2018 AND BEYOND POTENTIAL STUDY

DECEMBER WEBINAR

INDUSTRIAL AND AGRICULTURAL MARKETS

NAVIGANT

TABLE OF CONTENTS

AIMS METHODOLOGY: SCOPE

Scope of this discussion:

- 2018 PG Model Update Methodologies
  - Focus on Industrial and Agricultural sectors
    - Discuss approach to categorizing measures
    - Discuss approach to modelling each measure category
  - Limited and targeted updates for Mining and Street Lighting

INDUSTRIAL AND AGRICULTURAL MEASURE CATEGORIES

The 2018 model will define the Industrial and Agricultural markets with **five measures** categories

Examples

Identified deemed measures:

- Discrete deemed measures readily defined and forecasted using a diffusion model

Lighting, Pumps

Identified custom measures:

- Discrete custom measures readily defined and forecasted using a diffusion model

Process boilers, Process pumps

Generic custom measures:

- Projects unique to various subsectors that cannot be readily defined at the measure level or forecasted using a diffusion model, such as measures identified as 'Process-Other'

Process Other

Emerging technology measures:

- A combination of measures that may or may not be defined for diffusion modeling at the measure level. Modeling approach will vary depending on the nature of technology

Micro-channel HX
Other process specific

BROS:

- Based on SEM program paradigm. Modeling approach will use a top-down model and will not be based on a diffusion approach

Operational/SEM

INDUSTRIAL AND AGRICULTURAL MEASURE CATEGORIES

Review of recent measure category contribution from EEStats Data

- 2013 to 2015 ex-ante, Industrial and Agriculture Market Sectors
- Navigant classified savings as **identified deemed**, **identified custom**, and **generic custom**

Industrial percent of savings

Impact Type	Gross GWh	Gross MMth
Identified Deemed	6.0%	3.2%
Identified Custom	68.6%	60.5%
Generic Custom	25.4%	36.3%
Total	100.0%	100.0%

Source: Navigant analysis of EEStats

Agricultural percent of savings

Impact Type	Gross GWh	Gross MMth
Identified Deemed	26.5%	21.7%
Identified Custom	29.3%	34.2%
Generic Custom	44.2%	44.0%
Total	100.0%	100.0%

