULTURAL AND LARGE COMMERCIAL (IALC) ROADMAP

# ESPI PUBLIC STAKEHOLDER WORKSHOP PY2013 CUSTOM IMPACT EVALUATION

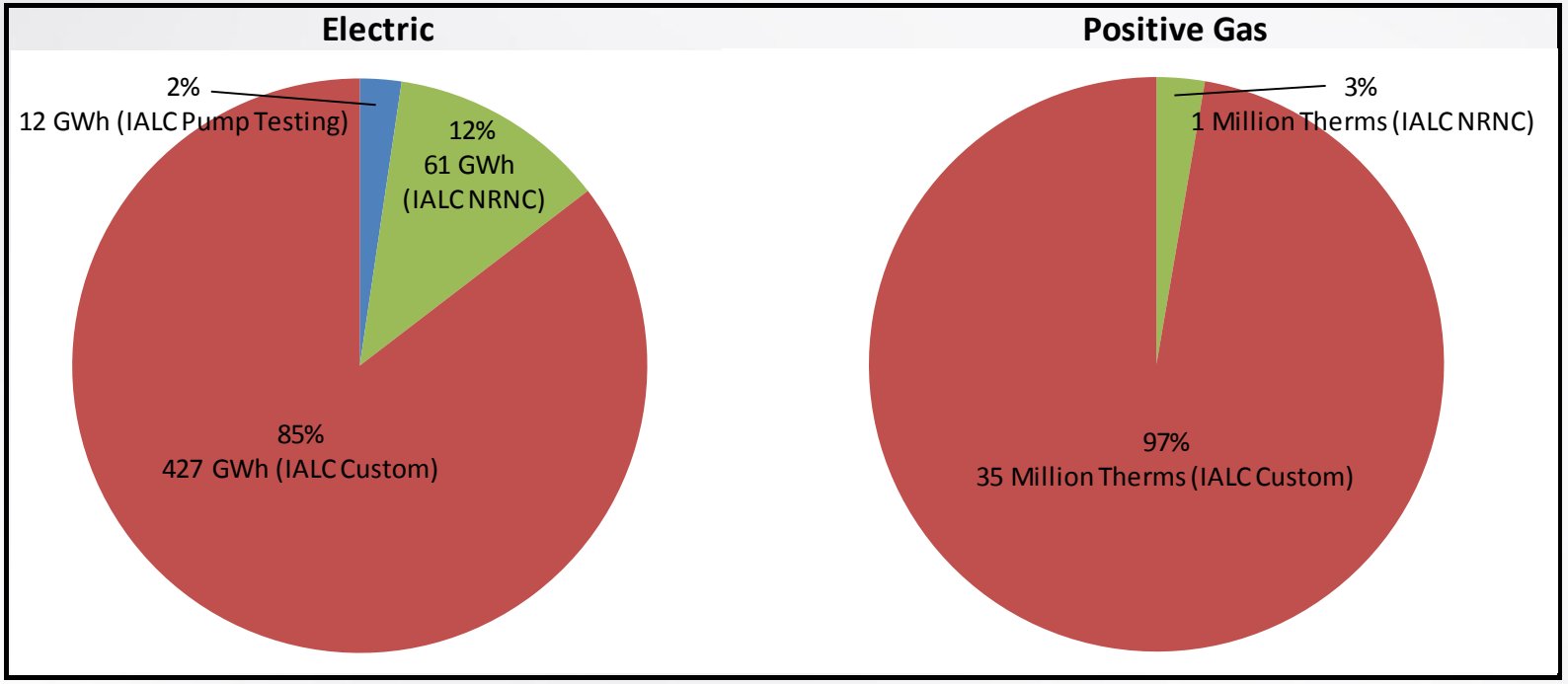
March 25, 2015

# IALC CUSTOM IMPACT EVALUATION AGENDA

- IALC Evaluation Overview
- ESPI Performance Parameter Updates
- Data Collection and Approach
- Evaluation Sample by IOU
- Aggregation of Sample Results
- Gross Impact Results
- Net Impact Results
- Comparison of Ex-Ante and Ex-Post Impact Results

# IALC EVALUATION OVERVIEW

- IALC Roadmap is composed of nonresidential, non-deemed claims:
  - Non-deemed lighting measures moved to Commercial RM
  - IALC percent of portfolio claims –19% of electric and 56% of gas
- PY2013 IALC savings claims:



# ESPI PERFORMANCE PARAMETER UPDATES

- IALC custom evaluation activities addressed each of the following:
  - Verified that measures were installed and operating as claimed
  - Assessed project savings – engineering review, on-site measurement, and adjusted savings claims using observed field operation
  - Estimated ex-post gross energy and demand savings
  - Estimated ex-post NTG ratios and net savings
  - Examined expected useful life and estimated lifecycle savings

# DATA COLLECTION AND APPROACH

- The gross impact evaluation developed gross realization rates (GRRs) for statistically representative samples of custom projects
  - The gross impact evaluation utilized project-specific measurement and verification (M&V) to estimate GRRs
  - Greater M&V rigor was used for strata 1 and 2 projects
    - Analysis involved on-site metering and extensive engineering analysis to calculate the ex-post impact of sampled strata 1 and 2 projects
    - Smaller projects received less rigor
  - 190 PY2013 M&V points were targeted and 189 were achieved
- The NTG evaluation used an interview-based approach for a representative sample of selected projects, yielding NTG ratios
- Similar to the gross impact approach, a mix of rigorous professional interviews and basic rigor CATI surveys were conducted
- 153 PY2013 points were targeted and 146 were achieved

# EVALUATION SAMPLE BY IOU

- Gross and net impact sampling by IOU
  - Electric and gas savings were collapsed
  - Sampling and analysis used source energy equivalents*

| IOU | Number of Evaluation Completes (n) | |
|---|---|---|
| | Gross Impact (M&V) | NTG Surveys |
| PG&E | 55 | 51 |
| SCE | 53 | 46 |
| SDG&E | 43 | 28 |
| SCG | 38 | 21 |
| **All IOUs** | **189** | **146** |

* Conversion rates obtained from "*2001 Energy Efficiency Standards for Residential and Non-residential Buildings, California Energy Commission*," June 2001: 1 kWh = 10,239 Btu source energy; 1 Therm = 100,000 Btu source energy. 1 MMBtu =1,000,000 Btu

# AGGREGATION OF SAMPLE RESULTS

- Sample-based gross and net results were aggregated by IOU to represent the population of custom claims
  - Within each of five strata, sample-weighted means were first derived by IOU, both GRRs and NTG ratios
    - For example, strata 1 GRR =

      sum(ex-post gross savings) / sum (ex-ante gross savings)
  - Means were then aggregated by IOU using population-level strata weights

PG&E Illustration of Population-Level Weights:

| Strata | N | MMBtu |
|---|---|---|
| 1 | 7 | 879,850 |
| 2 | 18 | 952,461 |
| 3 | 47 | 906,027 |
| 4 | 126 | 928,744 |
| 5 | 941 | 917,149 |

# GROSS IMPACT RESULTS

Mean Lifecycle Gross Realization Rates by IOU and Energy Metric (MMBtu and kW)

| Energy Metric | Sample Size (n) | LC Gross Realization Rate | Population (N) | Error Ratio** | 90% Confidence Interval | FY Gross Realization Rate |
|---|---|---|---|---|---|---|
| **PG&E** | | | | | | |
| MMBtu* | 55 | 0.63 | 1,126 | 0.47 | 0.57 to 0.70 | 0.74 |
| kW | 37 | 0.44 | 854 | 1.41 | 0.28 to 0.61 | 0.53 |
| **SCE** | | | | | | |
| MMBtu* | 53 | 0.44 | 932 | 1.05 | 0.34 to 0.54 | 0.54 |
| kW | 51 | 0.51 | 836 | 0.79 | 0.42 to 0.60 | 0.64 |
| **SDGE** | | | | | | |
| MMBtu* | 43 | 0.51 | 264 | 0.86 | 0.41 to 0.61 | 0.75 |
| kW | 28 | 0.79 | 143 | 0.89 | 0.59 to 0.98 | 1.03 |
| **SCG** | | | | | | |
| MMBtu* | 38 | 0.60 | 159 | 0.88 | 0.48 to 0.73 | 0.69 |

* The primary sample was designed and selected at this level. The kW sample sizes are lower due to the fact that kW impacts were not claimed by IOUs in every case.

** A measure of the statistical variation in the gross realization rates.

# NET IMPACT RESULTS

## Net-to-Gross Ratios by IOU

| Results | Mean Net-to-Gross Ratios | | | |
|---|---|---|---|---|
| | PGE | SCE | SDG&E | SCG |
| **Weighted NTGR** | **0.55** | **0.57** | **0.59** | **0.66** |
| 90 Percent Confidence Interval | 0.52 to 0.59 | 0.52 to 0.61 | 0.55 to 0.64 | 0.59 to 0.73 |
| Relative Precision | 0.07 | 0.09 | 0.08 | 0.10 |
| n NTGR Completes | 51 | 46 | 28 | 21 |
| N Sampling Units | 1,126 | 932 | 264 | 159 |
| Error ratio (ER) | 0.30 | 0.36 | 0.28 | 0.31 |

# COMPARISON OF PG&E IMPACT RESULTS

## PG&E Lifecycle Net Realization Rate Estimates and Comparisons

| Impact Element | LC Electric savings | | LC Gas savings |
|---|---|---|---|
| | kWh | Avg. Peak kW | Therms |
| **Tracking** | | | |
| a. Claimed LC Gross Savings | 3,070,606,193 | 412,731 | 293,168,434 |
| b. Claimed GRR | 0.91 | 0.90 | 0.90 |
| c. Claimed Adjusted Gross Savings (c = a x b) | 2,784,233,097 | 373,019 | 264,522,775 |
| d. Claimed NTGR | 0.65 | 0.64 | 0.62 |
| e. Claimed Net Savings (e = c x d) | 1,812,339,756 | 240,019 | 165,122,455 |
| f. Claimed Net Realization Rate (f = b x d) | 0.59 | 0.58 | 0.56 |
| **Evaluation** | | | |
| g. Evaluation LC GRR | 0.63 | 0.44 | 0.63 |
| h. Evaluated Gross Results (h = a x g) | 1,945,175,228 | 181,904 | 185,717,067 |
| i. Evaluation NTG Ratio | 0.55 | 0.49 | 0.55 |
| j. Evaluated Net Results (k = h x i) | 1,076,074,052 | 89,461 | 102,738,979 |
| k. Evaluation Net Realization Rate (l = g x i) | 0.35 | 0.22 | 0.35 |
| l. Evaluated Net Savings as a Fraction of Claimed Net Savings (m = k / f) | 0.59 | 0.37 | 0.62 |

# COMPARISON OF SCE IMPACT RESULTS

## SCE Lifecycle Net Realization Rate Estimates and Comparisons

| Impact Element | LC Electric savings | | LC Gas savings |
|---|---|---|---|
| | kWh | Avg. Peak kW | Therms |
| **Tracking** | | | |
| a. Claimed LC Gross Savings | 2,661,449,185 | 371,143 | 3,690,923 |
| b. Claimed GRR | 0.91 | 0.91 | 0.90 |
| c. Claimed Adjusted Gross Savings (c = a x b) | 2,415,366,304 | 336,935 | 3,321,870 |
| d. Claimed NTGR | 0.61 | 0.63 | 0.82 |
| e. Claimed Net Savings (e = c x d) | 1,483,081,260 | 211,055 | 2,708,592 |
| f. Claimed Net Realization Rate (f = b x d) | 0.56 | 0.57 | 0.73 |
| **Evaluation** | | | |
| g. Evaluation LC GRR | 0.44 | 0.51 | 0.44 |
| h. Evaluated Gross Results (h = a x g) | 1,173,093,281 | 190,051 | 1,626,857 |
| i. Evaluation NTG Ratio | 0.57 | 0.55 | 0.57 |
| j. Evaluated Net Results (k = h x i) | 663,208,110 | 104,216 | 919,743 |
| k. Evaluation Net Realization Rate (l = g x i) | 0.25 | 0.28 | 0.25 |
| l. Evaluated Net Savings as a Fraction of Claimed Net Savings (m = k / f) | 0.45 | 0.49 | 0.34 |

# COMPARISON OF SDG&E IMPACT RESULTS

## SDG&E Lifecycle Net Realization Rate Estimates and Comparisons

| Impact Element | LC Electric savings | | LC Gas savings |
|---|---|---|---|
| | kWh | Avg. Peak kW | Therms |
| **Tracking** | | | |
| a. Claimed LC Gross Savings | 644,866,138 | 51,185 | 13,699,322 |
| b. Claimed GRR | 0.90 | 0.90 | 0.90 |
| c. Claimed Adjusted Gross Savings (c = a x b) | 582,571,801 | 46,225 | 12,331,589 |
| d. Claimed NTGR | 0.61 | 0.60 | 0.64 |
| e. Claimed Net Savings (e = c x d) | 352,602,677 | 27,945 | 7,854,563 |
| f. Claimed Net Realization Rate (f = b x d) | 0.55 | 0.55 | 0.57 |
| **Evaluation** | | | |
| g. Evaluation LC GRR | 0.51 | 0.79 | 0.51 |
| h. Evaluated Gross Results (h = a x g) | 326,096,163 | 40,294 | 6,927,478 |
| i. Evaluation NTG Ratio | 0.59 | 0.59 | 0.59 |
| j. Evaluated Net Results (k = h x i) | 193,866,374 | 23,704 | 4,118,433 |
| k. Evaluation Net Realization Rate (l = g x i) | 0.30 | 0.46 | 0.30 |
| l. Evaluated Net Savings as a Fraction of Claimed Net Savings (m = k / f) | 0.55 | 0.85 | 0.52 |

# COMPARISON OF SCG IMPACT RESULTS

## SCG Lifecycle Net Realization Rate Estimates and Comparisons

| Impact Element | LC Gas savings Therms/year |
|---|---|
| **Tracking** | |
| a. Claimed LC Gross Savings | 192,784,844 |
| b. Claimed GRR | 0.91 |
| c. Claimed Adjusted Gross Savings (c = a x b) | 175,550,225 |
| d. Claimed NTGR | 0.50 |
| e. Claimed Net Savings (e = c x d) | 88,449,610 |
| f. Claimed Net Realization Rate (f = b x d) | 0.46 |
| **Evaluation** | |
| g. Evaluation LC GRR | 0.60 |
| h. Evaluated Gross Results (h = a x g) | 116,443,232 |
| i. Evaluation NTG Ratio | 0.66 |
| j. Evaluated Net Results (k = h x i) | 76,548,505 |
| k. Evaluation Net Realization Rate (l = g x i) | 0.40 |
| l. Evaluated Net Savings as a Fraction of Claimed Net Savings (m = k / f) | 0.87 |

# THANK YOU

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# 2013 ESPI IMPACT EVALUATION

## Custom Lighting

# AGENDA

## Custom Lighting

- Overview
  - Custom lighting projects
- Methodology and Sample Design
  - New field work includes phone surveys and on-site verification
- Results
  - Gross Realization Rates
  - Net-to-Gross Ratios
  - Net Realization Rates

# RESEARCH OBJECTIVES

- Attachment 2 of ESPI Decision
  - All components of custom projects are subject to review
    - **NTG** – estimate participant free-ridership to support the development of net-to-gross ratios and net savings values
    - **GRR** – site specific gross realization rates for sample of participants applied to population
    - **NRR** – product of the NTGR and GRR

# SAMPLE DESIGN

## On-Site Sample Design by Program Administrator and Size of Project

| Project Size | Project Size (MWh) | Population # of Projects | Target Sample Size | Achieved Projects Sampled |
|---|---|---|---|---|
| **PG&E** | | | | |
| Very Large | >1,000 | 6 | 4 | 3 |
| Large | 250-1,000 | 85 | 6 | 7 |
| Medium | 50-250 | 397 | 6 | 4 |
| Small | <50 | 1,790 | 6 | 7 |
| **PG&E Total** | | **2,278** | **22** | **21** |
| **SCE** | | | | |
| Very Large | >1,600 | 1 | 3 | 1 |
| Large | 250-1,600 | 67 | 6 | 10 |
| Medium | 50-250 | 260 | 6 | 2 |
| Small | <50 | 889 | 6 | 6 |
| **SCE Total** | | **1,217** | **21** | **19** |
| **SDG&E** | | | | |
| Very Large | >500 | 4 | 3 | 2 |
| Large | 200-500 | 8 | 4 | 3 |
| Medium | 50-200 | 19 | 4 | |
| Small | <50 | 135 | 4 | 1 |
| **SDG&E Total** | | **166** | **15** | **6** |

# SAMPLE DESIGN

## Phone Survey Sample Design by Program Administrator

| Program Administrator | Target Sample Size | Achieved from Onsite Sample | Achieved from Survey Only (no Onsite) | Total Achieved Projects Sampled |
|---|---|---|---|---|
| PG&E | 28 | 21 | 14 | 35 |
| SCE | 27 | 19 | 19 | 38 |
| SDG&E | 19 | 3 | 1 | 4 |
| **Statewide** | **74** | **43** | **34** | **77** |