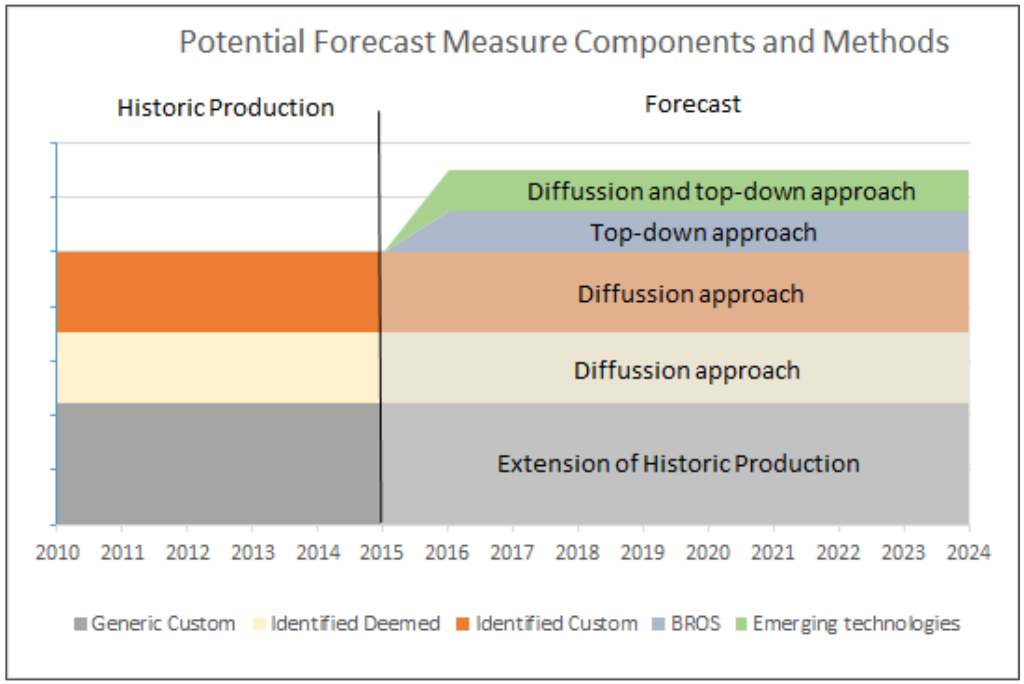
Source: Navigant analysis of EEStats

MEASURE CATEGORIES – MODELING APPROACH OVERVIEW

The team will approach the **five measures** categories with different methodologies

Measure Categories	Model Approach
Identified Deemed	Bottom-up bass diffusion approach
Identified Custom	Bottom-up bass diffusion approach
Generic Custom	Top-down approach
Emerging Technologies	Bottom-up bass diffusion approach and top-down approach
BROS	Top-down approach

Source: Navigant



Illustrative Example

Savings for each measure category will be forecasted separately and added together to form the sector forecast.

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APPROACH TO IDENTIFIED CUSTOM AND DEEMED MEASURES

Forecasting Approach

- Based on discrete measures identified and discussed in October DAWG meeting
- Diffusion model forecast will consider influence of market transformation:

Market Transformation Metrics (forecast influencers)	Model Default Assumptions (trends over analysis period)
Saturation levels	Increasing
NTG	Decreasing
Industry Standard Practice (ISP)	Increasing conversion Rate similar to codes and standards trends[1]
Codes & Standards (C&S)	Trends on commercial measures where applicable to the Industrial / Agricultural sectors

1. See supplemental slides for example.
Studies and guidance at http://www.cpuc.ca.gov/General.aspx?id=4133

Source: Navigant analysis

Questions for stakeholders:

1. Are the trend assumptions correct?
2. Is there any reason that past performance is not an indicator of future potential?
3. What is the role of new program initiatives, such as Strategic Energy Management (SEM), in driving more potential for **identified** measures?

APPROACH TO GENERIC CUSTOM MEASURES

The specific widget-based diffusion model approach cannot be applied to custom generic measures because they cannot be characterized

- Site, industry, and/or process-specific interventions
  - Not feasible or appropriate to define a typical widget for potential model purposes
- No codes or standards directly relate
- Not saturating due to continual process changes, equipment retooling, product evolution
- Examples of Custom Generic:
  - *E.g., factory-level compressed air system improvements: equipment replacements, re-piping distribution system, sequencing compressor controls, etc.*

EEStats Classifications	Data Descriptions
Building Types	Industrial, Other Industrial, Manufacturing, Biotech Agricultural, Other Agricultural
End Uses	Process, Refrigeration, HVAC, Other
Measure Groups	Ag Pump Other, Ag Pump Overhaul Process Compressed Air Other, Process Compressed Air System Configuration Process Boiler Controls Other Process Other Controls, Process Controls Refrigeration Other, Refrigeration Controls Other Process Other VFD

Source: Navigant

APPROACH TO GENERIC CUSTOM MEASURES (CONTINUED)

Forecasting approach

1. Historic savings (net and gross) for generic custom measures will be defined from CPUC reports, evaluations, and tracking data
2. Generic custom forecast will be constructed based on historic trends, and will account for:
   a) Any overlap with the BROS forecast
   b) The potential for emerging technologies to maintain or increase historic generic custom savings
   c) Historic trends in generic custom segments that might continue in the future