- NTGR survey administered as part of on-site recruitment
- Same stratification scheme used for telephone survey sampling (PA and size)
- However, NTGRs were estimated by PA only
- SDG&E achieved sample significantly below target

# METHODOLOGY

## Site Specific Gross Savings Generated from the Following Parameters

- Installation rate
  - Installed and operable measures from on-site
- Pre-Retrofit Hours of Operation*
  - Adjusted self-reports
- Post-Retrofit Hours of Operation*
  - Logger data and Adjusted self-reports
- Pre-Wattage
  - Wattage of replaced equipment, industry standard practice or combination of the two for dual baseline measures
- Post-Wattage
  - Wattage associated with the measures that were installed

* The Pre- and Post-Retrofit hours are assumed to be equal for all measures except for those associated with controls.
* We will attempt to monitor all measures, however, for PY 2013, given the timeline, we will rely on adjusted self-reports. However, these loggers will stay in the field to support future HOU estimates

# GROSS REALIZATION RATES

## First Year and Lifecycle GRRs by Program Administrator

| PA | Sample Size | First Year GRR | | Lifecycle GRR | |
|---|---|---|---|---|---|
| | | GRR kWh | GRR kW | GRR kWh | GRR kW |
| PG&E | 21 | 80% | 85% | 62% | 71% |
| SCE | 19 | 77% | 67% | 55% | 50% |
| SDG&E | 6 | 64% | 76% | 50% | 69% |
| **Statewide** | **46** | **78%** | **77%** | **58%** | **61%** |

- First year and Lifecycle GRR sample relative precision (kWh)
  - PG&E – 14% and 18%
  - SCE – 36% and 42%
  - SDG&E – 29% and 33%
  - **Statewide – 16% and 20%**

# NET-TO-GROSS RATIOS

## Comparison of Ex-Ante and Ex-Post NTGRs by Program Administrator

| PA | Sample Size | NTGR kWh Weighted | | | NTGR kW Weighted | | |
|---|---|---|---|---|---|---|---|
| | | Ex Ante | Ex Post | RP | Ex Ante | Ex Post | RP |
| PG&E | 35 | 0.65 | 0.50 | 9% | 0.65 | 0.50 | 9% |
| SCE | 38 | 0.71 | 0.56 | 7% | 0.70 | 0.60 | 6% |
| SDG&E | 4 | 0.64 | 0.57 | 22% | 0.62 | 0.54 | 24% |
| **Statewide** | **77** | **0.67** | **0.53** | **6%** | **0.67** | **0.54** | **6%** |

- NTGRs applied to the gross savings to estimate net savings
- SDG&E sample size small
  - Statistically significant at the 90% confidence level
  - Greater than statewide value for kWh

# NET REALIZATION RATES

## First Year and Lifecycle NRRs by Program Administrator

| PA | Sample Size | First Year NRR | | Lifecycle NRR | |
|---|---|---|---|---|---|
| | | NRR kWh | NRR kW | NRR kWh | NRR kW |
| PG&E | 21 | 62% | 65% | 48% | 53% |
| SCE | 19 | 61% | 57% | 44% | 42% |
| SDG&E | 6 | 57% | 63% | 45% | 57% |
| **Statewide** | **46** | **61%** | **62%** | **46%** | **48%** |

- First year and Lifecycle NRR sample relative precision (kWh)
  - PG&E – 16% and 20%
  - SCE – 37% and 43%
  - SDG&E – 37% and 39%
  - **Statewide – 17% and 21%**

# Downstream Deemed

# 2013 ESPI IMPACT EVALUATION

Deemed Lighting

# AGENDA

## Deemed Lighting

- Overview
  - ESPI Measures Evaluated
    - CFLs
    - T5 fluorescent fixtures replacing metal halides
    - LEDs
    - Occupancy sensors  (integrated and non-integrated)
    - Delamping of T12 lamps in existing fixtures
- Methodology and Impact Parameters
  - Updates include both new field work and best available information
- Results
  - Net-to-Gross Ratios
  - Gross/Net Realization Rates (based on UES)

# RESEARCH OBJECTIVES

## Parameters Updated

- Attachment 2 of ESPI Decision
  - **Verification** – confirm installations of measure installations
  - **Unit Energy Savings (UES)**– estimate baseline and replacement equipment wattages, operating hours and use shapes to support the estimate of energy savings values and 8760 impact load shapes
  - **NTG** – estimate participant free-ridership to support the development of net-to-gross ratios and net savings values
  - **Gross and Net energy savings**

# MEASURES EVALUATED

## 5 ESPI Lighting Measures Represent 9 Measure Groups

| Measure Group | % 2013 Savings* | Existing Data | New Data Collection | |
|---|---|---|---|---|
| | | | Phone | On-site |
| Indoor High Bay Fluorescent | 3.2% | Yes | Yes | Yes |
| Indoor LED lamp | 0.8% | Yes | Yes | Yes |
| Indoor LED reflector lamp | 1.1% | Yes | Yes | Yes |
| Indoor Controls (Wall or Ceiling Mounted) | 0.6% | Yes | Yes | **No** |
| Indoor Fixture Integrated Occupancy Sensor | 0.4% | Yes | Yes | **No** |
| Indoor HB Fixture Integrated Occupancy Sensor | 0.0% | Yes | Yes | **No** |
| Indoor CFL Basic | 0.2% | Yes | **No** | **No** |
| Indoor CFL Reflector | 0.1% | Yes | **No** | **No** |
| Indoor Linear Fluorescent Delamping | 0.0% | Yes | **No** | **No** |

* Values with 0.0% have a positive claim, but that claim is less than one tenth of one percent.

# METHODOLOGY

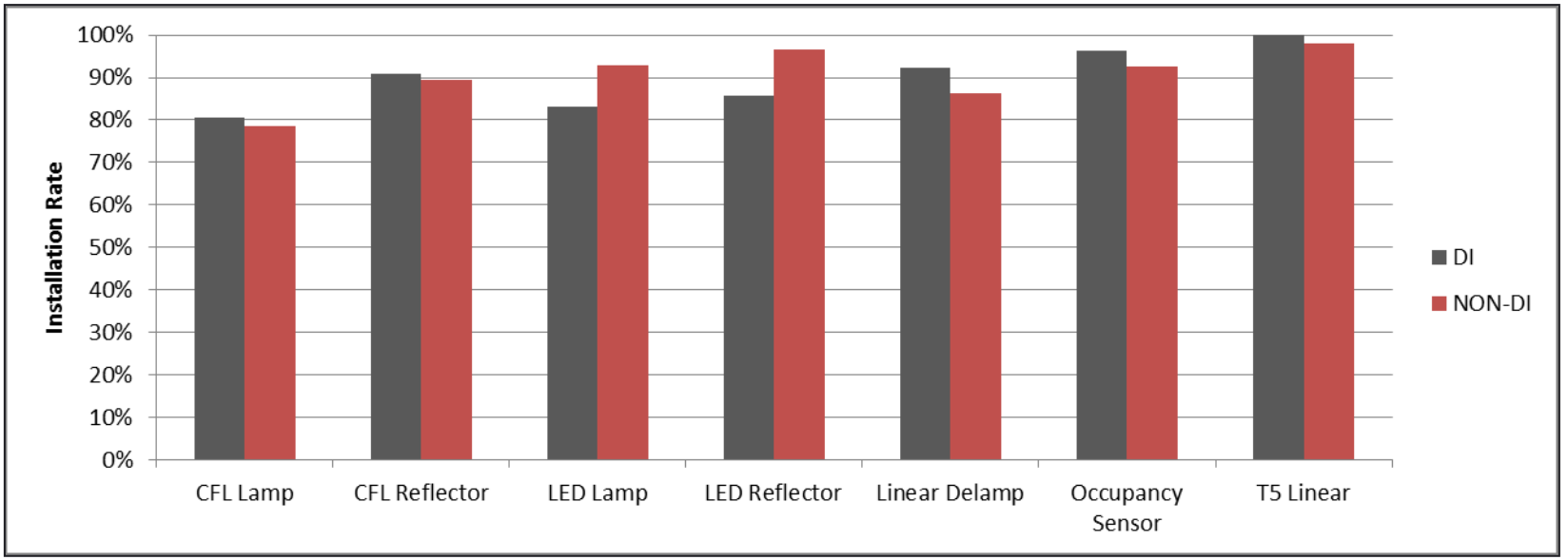
## UES Developed from the Following Impact Parameters

- Installation rate
  - Installed and operable measures from on-site
- Pre-Retrofit Hours of Operation*
  - Adjusted self-reports
- Post-Retrofit Hours of Operation*
  - Logger data and Adjusted self-reports
- Pre-Wattage
  - Wattage of replaced equipment, industry standard practice or combination of the two for dual baseline measures
- Post-Wattage
  - Wattage associated with the measures that were installed

* The Pre- and Post-Retrofit hours are assumed to be equal for all measures except for those associated with controls.
* We will attempt to monitor all measures, however, for PY 2013, given the timeline, we will rely on adjusted self-reports. However, these loggers will stay in the field to support future HOU estimates

# IMPACT PARAMETERS

## Installation Rates by Program Delivery




- Lowest installation rate – CFL lamps (79%)
- Highest installation rate – T5 linears (98%)
- Differences by program delivery for LED measures
  - Higher failure and removal rates in Direct Install programs

# IMPACT PARAMETERS

## Operating Hours by Building Type (weighted average of all building types)

**Most common building type installations by measure**

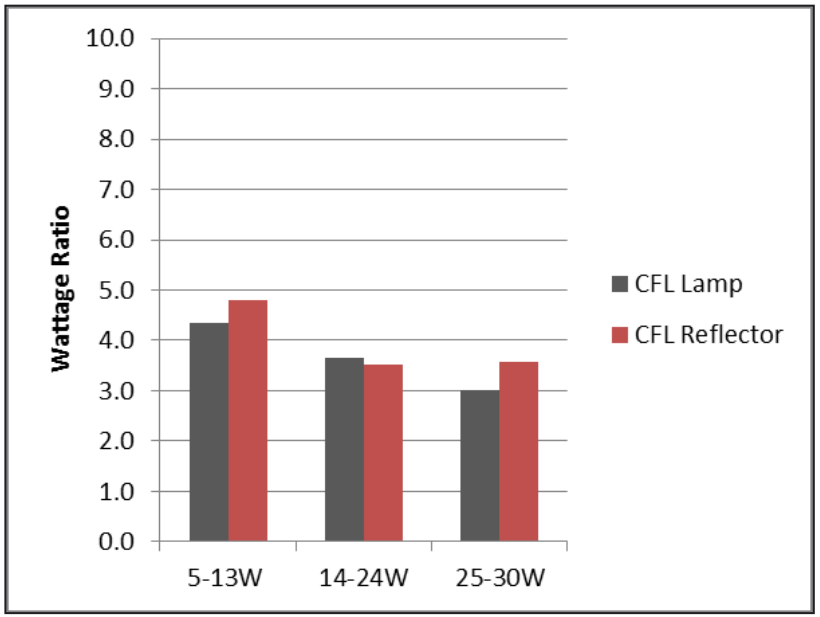
- CFL lamps
  - 29% Small Retail
- CFL Reflectors
  - 27% Small Retail
- LED Lamps
  - 25% Small Office
- LED Reflectors
  - 25% Small Retail
- Linear
  - 30% Small Retail
- T5 Linear
  - 30% Other Industrial
- Occupancy Sensors
  - 21% Other Industrial
  - 18% Small Retail

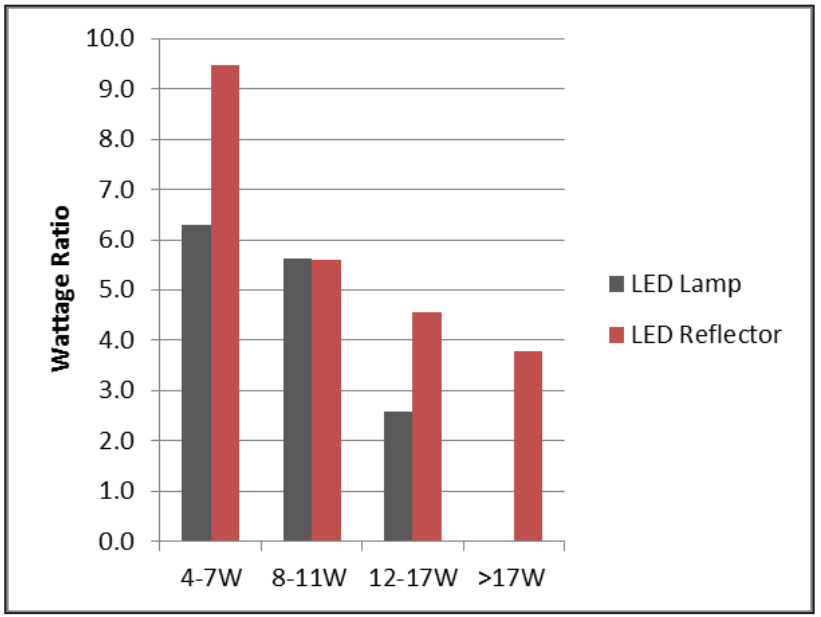
| ESPI Measure | Sites | Operating Hours | |
|---|---|---|---|
| | | Pre-Retrofit | Post-Retrofit |
| CFL Lamps* | 419 | 1,160 | 1,160 |
| CFL Reflectors | 132 | 2,731 | 2,731 |
| LED Lamps* | 184 | 1,215 | 1,215 |
| LED Reflectors | 177 | 3,294 | 3,294 |
| Linear | 902 | 2,776 | 2,776 |
| T5 Linear | 301 | 3,200 | 3,200 |
| Occupancy Sensors | 251 | 2,432 | 1,736 |

* These estimates include the operating hours associated with guest rooms in lodging

# IMPACT PARAMETERS

## Wattage Ratios by Measure Configuration for CFLs and LEDs

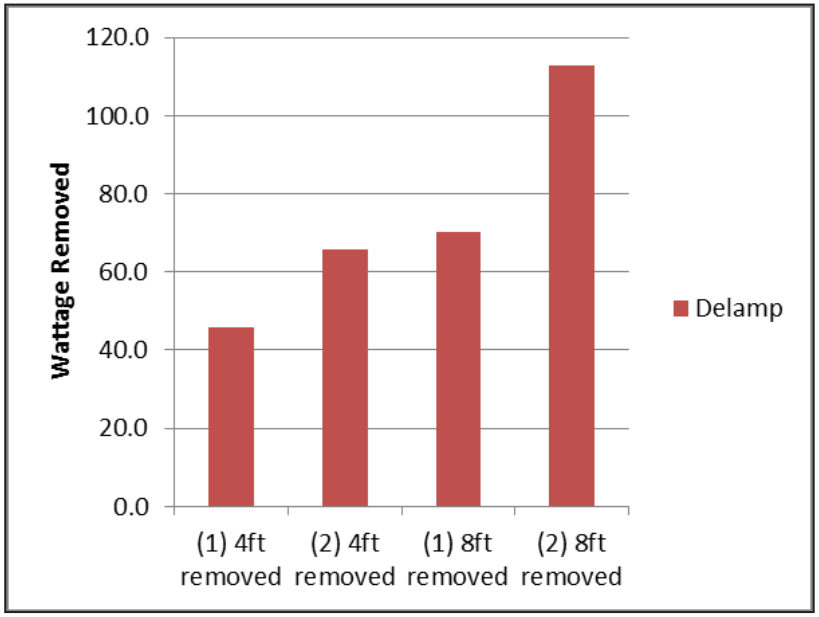


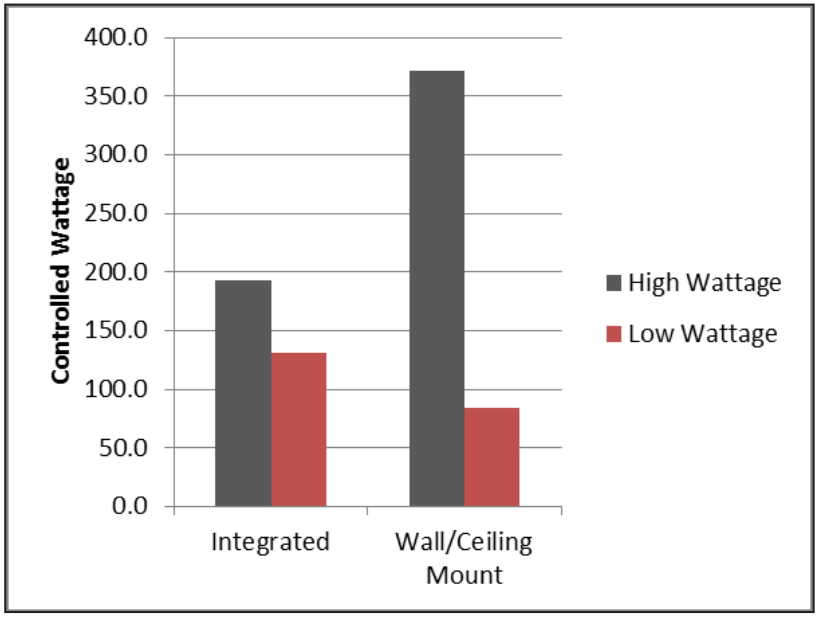




- Wattage ratio fairly similar for CFL lamps and reflectors
- Wattage ratio for 4-7W and 12-17W LED reflector much greater
  - 12-17W LED lamps generally replacing CFL (23-27W range)