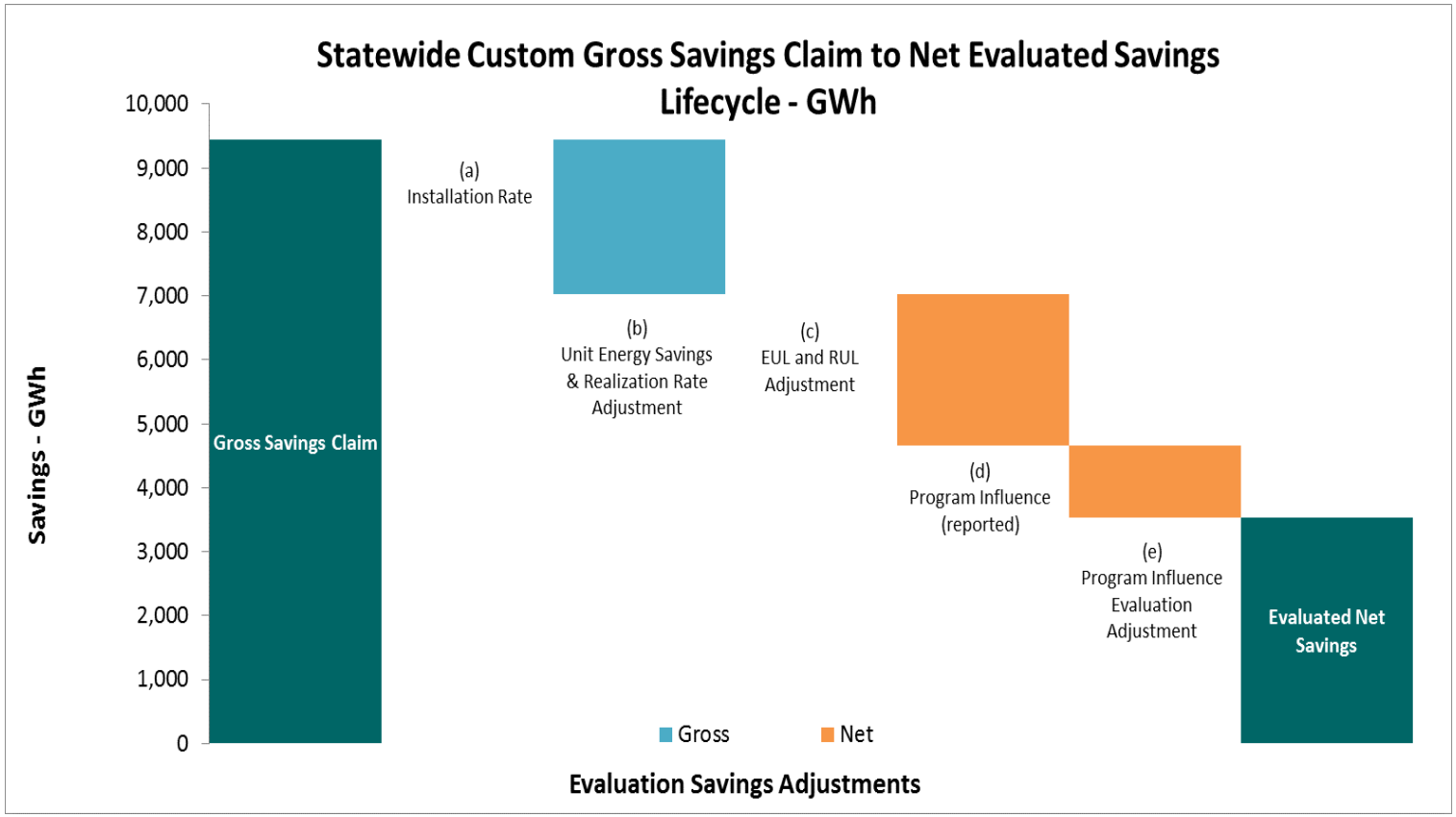
Questions for stakeholders:

1. History indicates ex-post net is 30% to 38% of ex-ante claim. Is a net forecast using these ranges and based on 2015 – 2016 ex-ante claim reasonable?
2. Is there any reason that past performance of custom programs is not an indicator of future potential?
3. What is the role (if any) of new program initiatives, such as SEM and emerging technologies in driving more potential for **generic custom** measures?

Source: Navigant

APPROACH TO GENERIC CUSTOM MEASURES (CONTINUED)

- Example from the 2014 Efficiency Savings and Performance Incentive (ESPI)[1] report
  - Adjusted lifecycle net evaluated savings (GWh) for custom projects: ~37% of ex-ante gross



1: 2014 Final Ex-Post performance Statement Report, http://www.cpuc.ca.gov/General.aspx?id=4137

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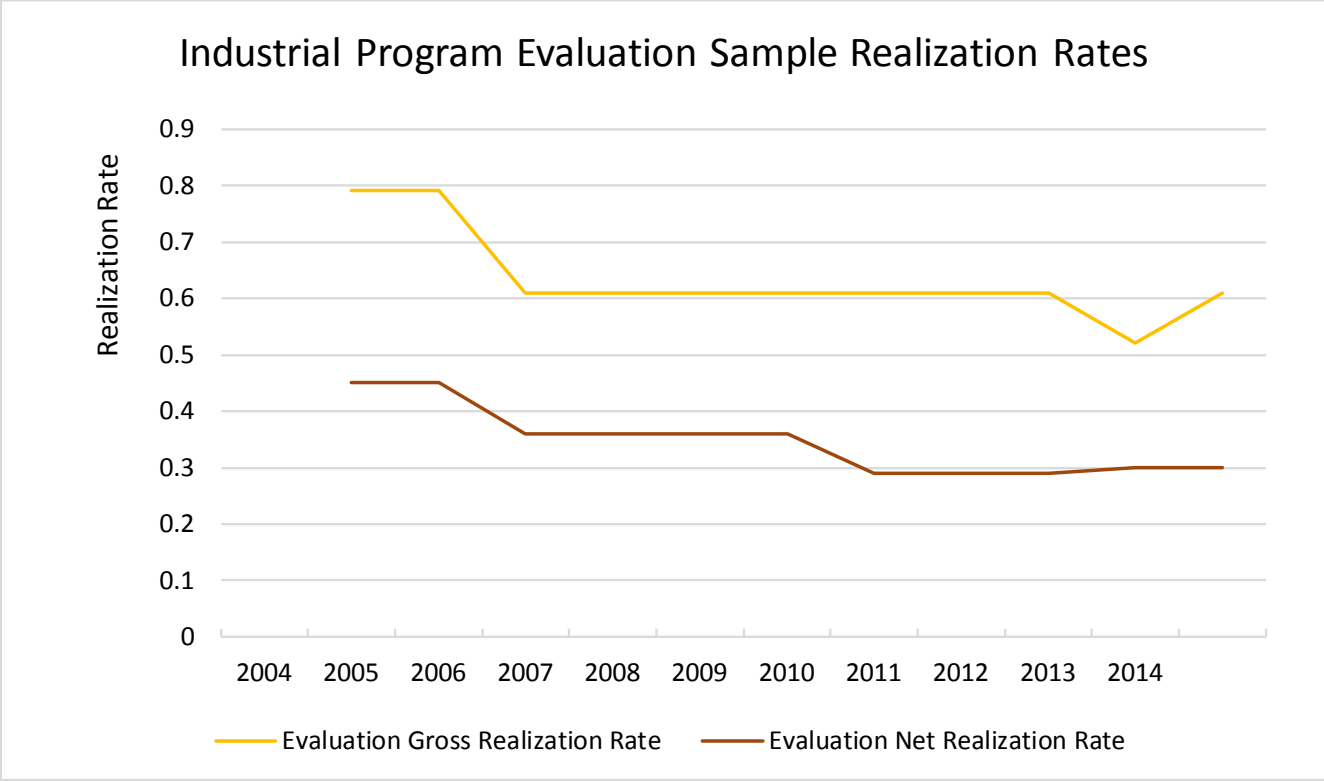
APPROACH TO GENERIC CUSTOM MEASURES (CONTINUED)