# IMPACT PARAMETERS

## Pre-Retrofit and Controlled Wattage by Configuration for Delamp and Controls



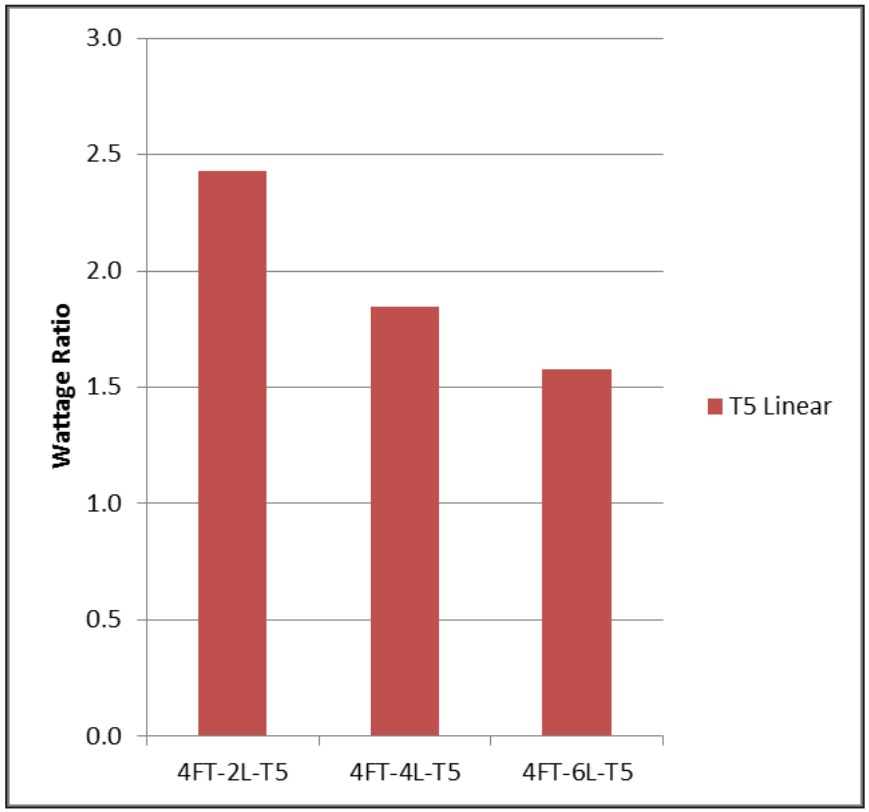

- 4 linear delamp cases evaluated
- For ER measures
  - Pre-retrofit wattage for RUL
- For ROB and Post-RUL
  - Industry standard practice

- Fixture integrated and wall/ceiling mount evaluated
  - High/Low wattages ranges for each control type

# IMPACT PARAMETERS

## Wattage Ratios by Measure Configuration for T5 Linears replacing Metal Halide

- 3 most prevalent configurations
  - 2L, 4L, 6L T5 systems
- For ER measures
  - Pre-retrofit wattage for RUL period
- For ROB and Post-RUL
  - Pulse start metal halide
- Vast majority of pre-retrofit equipment
  - 400W Metal halide



# GROSS REALIZATION RATES

## UES Values Applied to the Population of Measures to Generate GRRs

| PA<br>ESPI Measure | First Year GRR | | Lifecycle GRR | |
|---|---|---|---|---|
| | GRR kWh | GRR kW | GRR kWh | GRR kW |
| **PG&E** | | | | |
| CFL | 72% | 80% | 81% | 84% |
| Delamping | 94% | 107% | 96% | 109% |
| LED | 150% | 178% | 152% | 177% |
| Occupancy Sensors | 64% | 89% | 64% | 89% |
| T5 | 36% | 33% | 36% | 33% |
| **SCE** | | | | |
| CFL | 65% | 72% | 70% | 74% |
| Delamping | 91% | 89% | 93% | 91% |
| Occupancy Sensors | 59% | 34% | 59% | 34% |
| T5 | 57% | 46% | 63% | 32% |
| **SDG&E** | | | | |
| CFL | 90% | 91% | 92% | 91% |
| Delamping | 86% | 86% | 86% | 86% |
| Occupancy Sensors | 72% | 56% | 71% | 56% |

# NET-TO-GROSS RATIOS

## NTGRs by Program Delivery (weighted average of programs)

- NTGR generated by program delivery (or combined program delivery)
  - Deemed
  - Direct Install
  - LGP
  - L3P
- CFL/LED lamps and reflectors combined
- CFL and Delamping using existing NTGRs
- T5, LED and occupancy sensors using new phone survey results

| ESPI Measure | n | Ex-Post NTGR | |
|---|---|---|---|
| | | kWh weighted | kW weighted |
| CFL | 370 | 0.61 | 0.62 |
| LED | 232 | 0.59 | 0.60 |
| Delamping | 307 | 0.65 | 0.63 |
| Occupancy Sensors | 76 | 0.61 | 0.60 |
| T5 | 147 | 0.65 | 0.65 |

# NET REALIZATION RATES

## NTGR Applied to Gross Savings to Generate NRR

| PA<br>ESPI Measure | First Year NRR | | Lifecycle NRR | |
|---|---|---|---|---|
| | NRR kWh | NRR kW | NRR kWh | NRR kW |
| **PG&E** | | | | |
| CFL | 60% | 67% | 71% | 71% |
| Delamping | 77% | 86% | 78% | 86% |
| LED | 102% | 123% | 103% | 122% |
| Occupancy Sensors | 64% | 90% | 64% | 90% |
| T5 | 31% | 27% | 31% | 27% |
| **SCE** | | | | |
| CFL | 47% | 53% | 51% | 54% |
| Delamping | 69% | 58% | 71% | 59% |
| Occupancy Sensors | 47% | 26% | 47% | 26% |
| T5 | 49% | 39% | 55% | 27% |
| **SDG&E** | | | | |
| CFL | 92% | 93% | 93% | 93% |
| Delamping | 86% | 84% | 86% | 84% |
| Occupancy Sensors | 70% | 54% | 70% | 54% |

# 2013 ESPI IMPACT EVALUATION

## Deemed Non-Lighting

# AGENDA

**Deemed Non-Lighting**

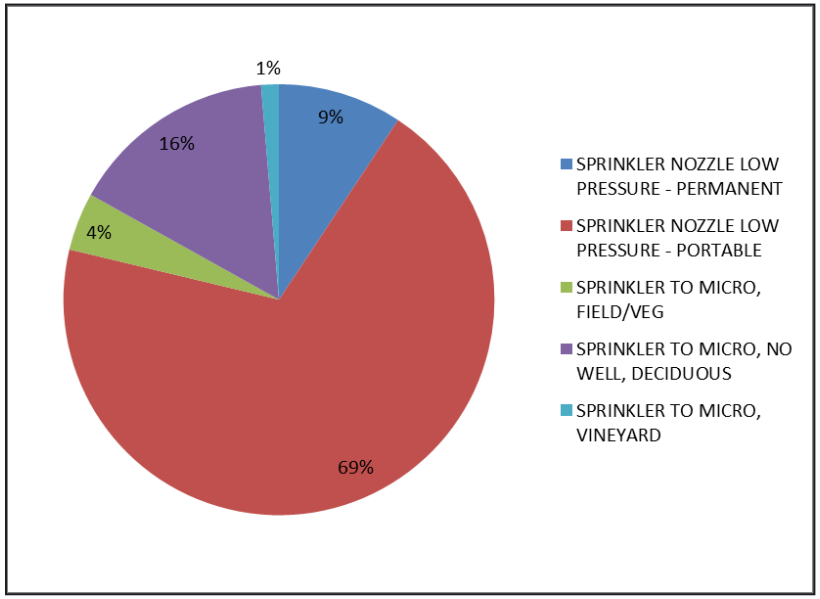
- Overview
  - ESPI Measures Evaluated
    - Agricultural Sprinklers
    - Pipe Insulation (Hot Application)
- Methodology and Sample Design
  - Updates include new field work (phone surveys only)
- Results
  - Net-to-Gross Ratios
  - Net Realization Rates

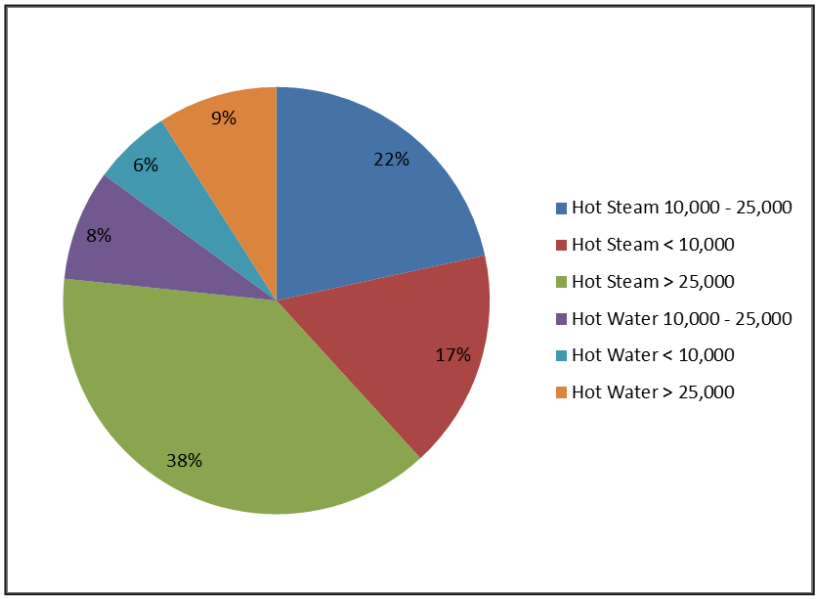
# RESEARCH OBJECTIVES

- Attachment 2 of ESPI Decision
  - An ex-post evaluation of portfolio parameters that require verification of assumptions and carry uncertainty
    - **NTG** – estimate participant free-ridership to support the development of net-to-gross ratios and net savings values
    - **Net energy savings**

# MEASURES EVALUATED

## Agricultural Sprinklers and Pipe Insulation (Hot Application)




- PG&E territory only
- Portable sprinklers
  - 69% of ex-ante savings

- PG&E and SCG territory only
- Hot steam and water boiler types

# SAMPLE DESIGN

## Sprinkler Nozzle Low Pressure - Portable

| Project Size | Percent Ex-Ante Savings | Population | Sample Design | Actual Completed Surveys |
|---|---|---|---|---|
| > 700,000 kWh | 43% | 8 | 8 | 7 |
| 250,000 – 700,000 kWh | 30% | 16 | 6 | 9 |
| < 250,000 kWh | 27% | 45 | 6 | 19 |
| **Total** | **100%** | **69** | **20** | **35** |

- 50% of sites in population agreed to phone survey
- 67% of claimed ex-ante savings represented

# SAMPLE DESIGN

## Pipe Insulation (Hot Application)

| Boiler Type (therms) | Percent of Ex-Ante Savings | Population | Sample Design | Actual Completed Surveys |
|---|---|---|---|---|
| Hot Steam (> 25,000) | 38% | 6 | 6 | 3 |
| Hot Steam (10 – 25,000) | 21% | 15 | 7 | 7 |
| Hot Steam (<10,000) | 16% | 57 | 7 | 4 |
| Hot Water (>25,000) | 9% | 3 | 3 | 1 |
| Hot Water (10 – 25,000) | 8% | 7 | 4 | 3 |
| Hot Water (< 10,000) | 6% | 26 | 3 | 0 |
| **Total** | **99%** | **103** | **30** | **18** |

- 17% of sites in population agreed to phone survey
- 41% of claimed ex-ante savings represented

# NET-TO-GROSS RATIOS

## NTGRs by ESPI Measure

| Measure | n | Weight | Ex-Ante NTGR | Ex-Post NTGR | Relative Precision |
|---|---|---|---|---|---|
| Pipe Insulation | 18 | Therms | 0.60 | 0.56 | 16% |
| Sprinklers | 35 | kWh | 0.60 | 0.38 | 12% |
| Sprinklers | 35 | kW | 0.60 | 0.38 | 12% |

- Pipe insulation very similar to ex-ante
- Sprinklers roughly a 1/3 less than ex-ante
  - Several respondents claimed they would have installed sprinkler measures in the absence of the program
    - 1/4 of respondents claimed sprinklers were better for their crops

# NET REALIZATION RATES

## Sprinkler Nozzle Low Pressure (Portable)

| PG&E | First Year Savings | | | Lifecycle Savings | | |
|---|---|---|---|---|---|---|
| | Ex-Ante Net | Ex-Post Net | NRR | Ex-Ante Net | Ex-Post Net | NRR |
| kWh | 12,541,831 | 7,919,107 | **63%** | 37,625,494 | 23,757,320 | **63%** |
| kW | 11,588 | 7,316 | **63%** | 34,764 | 21,948 | **63%** |

- Gross savings are ex-ante pass through values
- NRR are equal to the ratio of ex-post to ex-ante NTGRs

# NET REALIZATION RATES

## Pipe Insulation (Hot Applications)

| Program Administrator | First Year Therms Savings | | | Lifecycle Therms Savings | | |
|---|---|---|---|---|---|---|
| | Ex-Ante Net | Ex-Post Net | NRR | Ex-Ante Net | Ex-Post Net | NRR |
| PG&E | 124,499 | 115,402 | 93% | 1,867,486 | 1,731,035 | 93% |
| SCG | 601,419 | 557,475 | 93% | 6,615,606 | 6,132,224 | 93% |
| **Statewide** | **725,918** | **672,877** | **93%** | **8,483,093** | **7,863,259** | **93%** |

- Gross savings are ex-ante pass through values
- NRR are equal to the ratio of ex-post to ex-ante NTGRs


GONE FOR
LUNCH

# Upstream Lighting

ENERGY

# Upstream and Residential Lighting

## 2013 ESPI Measure

Tyler Mahone

# Upstream and Residential Lighting ESPI Measures

- Provide ex-post savings impacts for residential and upstream lighting measures identified as part of the 2013 ESPI process
  - 15 residential and upstream lighting measure groups identified as part of the 2013 ESPI process

- Evaluation results components from the 2010-2012 program cycle have been applied to 2013 tracking data to determine the ex-post results for 2013

- Ex-post results for the four upstream lighting measure groups that were evaluated in 2010-2012:
  - Lighting Indoor CFL Basic, Lighting Indoor CFL A-Lamp, Lighting Indoor CFL Reflector, and Lighting Indoor CFL Globe
  - Referred to as "2013 evaluated ESPI measures"

# Quantity of Rebated Measures by IOU, Delivery Method and Measure Group

| Delivery method | Measure Group | PG&E | SCE | SDG&E | Statewide |
|---|---|---|---|---|---|
| Upstream Measures | Lighting Indoor CFL > 30 Watts | 95,848 | 1,704,024 | 5,785 | 1,805,657 |
| | Lighting Indoor CFL 3 Way | 13,805 | 31,758 | 184 | 45,747 |
| | Lighting Indoor CFL A Lamp | 379,690 | 742,368 | 398,910 | 1,520,968 |
| | Lighting Indoor CFL Basic | 1,104,105 | 719,416 | 1,397,026 | 3,220,547 |
| | Lighting Indoor CFL Dimming | | 3,535 | | 3,535 |
| | Lighting Indoor CFL Globe | | 108,130 | 33,709 | 141,839 |
| | Lighting Indoor CFL Other | 100 | 4,359 | | 4,459 |
| | Lighting Indoor CFL Reflector | 446,312 | 981,844 | 343,785 | 1,771,941 |
| | Lighting Indoor LED Fixture | 158,593 | | | 158,593 |
| | Lighting Indoor LED Lamp | 99,980 | | | 99,980 |
| | Lighting Indoor LED Reflector Lamp | 92,061 | | | 92,061 |
| Residential Downstream and Direct Install Measures | Lighting Indoor CFL Basic | 55,283 | 669 | 5,022 | 60,974 |
| | Lighting Indoor CFL Globe | | 189 | | 189 |
| | Lighting Indoor CFL Other | | 8,463 | | 8,463 |
| | Lighting Indoor CFL Reflector | 6,397 | 3,627 | 245 | 10,269 |
| | Lighting Indoor LED Lamp | 93 | | | 93 |
| | Lighting Indoor LED Reflector Lamp | 616 | | | 616 |
| | Lighting Indoor Other | | 33,544 | | 33,544 |
| | Lighting Outdoor CFL Basic | 2,230 | 2,825 | 51 | 5,106 |
| | Lighting Outdoor CFL Fixture | | 12 | | 12 |
| | Lighting Outdoor CFL Reflector | 619 | 357 | | 976 |

# Data Sources

- Final Report – WO028: Impact Evaluation of 2010-2012 California IOU Residential, Advanced, and Upstream Lighting Programs

- Final Report – WO21: Residential On-site Study: California Lighting and Appliance Saturation Study (CLASS 2012)

- California Database for Energy Efficient Resources (DEER) http://www.energy.ca.gov/deer/.