Summary of past industrial sector evaluation reports[1]:

- Interpretation of a compilation of past evaluations indicate that industrial program net realization rates are declining



1: See Appendix: supplemental slide on evaluation report sources and data tables

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APPROACH TO EMERGING TECHNOLOGIES

- Forecasting Approach
  - Applicable Emerging Technologies (**ETs**) from the Commercial market will be applied to the Industrial and Agricultural markets (e.g., lighting, HVAC/shell)
    - Modelled using same diffusion parameters as commercial sector
  - **ETs** will serve to maintain long term forecast of generic custom measures at current levels
    - Assumption: **ETs** exist in AIMS that are more process-specific than in the Commercial market, and so a portion of AIMS **ET** potential cannot be defined via the diffusion model
    - Assumption: **ETs** implemented as custom measures keep the **generic custom** forecast from declining due to saturation, C&S, NTG, or ISP trends.
      - Or: **ETs** might result in an increase in the forecast for **generic custom**.

Questions for stakeholders:

1. Have stakeholders seen methodologies for forecasting **ETs** in high use industrial market segments?
2. Are there high use industrial market segments where **ETs** might have the most impact?
3. What is the role of new program initiatives, such as SEM, in driving more potential for **ETs**?
4. Will **ET** activities be significant enough to increase the **generic custom** forecast?

APPROACH TO EMERGING TECHNOLOGIES (CONTINUED)

Examples (non-comprehensive) of Industrial and Agricultural specific ETs from CPUC

- ETs for processes (excluding lighting and HVAC/shell)
- Commercial sector ETs (lighting, HVAC/shell) will be vetted for Industrial/Agriculture

Identified ET Measures	Sector	End Use
Closed Loop Irrigation Management	Agricultural	Other
Irrigation Leak Detection	Agricultural	Other
Soil Moisture Sensors	Agricultural	Pumps
Conductive Cooling System for Dairy Cows	Agricultural	Space Cooling
Immersion Cooling of IT Servers/Data Centers	Industrial	HVAC
Permanent Magnet AC (PMAC) Motors	Industrial	Other
VFD for Permanent Magnet AC (PMAC) Motors	Industrial	Other
Anaerobic Digestion for Waste Water Treatment	Industrial	Other
Wastewater Dissolved Oxygen Sensor	Industrial	Process
Zero Loss Compressed Air Drains	Industrial	Process/Other
Water Leak Detection and Control	Industrial	Pumps
Electronic Refrigerant Injection Control	Industrial	Refrigeration
Microchannel Heat Exchange	Industrial	Refrigeration
ULT Monitoring (Ultra Low-Temp Freezers)	Industrial	Refrigeration

Source: CPUC

APPROACH TO FORECASTING BROS

- Forecasting Approach
  - Top down approach as discussed in November DAWG workshop
  - Will be O&M savings based on SEM paradigm
  - Key forecasting parameters discuss in November DAWG
    - SEM Savings Potential
      - Research indicates that site level O&M savings range is 1.8% to 7.9% for participants. What do stakeholders estimate is an acceptable range for site level O&M savings?
    - SEM Uptake and Attribution
      - Modeling team assumption: Current SEM saturation is 0% across the industrial and agricultural sectors. Do stakeholders agree? If not, can they provide an alternative starting saturations and associated data?
      - Participation rates for programs similar to SEM appear to grow at about 1% per year across eligible participants. Can stakeholders provide sources of participation data?
      - Do the IOU's have SEM participation rates associated with their business plan and upcoming filings?
      - For the purpose of net goals, using an NTG value of 1 for SEM forecasts per D.16-08-19 (page 41).