# Results

## Three components to calculated savings

# Adjustments to Quantity of Measures Rebated

- The quantity adjustments determined by the 2010-2012 program evaluation were applied to the measure quantities in the 2013 IOU tracking data
- **Invoice Verification**
  - 100%
- **Residential versus Non-residential**

| Investor-Owned Utility (IOU) | Share of Upstream Lighting Program Measures | |
|---|---|---|
| | Non-residential | Residential |
| Pacific Gas & Electric Company (PG&E) | 7% | 93% |
| Southern California Edison (SCE) | 6% | 94% |
| San Diego Gas & Electric (SDG&E) | 6% | 94% |
| Overall | 7% | 93% |

- **Leakage**
  - 0%

# Gross Savings

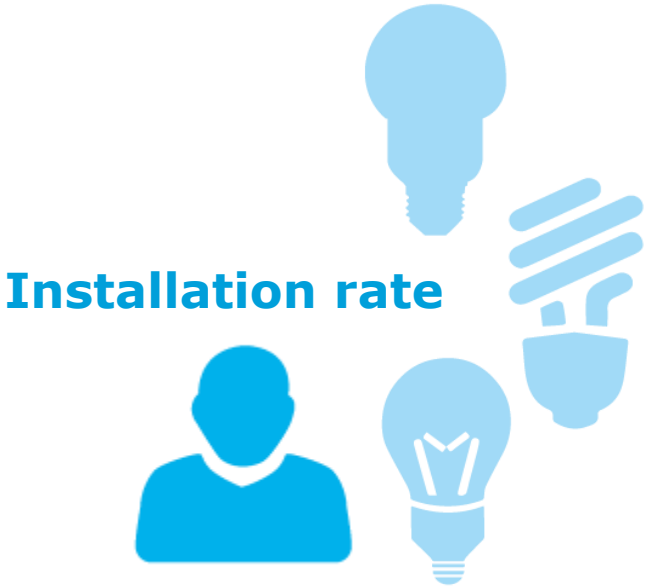
**There are six elements to the gross savings calculation:**

- Installation rate
- Average daily hours-of-use (HOU)
- Average percent of installed measures operating at peak (coincidence factor, or CF)
- Wattage displaced by IOU-discounted products (delta watts)
- HVAC interactive effects (IE)
- Unit energy savings (UES) estimates (kWh/year and peak kW)

# Gross Savings - Installation Rate

- The 2010-2012 impact evaluation applied an installation rate of 97 percent to all evaluated upstream CFLs

Installation rate is defined as the percentage of upstream lamps that will ultimately be installed by customers.



# Gross Savings – HOU and Peak Coincidence Factor

## HOU

| Measure Group | PG&E | | SCE | | SDG&E | |
|---|---|---|---|---|---|---|
| | HOU | 90% CI | HOU | 90% CI | HOU | 90% CI |
| Lighting Indoor CFL Basic | **1.6** | 0.2 | **1.9** | 0.2 | **1.4** | 0.2 |
| Lighting Indoor CFL A-Lamp | **1.5** | 0.2 | **1.9** | 0.2 | **1.3** | 0.3 |
| Lighting Indoor CFL Reflector | **1.7** | 0.3 | **1.9** | 0.2 | **1.2** | 0.4 |
| Lighting Indoor CFL Globe | **1.2** | 0.3 | **1.6** | 0.3 | **1.0** | 0.4 |

## Peak Coincidence

| Measure Group | PG&E | | SCE | | SDG&E | |
|---|---|---|---|---|---|---|
| | Peak CF | 90% CI | Peak CF | 90% CI | Peak CF | 90% CI |
| Lighting Indoor CFL Basic | **5.4%** | 1.3% | **6.7%** | 1.4% | **4.4%** | 1.8% |
| Lighting Indoor CFL A-Lamp | **4.6%** | 1.6% | **6.2%** | 1.5% | **4.4%** | 2.0% |
| Lighting Indoor CFL Reflector | **5.4%** | 2.1% | **6.5%** | 1.9% | **3.8%** | 2.5% |
| Lighting Indoor CFL Globe | **5.4%** | 2.2% | **6.9%** | 1.9% | **4.2%** | 2.4% |

# Gross Savings – Delta Watts

| Measure Group | Wattage category | PG&E | SCE | SDG&E |
|---|---|---|---|---|
| Lighting Indoor CFL Basic | Baseline Watt | 60.6 | 60.8 | 61.8 |
| | Rebated Watt | 15.4 | 14.4 | 15.8 |
| | Delta Watts | **45.2** | **46.4** | **46.0** |
| Lighting Indoor CFL A-Lamp | Baseline Watt | 60.6 | 60.8 | 61.8 |
| | Rebated Watt | 16.8 | 19.3 | 14.5 |
| | Delta Watts | **43.8** | **41.5** | **47.3** |
| Lighting Indoor CFL Reflector | Baseline Watt | 71.0 | 68.3 | 66.4 |
| | Rebated Watt | 16.6 | 19.2 | 17.5 |
| | Delta Watts | **54.4** | **49.1** | **48.9** |
| Lighting Indoor CFL Globe | Baseline Watt | n/a | 46.1 | 45.9 |
| | Rebated Watt | n/a | 18.8 | 13.1 |
| | Delta Watts | **n/a** | **27.3** | **32.8** |

# Gross Savings - HVAC Interactive Effects

- DEER includes savings factors for kWh, kW, and therms for indoor CFL measures.
- These savings factors are applied to the direct impacts as a multiplier for both kWh and kW and a decrement factor of therm/kWh for therm impacts.

| Building Type | CFL HVAC Interactive Effect Adjustment | IOU | | |
|---|---|---|---|---|
| | | PG&E | SCE | SDG&E |
| Residential | kWh | 1.02 | 1.07 | 1.03 |
| | kW | 1.33 | 1.4 | 1.23 |
| | therms | -0.025 | -0.019 | -0.018 |
| Commercial | kWh | 1.06 | 1.12 | 1.12 |
| | kW | 1.21 | 1.24 | 1.23 |
| | therms | -0.0061 | -0.0032 | -0.0028 |

# Gross Savings - Residential Unit Energy Savings

- UES (kWh/year): $IR_p$ x $HOU_p$ x $\Delta W_p/1000$ x $IE_p$, where:
  - $IR_p$ = installation rate for IOU-discounted product *p*
  - $HOU_p$ = annual average hours of use for IOU-discounted product *p*
  - $\Delta W_p$ = average displaced wattage for IOU-discounted product *p*
  - $IE_p$ = DEER HVAC Interactive Effects for IOU-discounted product *p*
- UES (peak kW): $IR_p$ x $CF_p$ x $\Delta W_p/1000$ x $IE_p$, where:
  - $IR_p$ = installation rate for IOU-discounted product *p*
  - $CF_p$ = average percent on at peak for IOU-discounted product *p*
  - $\Delta W_p$ = average displaced wattage for IOU-discounted product *p*
  - $IE_p$ = DEER HVAC Interactive Effects for IOU-discounted product *p*

# Gross Savings - Non-Residential Unit Energy Savings

- Between 6% and 7% of upstream CFLs were in non-residential applications.
- DEER-approved weighted commercial UES value was applied to the average wattage of rebated measures.

| Non-Residential UES Values | PG&E | SCE | SDG&E |
|---|---|---|---|
| kWh per Watt | 8.17 | 8.71 | 8.71 |
| kW per Watt | 0.002 | 0.002 | 0.002 |

# Gross Savings Results

- Overall, for the 2013 evaluated ESPI measures, the ex-post savings results were greater than the ex-ante values, resulting in a realization rate of greater than 100%
- The differences between the ex post results and the ex ante results are primarily due to the following factors:
  - Installation Rate
  - Hours-of-Use
  - Peak Coincidence factor
  - Residential vs Non-Residential split

# Gross Savings Results – kWh – All IOUs

| All IOUs | Ex-ante Gross Annual Energy Impacts (kWh/year) | Ex-post Gross Annual Energy Impacts (kWh/year) | Gross Realization Rate (kWh/year) |
|---|---|---|---|
| Lighting Indoor CFL Basic | 66,476,420 | 108,640,679 | 163% |
| Lighting Indoor CFL A-Lamp | 38,063,816 | 52,793,076 | 139% |
| Lighting Indoor CFL Reflector | 52,960,319 | 71,861,315 | 136% |
| Lighting Indoor CFL Globe | 4,250,029 | 3,465,148 | 82% |
| Pass-through Measure Groups | 141,337,814 | 141,337,814 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **303,088,399** | **378,098,031** | **125%** |

# Gross Savings Results - kWh

| PGE | Ex-ante Gross Annual Energy Impacts (kWh/year) | Ex-post Gross Annual Energy Impacts (kWh/year) | Gross Realization Rate (kWh/year) |
|---|---|---|---|
| Lighting Indoor CFL Basic | 20,711,778 | 36,809,632 | 178% |
| Lighting Indoor CFL A-Lamp | 7,774,633 | 12,126,647 | 156% |
| Lighting Indoor CFL Reflector | 10,671,851 | 18,216,162 | 171% |
| Lighting Indoor CFL Globe | n/a | n/a | n/a |
| Pass-through Measure Groups | 15,422,379 | 15,422,379 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **54,580,641** | **82,574,819** | **151%** |
| **SCE** | **Ex-ante Gross Annual Energy Impacts (kWh/year)** | **Ex-post Gross Annual Energy Impacts (kWh/year)** | **Gross Realization Rate (kWh/year)** |
| Lighting Indoor CFL Basic | 20,667,003 | 28,464,390 | 138% |
| Lighting Indoor CFL A-Lamp | 23,493,994 | 28,975,628 | 123% |
| Lighting Indoor CFL Reflector | 35,375,343 | 43,315,756 | 122% |
| Lighting Indoor CFL Globe | 3,844,178 | 2,835,541 | 74% |
| Pass-through Measure Groups | 125,555,836 | 125,555,836 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **208,936,354** | **229,147,151** | **110%** |
| **SDGE** | **Ex-ante Gross Annual Energy Impacts (kWh/year)** | **Ex-post Gross Annual Energy Impacts (kWh/year)** | **Gross Realization Rate (kWh/year)** |
| Lighting Indoor CFL Basic | 25,097,639 | 43,366,657 | 173% |
| Lighting Indoor CFL A-Lamp | 6,795,190 | 11,690,801 | 172% |
| Lighting Indoor CFL Reflector | 6,913,125 | 10,329,397 | 149% |
| Lighting Indoor CFL Globe | 405,851 | 629,606 | 155% |
| Pass-through Measure Groups | 359,599 | 359,599 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **39,571,404** | **66,376,061** | **168%** |

# Gross Savings Results – kW – All IOUs

| All IOUs | Ex-ante Gross Peak Demand Impacts (kW) | Ex-post Gross Peak Demand Impacts (kW) | Gross Realization Rate (kW) |
|---|---|---|---|
| Lighting Indoor CFL Basic | 9,139 | 16,251 | 178% |
| Lighting Indoor CFL A-Lamp | 5,309 | 7,789 | 147% |
| Lighting Indoor CFL Reflector | 7,041 | 10,553 | 150% |
| Lighting Indoor CFL Globe | 629 | 637 | 101% |
| Pass-through Measure Groups | 19,637 | 19,637 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **41,755** | **54,866** | **131%** |

# Gross Savings Results - kW

| PGE | Ex-ante Gross Peak Demand Impacts (kW) | Ex-post Gross Peak Demand Impacts (kW) | Gross Realization Rate (kW) |
|---|---|---|---|
| Lighting Indoor CFL Basic | 2,790 | 5,529 | 198% |
| Lighting Indoor CFL A-Lamp | 1,047 | 1,779 | 170% |
| Lighting Indoor CFL Reflector | 1,392 | 2,573 | 185% |
| Lighting Indoor CFL Globe | n/a | n/a | n/a |
| Pass-through Measure Groups | 1,993 | 1,993 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **7,223** | **11,873** | **164%** |
| **SCE** | **Ex-ante Gross Peak Demand Impacts (kW** | **Ex-post Gross Peak Demand Impacts (kW)** | **Gross Realization Rate (kW)** |
| Lighting Indoor CFL Basic | 3,226 | 4,638 | 144% |
| Lighting Indoor CFL A-Lamp | 3,386 | 4,315 | 127% |
| Lighting Indoor CFL Reflector | 4,962 | 6,469 | 130% |
| Lighting Indoor CFL Globe | 587 | 526 | 90% |
| Pass-through Measure Groups | 17,607 | 17,607 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **29,767** | **33,555** | **113%** |
| **SDGE** | **Ex-ante Gross Peak Demand Impacts (kW** | **Ex-post Gross Peak Demand Impacts (kW)** | **Gross Realization Rate (kW)** |
| Lighting Indoor CFL Basic | 3,123 | 6,085 | 195% |
| Lighting Indoor CFL A-Lamp | 876 | 1,695 | 194% |
| Lighting Indoor CFL Reflector | 687 | 1,511 | 220% |
| Lighting Indoor CFL Globe | 42 | 110 | 261% |
| Pass-through Measure Groups | 38 | 38 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **4,765** | **9,438** | **198%** |

# Gross Savings Results – therms – All IOUs

| All IOUs | Ex-ante Gross Annual therm Impacts | Ex-post Gross Annual therm Impacts | Gross Realization Rate (therms/year) |
|---|---|---|---|
| Lighting Indoor CFL Basic | -1,072,332 | -1,702,912 | 159% |
| Lighting Indoor CFL A-Lamp | -560,298 | -775,436 | 138% |
| Lighting Indoor CFL Reflector | -843,242 | -1,103,960 | 131% |
| Lighting Indoor CFL Globe | -63,895 | -40,412 | 63% |
| Pass-through Measure Groups | -1,957,744 | -1,957,744 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **-4,497,511** | **-5,580,463** | **124%** |

# Gross Savings Results - therms

| PGE | Ex-ante Gross Annual therm Impacts | Ex-post Gross Annual therm Impacts | Gross Realization Rate (therms/year) |
|---|---|---|---|
| Lighting Indoor CFL Basic | -392,265 | -714,792 | 182% |
| Lighting Indoor CFL A-Lamp | -147,239 | -226,916 | 154% |
| Lighting Indoor CFL Reflector | -211,034 | -364,817 | 173% |
| Lighting Indoor CFL Globe | n/a | n/a | n/a |
| Pass-through Measure Groups | -284,666 | -284,666 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **-1,035,204** | **-1,591,190** | **154%** |
| **SCE** | **Ex-ante Gross Annual therm Impacts** | **Ex-post Gross Annual therm Impacts** | **Gross Realization Rate (therms/year)** |
| Lighting Indoor CFL Basic | -318,194 | -417,846 | 131% |
| Lighting Indoor CFL A-Lamp | -317,042 | -393,372 | 124% |
| Lighting Indoor CFL Reflector | -509,202 | -609,759 | 120% |
| Lighting Indoor CFL Globe | -56,676 | -33,162 | 59% |
| Pass-through Measure Groups | -1,667,454 | -1,667,454 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **-2,868,567** | **-3,121,594** | **109%** |
| **SDGE** | **Ex-ante Gross Annual therm Impacts** | **Ex-post Gross Annual therm Impacts** | **Gross Realization Rate (therms/year)** |
| Lighting Indoor CFL Basic | -361,874 | -570,274 | 158% |
| Lighting Indoor CFL A-Lamp | -96,017 | -155,148 | 162% |
| Lighting Indoor CFL Reflector | -123,006 | -129,384 | 105% |
| Lighting Indoor CFL Globe | -7,219 | -7,250 | 100% |
| Pass-through Measure Groups | -5,623 | -5,623 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **-593,740** | **-867,679** | **146%** |

# Net-to-Gross (NTG) Ratios

- Net savings determined by applying NTG ratios:
  - The portion of IOU-discounted lighting products that would not have been sold, purchased, or installed had it not been for the upstream lighting program
  - The NTG ratios applied to the four 2013 evaluated ESPI measures are the evaluated results from the 2010-2012 impact report:

| Measure Group | PG&E | SCE | SDG&E |
|---|---|---|---|
| Lighting Indoor CFL Basic | 60% | 66% | 57% |
| Lighting Indoor CFL A-Lamp | 72% | 82% | 81% |
| Lighting Indoor CFL Reflector | 55% | 62% | 53% |
| Lighting Indoor CFL Globe | n/a | 75% | 71% |

# Net Savings Results - Kwh – All IOUs

| All IOUs | Ex-ante Net Annual Energy Impacts (kWh/year) | Ex-Post Net Annual Energy Impacts (kWh/year) | Net Realization Rate (kWh/year) |
|---|---|---|---|
| Lighting Indoor CFL Basic | 36,916,524 | 65,591,271 | 178% |
| Lighting Indoor CFL A-Lamp | 21,435,770 | 41,960,750 | 196% |
| Lighting Indoor CFL Reflector | 30,398,020 | 42,349,238 | 139% |
| Lighting Indoor CFL Globe | 3,047,496 | 2,573,677 | 84% |
| Pass-through Measure Groups | 79,157,066 | 79,157,066 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **170,954,877** | **231,632,001** | **135%** |

# Net Savings Results - Kwh

| PGE | Ex-ante Net Annual Energy Impacts (kWh/year) | Ex-Post Net Annual Energy Impacts (kWh/year) | Net Realization Rate (kWh/year) |
|---|---|---|---|
| Lighting Indoor CFL Basic | 11,184,360 | 22,085,779 | 197% |
| Lighting Indoor CFL A-Lamp | 4,198,302 | 8,731,186 | 208% |
| Lighting Indoor CFL Reflector | 5,762,800 | 10,018,889 | 174% |
| Lighting Indoor CFL Globe | n/a | n/a | n/a |
| Pass-through Measure Groups | 10,815,079 | 10,815,079 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **31,960,541** | **51,650,933** | **162%** |
| **SCE** | **Ex-ante Net Annual Energy Impacts (kWh/year)** | **Ex-Post Net Annual Energy Impacts (kWh/year)** | **Net Realization Rate (kWh/year)** |
| Lighting Indoor CFL Basic | 12,179,439 | 18,786,497 | 154% |
| Lighting Indoor CFL A-Lamp | 13,568,066 | 23,760,015 | 175% |
| Lighting Indoor CFL Reflector | 20,902,133 | 26,855,768 | 128% |
| Lighting Indoor CFL Globe | 2,828,337 | 2,126,656 | 75% |
| Pass-through Measure Groups | 68,100,550 | 68,100,550 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **117,578,525** | **139,629,487** | **119%** |
| **SDGE** | **Ex-ante Net Annual Energy Impacts (kWh/year)** | **Ex-Post Net Annual Energy Impacts (kWh/year)** | **Net Realization Rate (kWh/year)** |
| Lighting Indoor CFL Basic | 13,552,725 | 24,718,995 | 182% |
| Lighting Indoor CFL A-Lamp | 3,669,403 | 9,469,549 | 258% |
| Lighting Indoor CFL Reflector | 3,733,087 | 5,474,581 | 147% |
| Lighting Indoor CFL Globe | 219,160 | 447,021 | 204% |
| Pass-through Measure Groups | 241,436 | 241,436 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **21,415,811** | **40,351,581** | **188%** |

# Net Savings Results - kW

| All IOUs | Ex-ante Net Peak Demand Impacts (kW) | Ex-post Net Peak Demand Impacts (kW) | Net Realization Rate (kW) |
|---|---|---|---|
| Lighting Indoor CFL Basic | 5,097 | 9,847 | 193% |
| Lighting Indoor CFL A-Lamp | 3,006 | 6,192 | 206% |
| Lighting Indoor CFL Reflector | 4,087 | 6,227 | 152% |
| Lighting Indoor CFL Globe | 459 | 473 | 103% |
| Pass-through Measure Groups | 10,950 | 10,950 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **23,599** | **33,689** | **143%** |

# Net Savings Results - kW

| PGE | Ex-ante Net Peak Demand Impacts (kW) | Ex-post Net Peak Demand Impacts (kW) | Net Realization Rate (kW) |
|---|---|---|---|
| Lighting Indoor CFL Basic | 1,507 | 3,317 | 220% |
| Lighting Indoor CFL A-Lamp | 566 | 1,281 | 226% |
| Lighting Indoor CFL Reflector | 752 | 1,415 | 188% |
| Lighting Indoor CFL Globe | n/a | n/a | n/a |
| Pass-through Measure Groups | 1,392 | 1,392 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **4,217** | **7,405** | **176%** |
| **SCE** | **Ex-ante Net Peak Demand Impacts (kW)** | **Ex-post Net Peak Demand Impacts (kW)** | **Net Realization Rate (kW)** |
| Lighting Indoor CFL Basic | 1,904 | 3,061 | 161% |
| Lighting Indoor CFL A-Lamp | 1,967 | 3,538 | 180% |
| Lighting Indoor CFL Reflector | 2,964 | 4,011 | 135% |
| Lighting Indoor CFL Globe | 436 | 395 | 91% |
| Pass-through Measure Groups | 9,533 | 9,533 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **16,804** | **20,538** | **122%** |
| **SDGE** | **Ex-ante Net Peak Demand Impacts (kW)** | **Ex-post Net Peak Demand Impacts (kW)** | **Net Realization Rate (kW)** |
| Lighting Indoor CFL Basic | 1,686 | 3,468 | 206% |
| Lighting Indoor CFL A-Lamp | 473 | 1,373 | 290% |
| Lighting Indoor CFL Reflector | 371 | 801 | 216% |
| Lighting Indoor CFL Globe | 23 | 78 | 343% |
| Pass-through Measure Groups | 25 | 25 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **2,578** | **5,745** | **223%** |

# Net Savings Results – therms – All IOUs

| All IOUs | Ex-ante Net Annual therm Savings | Ex-post Net Annual therm Savings | Net Realization Rate (therms/year) |
|---|---|---|---|
| Lighting Indoor CFL Basic | -595,177 | -1,029,710 | 173% |
| Lighting Indoor CFL A-Lamp | -316,415 | -611,614 | 193% |
| Lighting Indoor CFL Reflector | -483,815 | -647,274 | 134% |
| Lighting Indoor CFL Globe | -46,277 | -30,019 | 65% |
| Pass-through Measure Groups | -1,109,442 | -1,109,442 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **-2,551,126** | **-3,428,058** | **134%** |

# Net Savings Results - therms

| PGE | Ex-ante Net Annual therm Savings | Ex-post Net Annual therm Savings | Net Realization Rate (therms/year) |
|---|---|---|---|
| Lighting Indoor CFL Basic | -211,823 | -428,875 | 202% |
| Lighting Indoor CFL A-Lamp | -79,509 | -163,380 | 205% |
| Lighting Indoor CFL Reflector | -113,958 | -200,649 | 176% |
| Lighting Indoor CFL Globe | n/a | n/a | n/a |
| Pass-through Measure Groups | -202,190 | -202,190 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **-607,481** | **-995,094** | **164%** |
| **SCE** | **Ex-ante Net Annual therm Savings** | **Ex-post Net Annual therm Savings** | **Net Realization Rate (therms/year)** |
| Lighting Indoor CFL Basic | -187,942 | -275,779 | 147% |
| Lighting Indoor CFL A-Lamp | -185,057 | -322,565 | 174% |
| Lighting Indoor CFL Reflector | -303,433 | -378,051 | 125% |
| Lighting Indoor CFL Globe | -42,379 | -24,871 | 59% |
| Pass-through Measure Groups | -903,576 | -903,576 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **-1,622,387** | **-1,904,841** | **117%** |
| **SDGE** | **Ex-ante Net Annual therm Savings** | **Ex-post Net Annual therm Savings** | **Net Realization Rate (therms/year)** |
| Lighting Indoor CFL Basic | -195,412 | -325,056 | 166% |
| Lighting Indoor CFL A-Lamp | -51,849 | -125,670 | 242% |
| Lighting Indoor CFL Reflector | -66,423 | -68,574 | 103% |
| Lighting Indoor CFL Globe | -3,898 | -5,147 | 132% |
| Pass-through Measure Groups | -3,676 | -3,676 | 100% |
| **All Residential and Upstream Lighting ESPI Measures** | **-321,259** | **-528,123** | **164%** |

# Thank you. Questions?

**Tyler Mahone, Consultant**
**Policy Advisory and Research, Sustainable Energy Use**
**DNV GL - Energy**
Tyler.Mahone@dnvgl.com
+1 510 298 2710

**www.dnvgl.com**

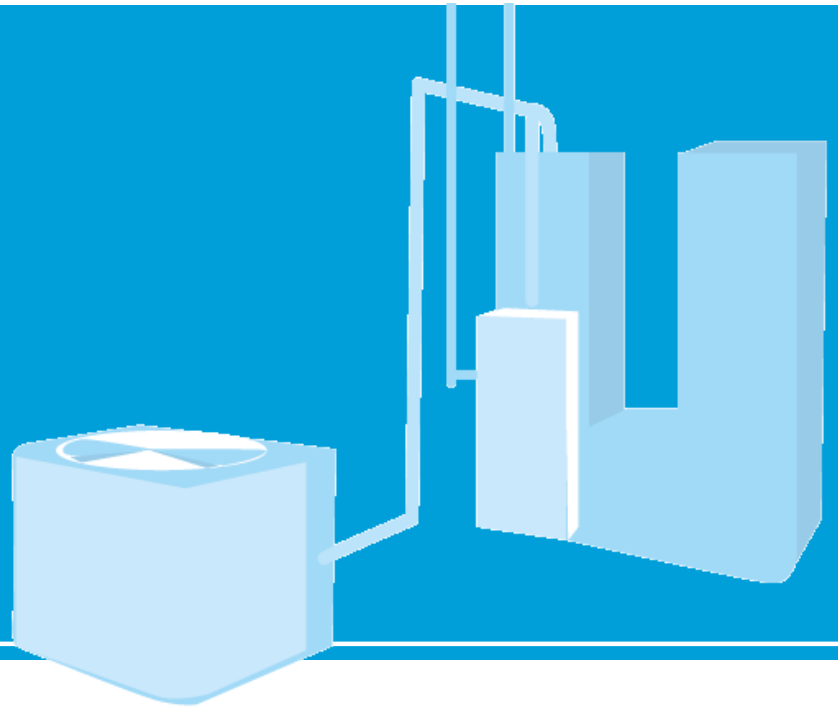
**SAFER, SMARTER, GREENER**

# HVAC

ENERGY

# Quality Maintenance (QM)

## 2013 ESPI Measure



## Description of ESPI Measure

**QM**

A specific statewide program that provides tune-ups on HVAC systems according to ANSI/ASHRAE/ACCA Standard 180.

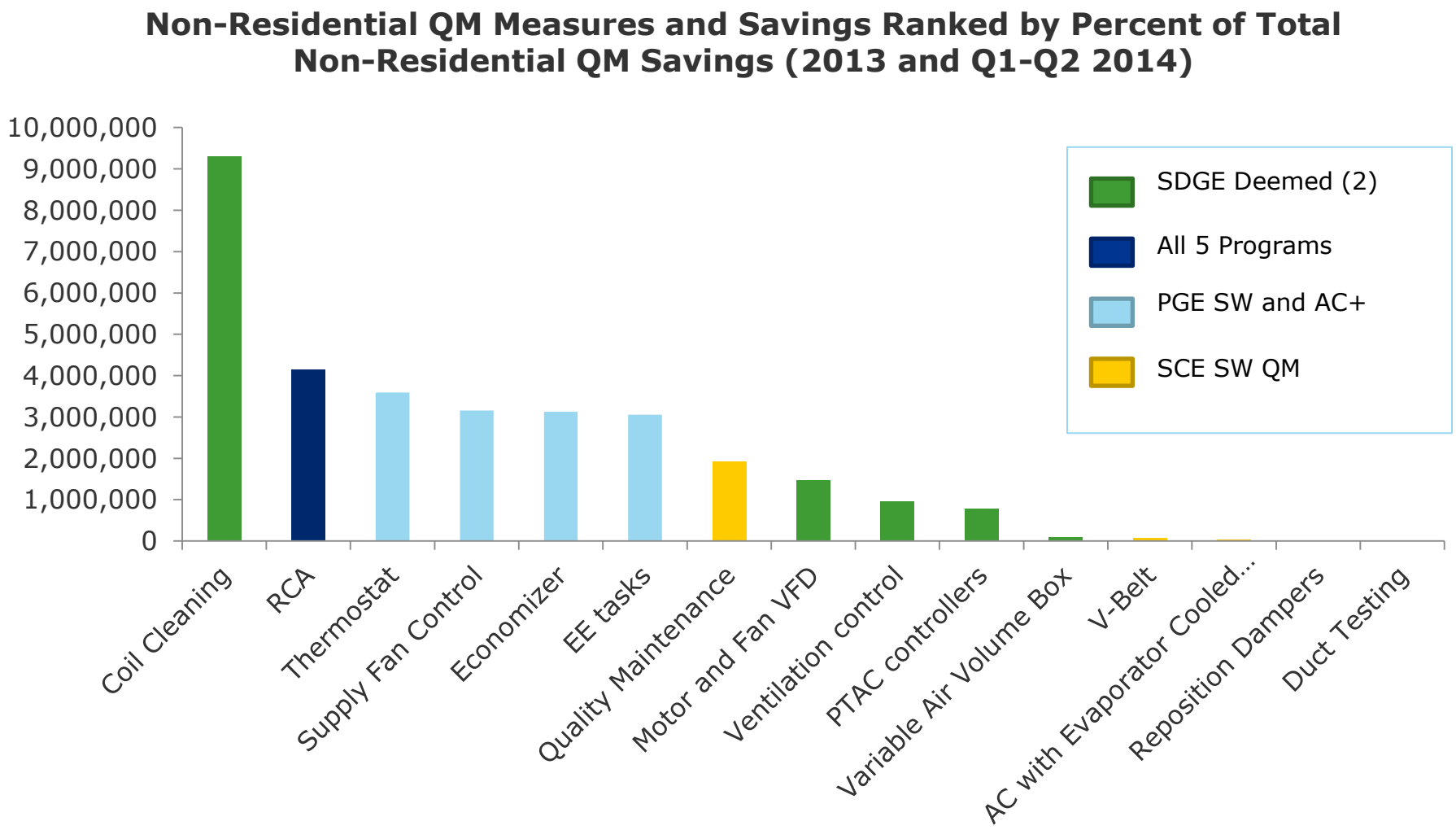
**QM-related measures**

Any other measure intended to improve the efficiency of HVAC systems offered through various programs

**Parameters updated**

- Installation rate of economizer and refrigerant charge adjustment measures.
- kWh, kW, and therms where workpaper savings could be matched to tracking data

# Tracking Data Measure Breakdown for 5 Commercial QM Programs



# QM Focused Programs in 2013

| Program ID | Program Name | Measure Count | Workpaper |
|---|---|---|---|
| PGE21006 | RESIDENTIAL HVAC | 4,701 | PGECOHVC139 |
| PGE21008 | ENHANCE TIME DELAY RELAY | 5,147 | PGECOHVC150 |
| PGE21009 | DIRECT INSTALL FOR MANUFACTURED AND MOBILE HOMES | 6,926 | PGECOHVC139 |
| PGE21015 | COMMERCIAL HVAC | 21,436 | PGECOHVC138, PGECOHVC144, PGE3PHVC151, PGE3PHVC152, PGE3PHVC153, PGE3PHVC156, PGE3PHVC157, PGE3PHVC158, PGE3PHVC160 |
| PGE21016 | AIR CARE PLUS | 12,364 | |
| SCE-13-TP-001 | COMPREHENSIVE MANUFACTURED HOMES | 10,495 | SCE13HC028, SCE13HC029 SCE13HC040 |
| SCE-13-SW-001E | RESIDENTIAL HVAC PROGRAM | 3,780 | |
| SCE-13-SW-002F | NONRESIDENTIAL HVAC PROGRAM | 44,542 | SCE13HC037, SCE13HC040 SCE13HC049 |
| SCE-13-SW-010B | WE&T CONNECTIONS | 703 | SCE13HC011 |
| SDGE3212 | SW-CALS - RESIDENTIAL HVAC-QI/QM | 1,135 | WPSDGEREHC1065 |
| SDGE3223 | SW-COM-DEEMED INCENTIVES-COMMERCIAL REBATES | 6 | WPSDGENRHC1010, WPSDGENRHC1020, WPSDGENRHC1030, WPSDGENRHC1040, WPSDGEREHC1065 |
| SDGE3224 | SW-COM-DEEMED INCENTIVES-HVAC COMMERCIAL | 29,892 | |
| SDGE3226 | SW-COM DIRECT INSTALL | 8,360 | |
| SDGE3279 | 3P-RES-COMPREHENSIVE MANUFACTURED-MOBILE HOME | 5,484 | WPSDGEREHC1065 |

# Additional Programs with Some QM Measures

| Program ID | Program Name | Measure Count |
|---|---|---|
| PGE210111 | LODGINGSAVERS | 53 |
| PGE210118 | FURNITURE STORE ENERGY EFFICIENCY | 38 |
| PGE21012 | COMMERCIAL DEEMED INCENTIVES | 10 |
| PGE210122 | CASINO GREEN | 1 |
| PGE210125 | CALIFORNIA PRESCHOOL ENERGY EFFICIENCY PROGRAM | 59 |
| PGE210126 | K-12 PRIVATE SCHOOLS AND COLLEGES AUDIT RETRO | 15 |
| PGE2110051 | LOCAL GOVERNMENT ENERGY ACTION RESOURCES (LGEAR) | 1 |
| PGE211007 | ASSOCIATION OF MONTEREY BAY AREA GOVERNMENTS (AMBAG) | 7 |
| PGE211011 | KERN | 33 |
| PGE211018 | SAN LUIS OBISPO COUNTY | 3 |
| SCE-13-L-003G | UC/CSU ENERGY EFFICIENCY PARTNERSHIP | 1 |
| SCE-13-SW-002C | COMMERCIAL DEEMED INCENTIVES PROGRAM | 1 |
| SCE-13-SW-002D | COMMERCIAL DIRECT INSTALL PROGRAM | 1 |
| SCE-13-TP-013 | COOL SCHOOLS | 7 |
| SDGE3211 | LOCAL-CALS - MIDDLE INCOME DIRECT INSTALL (MIDI) | 138 |
| SDGE3220 | SW-COM-CALCULATED INCENTIVES-CALCULATED | 2 |
| SDGE3233 | SW-IND-DEEMED INCENTIVES | 3 |
| Grand Total | | 373 |

# Sources – Ex Ante Savings from Workpapers

| Measure Category | Service Incentive | Related Workpapers |
|---|---|---|
| RCA and Coil Cleaning | Evaporator Coil Cleaning | WPSDGENRHC1010 |
| | Condenser Coil Cleaning | WPSDGENRHC1020 |
| | Refrigerant System Service | WPSDGENRHC1040 |
| | Refrigerant Adjustment and Coil Cleaning | WPSDGEREHC1065 |
| | Refrigerant Adjustment and Coil Cleaning | SCE13HC029 |
| | Condenser Coil Cleaning | SCE13HC037 |
| | Evaporator Coil Cleaning | PGE3PHVC158 |
| | Condenser Coil Cleaning | PGE3PHVC156 |
| | Refrigerant Charge and Airflow Service | PGE3PHVC160 |
| | Nonresidential HVAC RTU Quality Maintenance | PGECOHVC138 |
| | Residential HVAC Quality Maintenance | PGECOHVC139 |
| Economizer Repair and Control Revision | Economizer Functional Test | SCE13HC037 |
| | Economizer Functional Test | PGE3HVC151 |
| | Integrate Economizer Wiring | SCE13HC037 |
| | Integrate Economizer Wiring | PGE3HVC151 |
| | Replace Damper Motor | SCE13HC037 |
| | Replace Damper Motor | PGE3HVC151 |
| | Replace Controller/Sensor | SCE13HC037 |
| | Replace Controller/Sensor | PGE3HVC152 |
| | Renovate Linkage and Other Components | PGE3HVC151 |
| | Economizer Control Package | PGE3HVC151 |
| | Economizer Adjustment | PGE3HVC151 |
| Thermostat Replacement and Reprogramming | Replace Thermostat | PGE3PHVC153 |
| | Unoccupied Fan Control | PGE3PHVC157 |
| | Replace Thermostat | SCE13HC049 |
| | Adjust Thermostat Schedule | |
| Filter Replacement | Air Filter Replacement | WPSDGENRHC1030 |
| Cogged V-Belt Replacement | HVAC Fans Cogged V-belt Replacement | PGECOHVC144 |
| Motor Retrofit | Residential Evaporator Motor Retrofit | SCE13HC029 |
| | Brushless Fan Motor for Residential Central AC | SCE13HC028 |
| | Residential Motor Retrofit | WPSDGEREHC1065 |

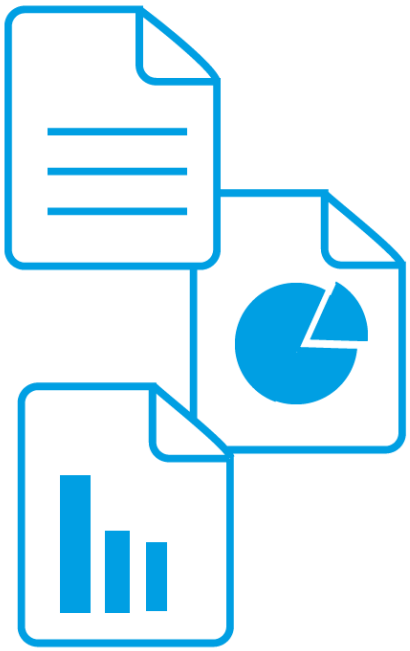
# Sources – Savings Installation Rate

**Data from the 2010-12 impact evaluation and 2013-14 measurement and verification pilot sites were applied**

Refrigerant charge adjustment data was applied only to two local programs

Economizer data was applied across all programs with economizer repair measures

# Field Data Collection (Refrigerant Charge Adjustment)



- Pilot included random sample of 7 packaged rooftop air conditioners from project year 2013.
- Refrigerant charge removed, weighed, and added according to manufacturer's recommendations for the HVAC unit.
- Program records showed how much charge was added or removed by the program.
- The team calculated program-assumed energy efficiency ratings (using the efficiency curve in the 2009 PG&E workpaper) based on claimed initial charge, actual initial charge, and final charge state.

# Field Data Collection (Economizer)

- The team observed 33 economizers in AirCare Plus and 8 economizers in SDG&E Local Programs
- Overall, only 5% of economizer measures in the PG&E AirCare Plus program sample and none in the SDG&E local program sample passed the post-diagnostic assessment.
- Considering the effective useful life of the measures and the timing of inspections, we assumed that an average of 20% of the measures would have failed at the time of the inspection.
- Therefore, the installation rate was estimated to be 25% for PG&E AirCare Plus and 20% for SDG&E's local program.

# Results

| Attempt to Merge with Disposition | Successfully Merged with Disposition | IR Updated | Updated with Disposition values (When values from Tracking Data did not match disposition) | |
|---|---|---|---|---|
| | | | No | Yes |
| **No** | No | No | Pass through (105,484) | |
| | | Yes | Updated (39) | |
| **Yes** | No | No | Pass through (3,566) | |
| | | Yes | Updated (3,221) | |
| | Yes | No | Pass through (1,203) | Updated (29,967) |
| | | Yes | Updated (3,118) | Updated (8,707) |
| **Total (155,305)** | | | 116,631 | 38,674 |

# Results – Reasons for Inability to Match tracking to Disposition

**Primary reasons why tracking data failed to merge with disposition sheets:**

- Building type was not specified in tracking data, but was required on disposition sheet
- Building type listed in tracking data was not available on disposition sheet (i.e., GRO, NRS)
- Climate Zone listed in tracking data was not available on disposition sheet (i.e., system)
- HVAC type was not available in tracking data, but required on disposition sheet (i.e., any)

# kWh Results by Measure Group

| Measure Group | Ex-Ante Gross Savings kWh (sum) | Ex-Post Gross Savings kWh (sum) | No of UES Updates | No. of Claims | % of claims updated | Ex Post kWh/Ex Ante kWh |
|---|---|---|---|---|---|---|
| HVAC OTHER | 61,561 | 0 | 0 | 1,224 | 0% | 0% |
| HVAC DUCT SEALING | 287,126 | 0 | 0 | 3,217 | 0% | 0% |
| HVAC AIR FILTER REPLACEMENT | 555,634 | 0 | 0 | 2,035 | 0% | 0% |
| HVAC DCV | 735,704 | 0 | 0 | 9 | 0% | 0% |
| HVAC CONTROLS TIME DELAY RELAY | 2,620,195 | 0 | 4,922 | 8,474 | 58% | 0% |
| HVAC CONTROLS FAN | 2,901,770 | 3,920,029 | 1,060 | 1,376 | 77% | 135% |
| HVAC CONTROLS THERMOSTAT | 2,970,591 | 0 | 0 | 9,875 | 0% | 0% |
| HVAC CONTROLS PTAC | 4,883,502 | 0 | 39 | 1,563 | 2% | 0% |
| HVAC ECONOMIZER REPAIR | 5,614,767 | 0 | 5,364 | 17,129 | 31% | 0% |
| HVAC MOTOR REPLACEMENT | 6,253,090 | 30,301 | 5,360 | 10,273 | 52% | 0% |
| HVAC COIL CLEANING | 6,384,419 | 508,001 | 15,494 | 30,774 | 50% | 8% |
| HVAC RCA | 6,611,613 | 1,713,105 | 2,300 | 66,046 | 3% | 26% |

# Results – Install Rate

| Parameters | Ex Ante | Ex Post |
|---|---|---|
| RCA Install Rate | 89% | 77% |
| Economizer Install Rate | 97% | 23% |

# Thank you. Questions?

**Name** **Jennifer McWilliams**
Email Jennifer.McWilliams@dnvgl.com
Phone +1 510 891 0446

**www.dnvgl.com**

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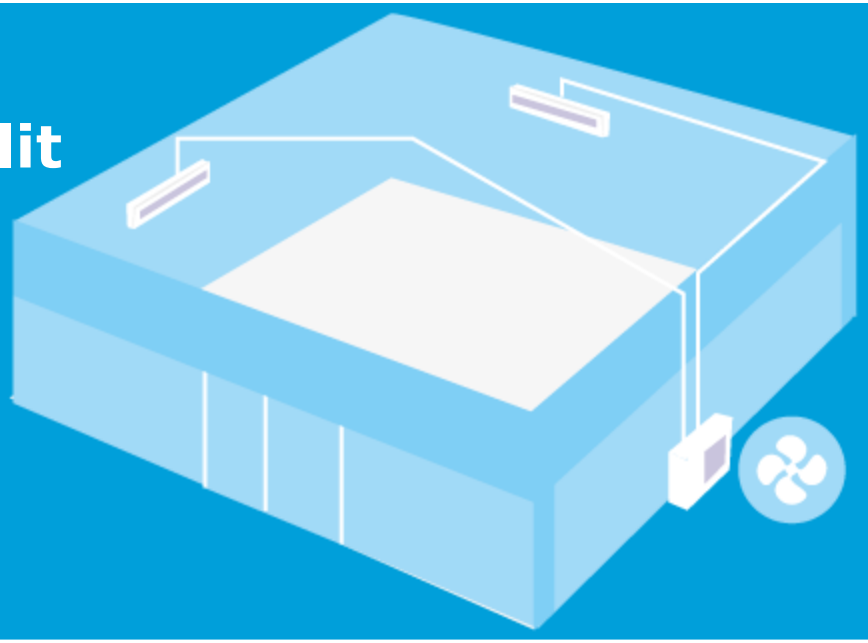
# Ductless Mini & Multi-Split Heat Pumps <65 kBtuh

## 2013 ESPI Measure



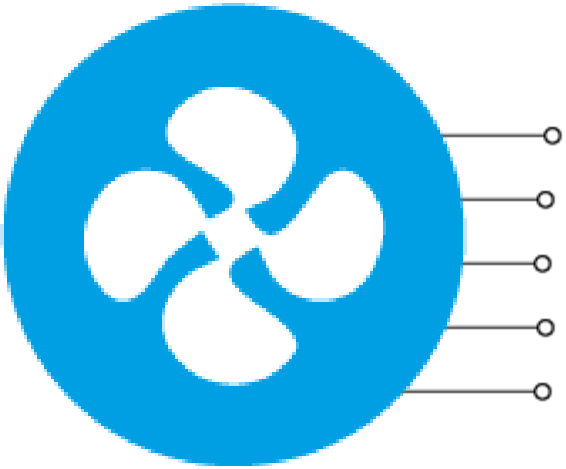
# Description of Mini-split and Multi-split Measures

- These measures are the replacement-on-burnout (ROB) of conventional split-system air conditioning units <65 kBtuh in commercial applications with equivalently sized, mini-split, ductless heat pump (HP) systems with a seasonal energy efficiency ratio (SEER) of 16, 19, and 22, and multi-split SEER of 16 and 19.

| Investor-Owned Utility (IOU) | Workpaper Title | Measure Description |
|---|---|---|
| **Southern California Edison (SCE)** | Ductless Mini-Split and Multi-Split Heat Pump units under 65 kBtuh. May 30, 2012. | Single- and multi-zone configurations <65 kBtuh |
| **SCE** | Variable Refrigerant Flow Commercial Heat Pumps & Heat Recovery Systems >65 kBtuh. May 25, 2012. | Single and multi-zone configurations, with and without heat recovery, >65 kBtuh |
| **Pacific Gas & Electric Company (PG&E)** | Variable Refrigerant Flow Nonresidential Systems. August 28, 2012. | All variable refrigerant-flow system sizes with single- or multi-zone configurations |

# Description of Mini-split Measure

- Mini-split and multi-split measures:



| Measure ID | Measure name |
|---|---|
| **AC-39892** | Ductless mini-split SEER 16 HP units <65 kBtuh |
| **AC-70999** | Ductless mini-split SEER 19 HP units <65 kBtuh |
| **AC-95843** | Ductless mini-split SEER 22 HP units <65 kBtuh |
| **AC-67222** | Ductless multi-split SEER 16 HP units <65 kBtuh |
| **AC-80111** | Ductless multi-split SEER 19 HP units <65 kBtuh |

- There are a total of five measures included in the SCE workpaper.
- The baseline is a 13 SEER commercial split system <65 kBtuh.
- Only cooling savings are accounted for.
- These are nonresidential applications only
- Variable refrigerant-flow, nonresidential system measures are not included

## Parameters Updated & Sources

- Mini-split updated parameters:
  - Unit energy savings: EvalUESkW, EvalUESkWh, EvalUESTherms
  - First year savings: 1stYrGrossKW, 1stYrGrosskWh, 1stYrGrossTherms
  - Life cycle savings: LifeCycleNetKW, LifeCycleNetkWh, LifeCycleNetTherms
- Data Sources:
  - Program tracking data: 2013 SCE Quarters 2, 3 and 4
  - Workpaper: Ductless Mini-Split and Multi-Split Heat Pump units under 65 kBtuh
  - California Database for Energy Efficient Resources (DEER)

# Approach Comparison

- SCE program tracking data in 2013 Q2, Q3, and Q4

| Measure ID | Measure name | Counts | Tonnage |
|---|---|---|---|
| **AC-39892** | Ductless mini-split SEER 16 HP units <65 kBtuh | 28 | 51.4 |
| **AC-70999** | Ductless mini-split SEER 19 HP units <65 kBtuh | 76 | 151.5 |
| **AC-95843** | Ductless mini-split SEER 22 HP units <65 kBtuh | 6 | 17.3 |
| **AC-67222** | Ductless multi-split SEER 16 HP units <65 kBtuh | 7 | 25.4 |
| **AC-80111** | Ductless multi-split SEER 19 HP units <65 kBtuh | 0 | 0.0 |
| | Total | 117 | 245.6 |

- Comparison between tracking data and savings based on the workpaper (WP)

| | kW | | | kWh | | | therms | | |
|---|---|---|---|---|---|---|---|---|---|
| | Tracking | WP | Ratio | Tracking | WP | Ratio | Tracking | WP | Ratio |
| **AC-39892** | 2.6 | 2.5 | 0.96 | 17,053 | 16,060 | 0.94 | -46 | 0 | N/A |
| **AC-70999** | 21.3 | 22.1 | 1.04 | 132,339 | 127,080 | 0.96 | -401 | 0 | N/A |
| **AC-95843** | 5.1 | 4.1 | 0.81 | 42,654 | 29,201 | 0.68 | 22 | 0 | N/A |
| **AC-67222** | 1.2 | 1.2 | 0.96 | 7,381 | 6,951 | 0.94 | -17 | 0 | N/A |
| **Total** | 30.2 | 29.9 | 0.99 | 199,427 | 179,292 | 0.90 | -441.2 | 0.0 | N/A |

# Approach Comparison

- Comparison of DEER databases used by SCE workpaper and ESPI memo

| | Workpaper | ESPI Memo |
|---|---|---|
| **DEER Version** | DEER 2011 Version D11 v4.00 | DEER 2011 Version D11 v4.00 |
| **Last Modification Date** | June 15, 2009 | February 13, 2012 |
| **SEER for Residential** | 13, 14, 16, 19, and 21 | 13, 14, 15, 16, 17, 18, 19, 20, and 21 |
| **SEER for Non-residential** | 13 and 14 | 13 and 14 |
| **Deemed Savings** | **There are minor differences in forecasted savings between these two data sources for the units with the same SEER number** | |

# Approach Comparison

| | Workpaper | ESPI Memo |
|---|---|---|
| **Project Types** | The workpaper specified savings for ROB for existing systems but the tracking data also used the same savings for new construction project | Uses different deemed savings for pre-existing and new construction projects |
| **Scaling factors** | Calculated based on simple averages of the unit energy savings across all building types, all IOUs and all Climate Zones (CZ). | Calculated for each of climate zones in SCE territories (CZ 05, 06, 08, 09, 10, 13, 14, 15, and 16) |
| **Average Method** | Straight average | Capacity tonnage weighted average |
| **Savings from Eliminating Ducting** | 14% for kWh and 25% for kW | No change |

# Results

- Calculated deemed savings for pre-existing and new construction projects
- Scaling factors:
  - Use a combination of residential and commercial baseline values
  - By climate zone
  - Capacity tonnage weighted average

- New scaling factors and unit energy savings based on the more recent DEER database were used to update unit energy savings, first year savings, and life cycle savings
- The new results can provide savings results for each CZ and SEER number. The updated scaling factors are based on updated DEER data.

# Results

- Total first-year gross savings comparison for each measure:

| | kW | | | kWh | | | therms | | |
|---|---|---|---|---|---|---|---|---|---|
| | Ex-ante | Ex-post | Ratio | Ex-ante | Ex-post | Ratio | Ex-ante | Ex-post | Ratio |
| **AC-39892** | 2.6 | 3.3 | 1.31 | 17,053 | 25,439 | 1.49 | -46 | 0 | N/A |
| **AC-70999** | 21.3 | 26.6 | 1.25 | 132,339 | 199,853 | 1.51 | -401 | 0 | N/A |
| **AC-95843** | 5.1 | 8.5 | 1.68 | 42,654 | 57,621 | 1.35 | 22 | 0 | N/A |
| **AC-67222** | 1.2 | 1.4 | 1.14 | 7,381 | 10,421 | 1.41 | -17 | 0 | N/A |
| **Total** | 30.2 | 39.9 | 1.32 | 199,427 | 293,335 | 1.47 | -441.2 | 0.0 | N/A |

**32% increase**

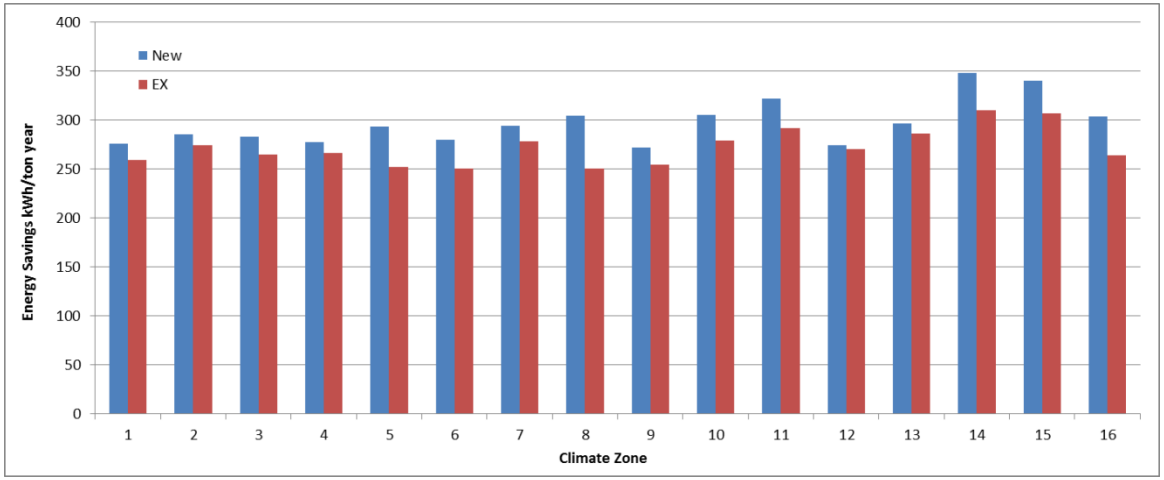
**47% increase**

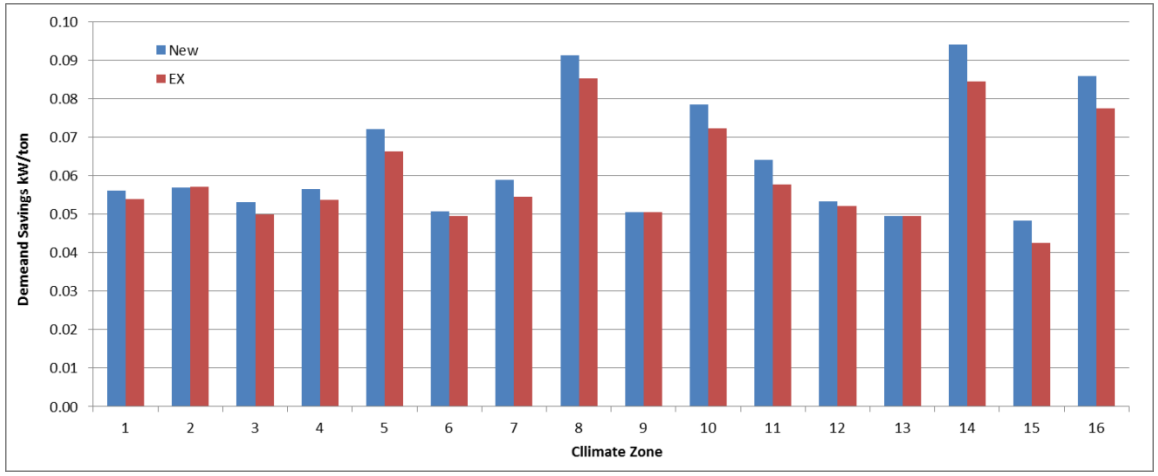
**No therms savings**

Total first year gross savings comparison between ex-ante and ex-post data

# Results

- Deemed savings for pre-existing buildings and new construction.



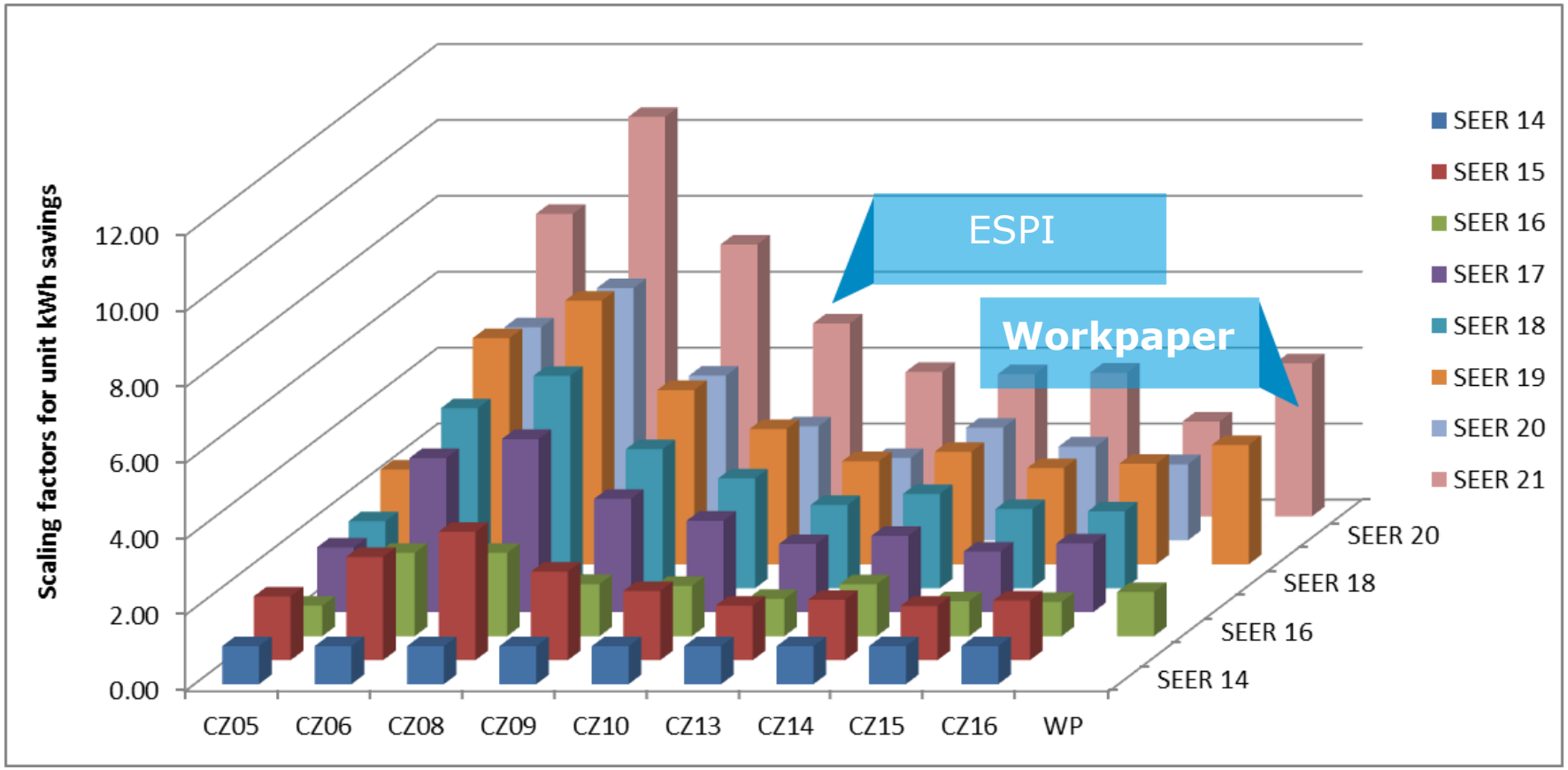

**9.1% greater kWh savings for new construction**

**6.5% greater kW savings for new construction**

Unit power and demand savings for commercial SEER 14 units in individual Climate Zones

# Results

- The residential scaling factors were used to calculate savings for each climate zone and each SEER level based on tonnage weighted demand savings.




kWh savings scaling factors for each Climate Zone and each SEER number

# Thank you. Questions?

**Jason Meyer**
jason.meyer@dnvgl.com
707.266.8332 (mobile)

**www.dnvgl.com**

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# Home Upgrade Program

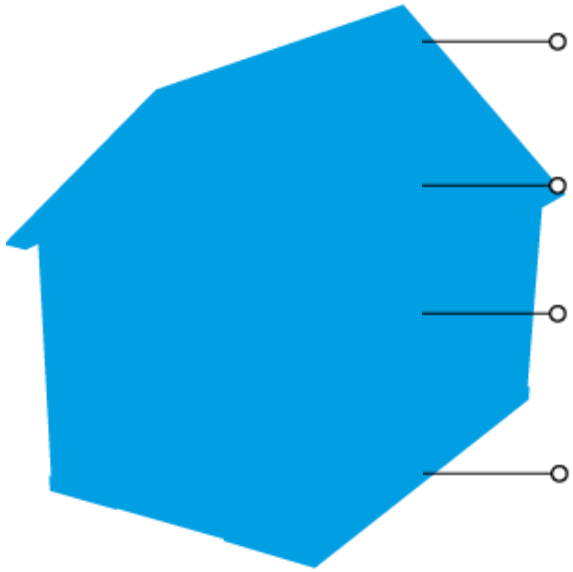
ENERGY

# Whole House Retrofit Home Upgrade Program

## 2013 ESPI Measure

# Description of ESPI Measure

- The Whole House Retrofit programs provide wide-ranging energy efficiency measures to existing residential dwellings. The main objectives of the program are to:



Promote completion of retrofits based on preferred building science loading order

Funnel participation to core Energy Efficiency (EE), Demand Response (DR), and distributed generation portfolios

Increase awareness of energy savings retrofits through statewide coordinated marketing campaigns

Coordinate with communities, local governments, and allied third-parties for outreach on local retrofit and available contractor training opportunities

- For this ESPI update, the evaluation team applied the realization rates (RRs) estimated in the 2010-2012 impact evaluation. All other factors, including unit energy savings (UES), effective useful life (EUL), installation rate (IR), quantity, and net-to-gross (NTG), are as estimated by the investor-owned utilities (IOUs) for the 2013 program.

# Sources

**Whole House Retrofit Impact Evaluation**. Evaluation of the Energy Upgrade California Programs (Work Order 46), September 2014 (CALMAC report ID: CPU0093.01)

This study estimated gross RRs and NTG ratios

The NTG ratio estimates (not applied to the ESPI update) were based on a program participant survey

The gross RR was estimated with billing analysis of program participants with a comparison group

- Billing analysis based on 12 months pre- and 12 months post-participation energy use (electric and gas)
- The comparison group was comprised of future program participants

# Billing Analysis Sample Sizes

| IOU | FUEL | Group | Basic | | Advanced | |
|---|---|---|---|---|---|---|
| | | | 2011 | 2012 | 2011 | 2012 |
| PG&E | Electric | Comparison | - | - | 854 | 704 |
| | | Participants | - | - | 422 | 1,203 |
| | Gas | Comparison | - | - | 1,489 | 1,063 |
| | | Participants | - | - | 854 | 2,030 |
| SCE | Electric | Comparison | 712 | 340 | 712 | 340 |
| | | Participants | 313 | 721 | 149 | 303 |
| SCG | Gas | Comparison | - | - | 346 | 66 |
| | | Participants | - | - | 57 | 479 |
| SDG&E | Electric | Comparison | 302 | 32 | 302 | 32 |
| | | Participants | 19 | 303 | 113 | 109 |
| | Gas | Comparison | 296 | 38 | 296 | 38 |
| | | Participants | 20 | 295 | 110 | 107 |

(a) When applicable, the comparison groups are the same for Basic and Advanced and for both years

# Application of Impact Evaluation RR factors to the ESPI Update

- The 2010-2012 impact evaluation estimated RRs and NTG ratios
- The evaluation team decided to apply the RRs from the study, but not the NTG ratios
- We expect that the NTG ratios will increase as the program matures
- We expect that the 2013 RRs were similar to 2010-2012 because:
  1. The 2013 distribution of program participants by Climate Zone (CZ) was similar to 2010-2012. In 2013:
     - PG&E: CZ 3 and 12 were 62% of ex ante kWh and 74% of ex ante therms
     - SCE and SCG: CZ 9 represented 65% of ex ante kWh and 63% of ex ante therms
     - SDG&E: CZ 7 represented 53% of ex ante kWh and 65% of ex ante therms
  2. The software used for ex ante estimation in 2010-2012 was still in use in 2013

# Comparison of Ex Ante and Ex Post RRs and NTG Ratios

| | | | Used in 2013 Ex Ante | | Estimated in 2010-2012 Study | |
|---|---|---|---|---|---|---|
| **PA** | Program ID | Measure Group | RR (kW and kWh) | RR (therms) | RR (kW and kWh) | RR (therms) |
| | | **Custom** | | | | |
| **PGE** | PGE21004 | whole building retrofit | 0.40 | 0.60 | 0.128 | 0.356 |
| **PGE** | PGE21004 | lighting indoor other | 0.40 | 0.60 | 0.128 | 0.356 |
| **PGE** | PGE21004 | other | 0.90 | 0.90 | 0.128 | 0.356 |
| **SCE** | SCE-13-SW-001D | whole building retrofit | 0.90 | 0.90 | 0.503 | n/a |
| **SCG** | SCG3705 | whole building retrofit | 0.80 | 0.80 | n/a | 0.634 |
| **SDGE** | SDGE3209 | whole building retrofit | 0.40 | 0.80 | 0.140 | 0.365 |
| | | **Deemed** | | | | |
| **PGE** | PGE21004 | whole building retrofit | 1.00 | 1.00 | 1.000 * | 1.000 * |
| **SCE** | SCE-13-SW-001D | whole building retrofit | 1.00 | 1.00 | 0.880 | n/a |
| **SCG** | SCG3705 | whole building retrofit | 1.00 | 1.00 | n/a | 1.000 * |
| **SDGE** | SDGE3209 | lighting indoor led lamp | 1.00 | 1.00 | 0.308 | 0.391 |
| **SDGE** | SDGE3209 | plug load sensor | 1.00 | 1.00 | 0.308 | 0.391 |
| **SDGE** | SDGE3209 | water heating faucet aerator | 1.00 | 1.00 | 0.308 | 0.391 |
| **SDGE** | SDGE3209 | water heating showerhead | 1.00 | 1.00 | 0.308 | 0.391 |

* Pass through (not estimated in the 2010-2012 evaluation)

# Results: Whole House Retrofit Programs Comparison of 2013 Ex Ante and Ex Post kW, kWh, and therms

| PA | Gross Savings kW | Gross Savings kWh | Gross Savings therms | Net Savings kW | Net Savings kWh | Net Savings therms |
|---|---|---|---|---|---|---|
| **Ex Ante** | | | | | | |
| **PG&E** | 2,386 | 2,407,813 | 507,828 | 2,028 | 2,046,585 | 431,643 |
| **SCE** | 2,051 | 1,577,643 | 135,668 | 1,129 | 868,130 | 74,893 |
| **SCG** | - | 1,749 | 122,042 | - | 1,487 | 103,735 |
| **SDG&E** | 113 | 142,474 | 16,292 | 96 | 119,288 | 13,824 |
| **TOTAL** | 4,549 | 4,129,680 | 781,829 | 3,252 | 3,035,490 | 624,095 |
| **Ex Post Using RR from 2010-2012 Study and NTG from 2013 Ex Ante** | | | | | | |
| **PG&E** | 652 | 554,885 | 243,131 | 554 | 471,596 | 206,651 |
| **SCE** | 1,150 | 882,585 | 75,086 | 635 | 486,107 | 41,297 |
| **SCG** | - | 1,166 | 96,593 | - | 991 | 82,101 |
| **SDG&E** | 25 | 30,324 | 6,558 | 4 | 5,401 | 5,563 |
| **TOTAL** | 1,826 | 1,468,961 | 421,368 | 1,192 | 964,095 | 335,612 |
| **Ex Post Using RR from 2010-2012 Study and NTG from 2013 Ex Ante as Percent of Ex Ante** | | | | | | |
| **PG&E** | 27% | 23% | 48% | 27% | 23% | 48% |
| **SCE** | 56% | 56% | 55% | 56% | 56% | 55% |
| **SCG** | | 67% | 79% | | 67% | 79% |
| **SDG&E** | 22% | 21% | 40% | 4% | 5% | 40% |
| **TOTAL** | 40% | 36% | 54% | 37% | 32% | 54% |

# Thank you. Questions?

**Paula Ham-Su**
Paula.Ham-Su@dnvgl.com
630-480-3434 ext. 74244

**www.dnvgl.com**

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# Water Kits

DNV·GL

ENERGY

# Water Kits

## 2013 ESPI Measure

APEX ANALYTICS, LLC

# Description of ESPI Measure

**Measures:**

- Water Kits, faucet aerators, low-flow showerheads

**Delivery:**

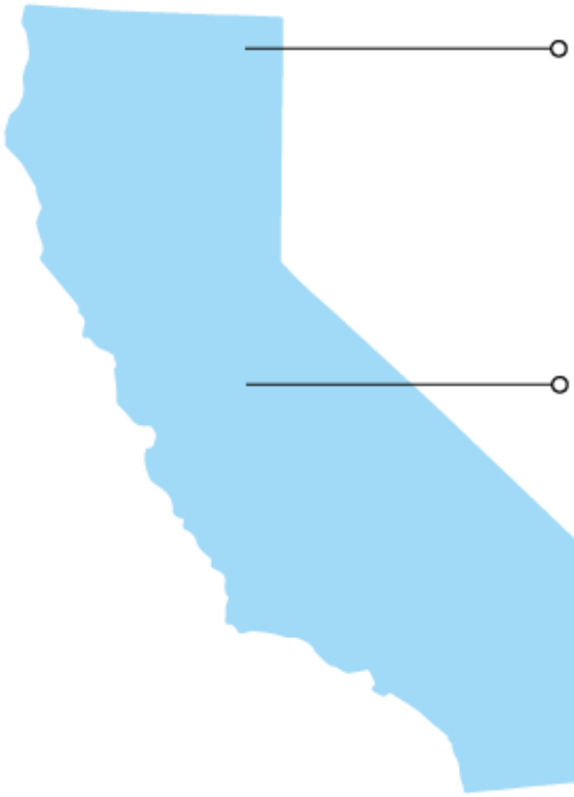
- Residential and multifamily programs implemented by San Diego Gas & Electric (SDGE) & Southern California Gas Company (SCG)

**Programs:**

| Program ID | Measure Name |
|---|---|
| **SDGE3207** | Water Heating–Faucet Aerators |
| **SDGE3207** | Water Heating–Low-Flow Showerheads |
| **SDGE3203** | Water Saving Kit |
| **SCG3702** | Water Saving Kit |

# Sources

February 22, 2013 California Public Utilities Commission Energy Division Workpaper Disposition for Water Fixtures:



- Used SCG and SDG&E field research (flow rates), California Database for Energy Efficient Resources (DEER) values (hot water usage, climate zone multipliers), and READI (in service rate (ISR))
- Allowed stratification by:
  - Climate Zone
  - Delivery Mechanism
  - Housing Type

# Results

For each program measure, the DNV GL & Apex evaluation team applied:

- Unit energy savings (UES) by installed Climate Zone
- ISR by delivery mechanism and housing type
- Net-to-gross (NTG) ratio by delivery mechanism and housing type

| | Claimed Value (ex ante) | Recommended Value (ex post) |
|---|---|---|
| **Faucet Aerators – SDGE 3207** | | |
| **UES (average per unit)** | 1.5 | 0.84 |
| **ISR** | 0.59 | 0.67 |
| **NTG** | 0.65 | 0.65 |
| **Low Flow Showerheads – SDGE 3207** | | |
| **UES (average per unit)** | 7.5 | 8.12 |
| **ISR** | 0.74 | 0.74 |
| **NTG** | 0.55 | 0.7 |
| **Water Saving Kits – SDGE 3203** | | |
| **UES (average per unit)** | 16.4 | 14.52 |
| **ISR** | 0.76 | 0.45 |
| **NTG** | 0.55 | 0.55 |
| **Water Saving Kits – SCG 3702** | | |
| **UES (average per unit)** | 16.4 | 14.46 |
| **ISR** | 0.43 | 0.45 |
| **NTG** | 0.55 | 0.55 |

# Results

Overall:

- Gross Savings Realization Rate: 66%
- Net Savings Realization Rate: 71%

| Program ID | Measure Name | First Year Gross Savings (Therms) | | First Year Net Savings (Therms) | |
|---|---|---|---|---|---|
| | | Ex Ante | Ex Post | Ex Ante | Ex Post |
| **SDGE3207** | Water Heating–Faucet Aerators | 3,160 | 2,006 | 2,054 | 1,304 |
| **SDGE3207** | Water Heating–Low-Flow Showerhead | 4,124 | 4,463 | 2,268 | 3,124 |
| **SCG3702** | Water Saving Kit | 183 | 169 | 101 | 93 |
| **SDGE3203** | Water Saving Kit | 13,000 | 6,813 | 7,150 | 3,747 |
| **Total Water Kit Savings** | | 20,467 | 13,451 | 11,573 | 8,268 |

# Thank you. Questions?

**Katie Parkinson, Apex Analytics**
katiep@apexanalyticsllc.com
303-590-9888

**www.dnvgl.com**

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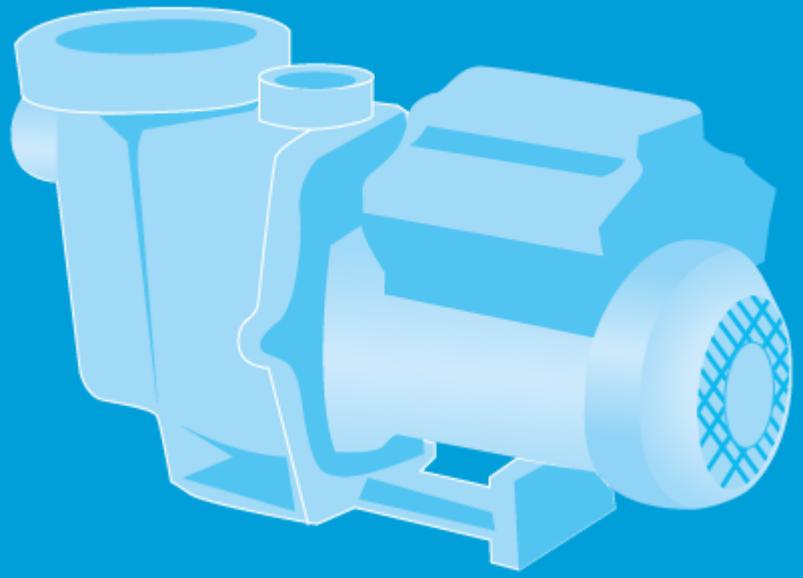
# Pool Pumps

DNV·GL

ENERGY

# Variable-Speed Pool Pumps

## 2013 ESPI Measure



**Elizabeth Steele**

# Description of ESPI Measure

- Measure is for a new, variable-speed drive (VSD) pool pump in a single family home as part of program implemented by San Diego Gas & Electric, program ID: SDGE3203.
- Baseline is a California Code of Regulations Title 20, minimally code compliant two-speed pump.
- The workpaper assumes savings result from the VSD pump running just fast enough to produce the required flow rate.
  - VSD pumps will operate at two speeds—high speed to support pool sweepers and low speed for water filtration, but these will be lower than the two-speed baseline model.
- Because this is a replace on burnout measure, savings are not based on existing equipment.
- The workpaper assumes a default net-to-gross ratio of 0.55 from the California Database for Energy Efficient Resources (DEER).
- The workpaper assumes an effective useful life (EUL) of 10 years.

# Sources

- SDGE Workpaper Residential Variable-Speed Pool Pump provided the ex ante savings and inputs:
  - Hours of operation came from the 2009 Pacific Gas & Electric Company (PGE)/KEMA Mass Markets Study.
  - Pump flow rates came from a Pentair Technical Training Manual.
  - Pump power draw also came from Pentair's manual.
  - Since this measure is not weather dependent, the savings were the same for all Climate Zones (1,169 kWh and 0.166 kW).
- DEER does not include variable-speed pool pumps:
  - Two-speed pumps were included in previous versions, but were removed in 2011 since Title 20 no longer allowed single-speed pumps.
  - Two-speed pumps had an EUL of 10 years in DEER, which was used in the workpaper for VSD pumps.
  - This EUL was confirmed in Hawaii and Pennsylvania technical reference manuals (TRMs).

## Discussion & Results

- Pump affinity laws show that small changes in flow rate can result in large changes in energy consumption. The DNV GL review team was unable to verify the flow rates used in the workpaper.
- The review team was also unable to verify the power draw (838 W at high speed, 130 W at low speed) used in the workpaper for the VSD pump. The team suggests using the Pennsylvania TRM's regression curve instead.
  - TRMs go through an independent technical review while the Pentair documentation is from the manufacturer.
  - The Pennsylvania TRM regression results in a power draw of 803 W (high) and 299 W (low), which leads to annual savings that are 68% of the savings claimed in the workpaper.
  - DNV GL recommends a conservative adjustment factor of 75% be applied to the ex ante savings. This results in adjusted savings of 877 kWh and 0.125 kW.
  - Updated Unit Energy Savings and therefore Gross, Net and Lifecycle Savings.

# Discussion & Results

- The workpaper used a residential HVAC load shape in its calculations.
  - The workpaper noted that there is not a residential pool-pump load shape, but did not detail the rationale to use a residential HVAC load shape instead.
  - It is unlikely the hours of operation for a HVAC load shape are similar to those of a residential pool pump. HVAC usage peaks in middle to late afternoon while the workpaper's supporting documentation shows that pool pump loads are higher in the morning and early afternoon.

DNV GL recommends the workpaper develop a more conservative and pool-pump-specific load shape that accounts for higher pump power earlier in the operating cycle and low pump power in the rest of the cycle

## Results

| Per unit Savings | Energy Savings (kWh) | Demand Savings (kW) |
|---|---|---|
| Ex Ante Savings from Workpaper | 1,169 | 0.166 |
| Ex Post Adjusted Savings | 877 | 0.125 |

| Total Gross Program Savings | Energy Savings (kWh) | Demand Savings (kW) |
|---|---|---|
| Ex Ante Savings from Workpaper | 2,727,277 | 387.3 |
| Ex Post Adjusted Savings | 2,045,574 | 291.6 |

# References


1. California Code of Regulations, Title 20: Division 2, Chapter 4, Article 4, Sections 1601-1608: Appliance Efficiency Regulations. May 2014. (http://www.energy.ca.gov/2014publications/CEC-400-2014-009/CEC-400-2014-009-CMF.pdf)
2. Hawaii Energy TRM, No. 2011. Program Year 3, July 2011 to June 2012. (http://www.hawaiienergy.com/media/W1siZiIsIjIwMTMvMDUvMTcvMTlfNTNfMTZfOTk1X1BZMTFfSGF3YWlpRW5lcmd5VFJNLnBkZiJdXQ/PY11-HawaiiEnergyTRM.pdf?sha=c230e920)
3. Pennsylvania Public Utility Commission TRM. June 2014. (http://www.puc.pa.gov/Electric/pdf/Act129/Act129_TRM-2014_Redlined_V2.pdf)
4. PGE & KEMA. Process Evaluation of 2006-2008 PG&E Mass Markets Program Portfolio and CFL, Swimming Pool Market Characterizations Final Report. December 11, 2009.

# Thank you. Questions?

**Elizabeth Steele**
Elizabeth.Steele@dnvgl.com
510-891-0446

**www.dnvgl.com**

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DNV·GL

# Behavior

ENERGY

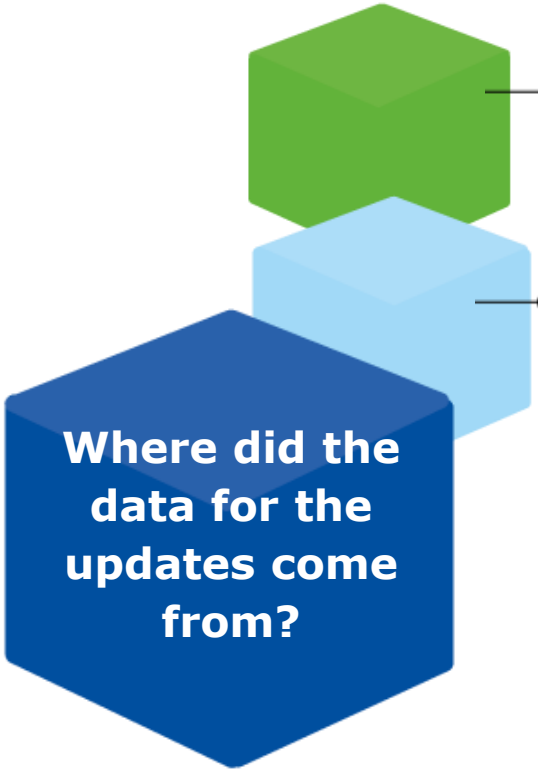
# Home Energy Reports

## 2013 ESPI Measure

# Description of ESPI Measure

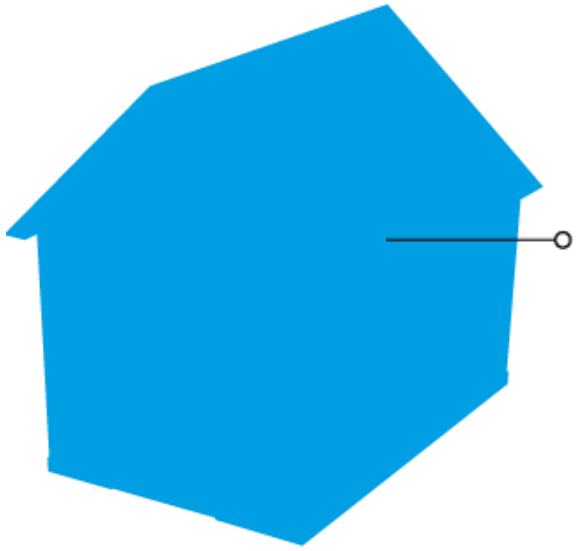
- Home Energy Reports (HER) are comparative feedback reports that:
  - Provide comparison data on household energy consumption versus similar homes and to more efficient homes
  - Provide tips for reducing energy consumption through behavioural changes and participation in other investor-owned utility (IOU) programs
- HER Programs
  - Pacific Gas & Electric (PG&E) initiated in August 2011, 5 phases (different launch dates), currently 1.6 million treatment households
  - Southern California Edison (SCE) initiated Phase 1 Dec 2012 through Dec 2013 with 75,000 treatment households; started Phase 2 in 2013, with new cohort of 75,000 treatment
  - San Diego Gas & Electric (SDG&E) initiated in July 2011, 20,000 treatment households; added 95,000 treatment in 2014
- Parameters being updated
  - Impact of HER programs on energy and demand consumption

# Sources




- Billing Analysis
  - IOU monthly billing data
- Joint Savings Analysis
  - Downstream programs: IOU program tracking database
  - Upstream programs
    - PG&E Home Inventory Survey (Evaluation of Pacific Gas and Electric Company's Home Energy Report Initiative for the 2010–2012 Program, study ID: ID PGE0329.01)
    - Compact Fluorescent Lamps Market Effects Final Report, 2010
    - Final Evaluation Report: Upstream Lighting Program, 2010 (study ID: CPU0015.02)

# How Results were Applied to 2013 Records



- DNV GL provided energy and demand savings estimates for PG&E, SCE, and SDG&E HER programs.
  - DNV GL conducted validation of estimates provided by PG&E and SCE third-party consults; including replicating results using a DNV GL-specific model
  - DNV GL conducted the impact evaluation for SDG&E HER program

# How Results were Applied to 2013 Records

- Ex post results at the ESPI measure level:

| IOU | Ex-Post Net Savings (kWh) | Ex-Post Net Savings (therms) | Ex-Post Net Savings (kW) |
|---|---|---|---|
| PG&E | 80,356,283 | 2,825,237 | 15,400 |
| SCE | 8,264,975 | NA | 2,627 |
| SDG&E | 4,193,200 | 189,300 | NA |

- Based on DNV GL final verification and impact evaluation reports:
  - 2013 PG&E Home Energy Reports Program Review and Validation of Impact Evaluation; ED Res 3.1 (study ID: CPU0096.00)
  - 2013 SCE Home Energy Reports Program Review and Validation of Impact Evaluation; ED Res 3.2 (study ID: CPU0097.00)
  - SDG&E Home Energy Reports Program 2013 Impact Evaluation; ED Res 3.3 (study ID: CPU0098.00)

# Why are Results Applicable?

**The HER program uses randomized control/treatment (RCT) or experimental design**

- Experimental design provides the most robust framework for baseline conditions
- DNV GL applied a fixed effects, econometric model with a difference of difference structure that is common for estimating savings in an RCT program

**DNV GL vetted the approach, analysis, and results for the 2013 HER program with IOUs and California Public Utility Commission Energy Division consultants**

- Results produced were consistent with results from the third-party evaluators hired by PG&E and SCE
- DNV GL worked with third party evaluators and the IOUs to determine source of discrepancies and made recommendations as needed to bring estimates into alignment
- DNV GL presented results in a public webinar in December 2014

# Thank you. Questions?

**Valerie Richardson**
valerie.richardson@dnvgl.com

**www.dnvgl.com**

**SAFER, SMARTER, GREENER**

# Additional Q & A

# Thank you!


Energy Division Contact:

Jeorge Tagnipes

Jeorge.tagnipes@cpuc.ca.gov

415-703-2451