MINING AND STREET LIGHTING

Navigant will complete targeted updates only for the Mining and Street Lighting sectors

- Mining:
  - Oil and Gas extraction characterized in previous studies
  - Inputs will be used for current model (the team will convert inputs as needed for compatibility)
  - Targeted updates may include: Saturation levels, incremental costs, etc.

- Street Lighting:
  - Previous studies relied on IOU-supplied inventories
    - **Navigant requests updated equipment inventories from the IOUs for this study**
    - Inventories inform saturation levels, densities, etc.
  - Other targeted updates may include: LED cost curves

Upcoming Street Lighting data request sample:

Data field >>	Lamp Type Description/ Identifier/ Service Plan/ etc.	Lamp Watts	Rate Schedule (i.e., utility or customer owned)	Quantity (lamp counts)
Examples >>	LED-2	150	LS-1, LS-2, etc.	15,000

QUESTIONS FOR STAKEHOLDERS

In addition to feedback on these questions, the team will ask stakeholders for input on

1. Specific Industrial and Agricultural measures inputs
2. Street Lighting inventories.

Generic Custom Measures:

1. History indicates ex-post net is 30% to 38% of ex-ante claim. Is a net forecast using these ranges and based on 2015 – 2016 ex-ante claim reasonable?
2. Is there any reason that past performance is not an indicator of future potential?
3. What is the role (if any) of new program initiatives, such as SEM and emerging technologies in driving more potential for generic custom measures??

Emerging Technologies:

1. Have stakeholders seen methodologies for forecasting **ETs** in high use industrial market segments?
2. Are there high use industrial market segments where **ETs** might have the most impact?
3. What is the role of new program initiatives, such as SEM, in driving more potential for **ETs**?
4. Will **ET** activities be significant enough to increase the **generic custom** forecast?

INFORMAL WRITTEN COMMENTS

- CPUC staff welcome additional informal, written comments.
- Due date: December 20, 2016
- E-mail to **all three**:
  - Paula Gruendling paula.gruendling@cpuc.ca.gov
  - Amul Sathe amul.sathe@navigant.com
  - Chris Ann Dickerson cadickerson@cadconsulting.biz

- No need to e-mail the entire service list, these are not formal comments.

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SUPPLEMENTAL SLIDES

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INDUSTRIAL AND AGRICULTURAL: SUPPLEMENT – EVALUATION SOURCE FILES

Summary of past industrial sector evaluation reports

- 2004-2005 Statewide Nonresidential Standard Performance Contract Program Measurement and Evaluation Study at CALMAC
- 2006-2008 Evaluation Report for PG&E Fabrication, Process and, Manufacturing Contract Group, California Public Utilities Commission. Itron, Inc. February 3, 2010. CALMAC Study ID: CPU0017.01 at CALMAC
- 2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group, California Public Utilities Commission. Itron, Inc. February 3, 2010, CALMAC Study ID: CPU0018.01 at CALMAC
- 2010-12 WO033 Custom Impact Evaluation Final Report. California Public Utilities Commission. Itron, Inc. July 14, 2014. 2010-12 WO033 at CALMAC
- Final Report 2013 Custom Impact Evaluation, Industrial, Agricultural, and Large Commercial Submitted to California Public Utilities Commission. Itron, Inc. July 17, 2015 at CALMAC
- Final Report 2014 Custom Impact Evaluation Industrial, Agricultural, and Large Commercial. California Public Utilities Commission. Itron, Inc. April 29, 2016 at CALMAC

INDUSTRIAL AND AGRICULTURAL: SUPPLEMENT – EVALUATION SOURCE DATA

2004-2005 Statewide Nonresidential Standard Performance Contract Program Measurement and Evaluation Study at CALMAC

Statewide	Net Electric Savings†		Net Gas Savings†	Total Net Energy Savings
	kWh/year	Avg. peak kW	Therms/year	Millions Btu/year*
Evaluation Gross Realization Rate	79%	74%	79%	79%
Claimed NTGR[x]	71%	72%	74%	72%
Evaluation NTFR	57%	56%	57%	57%
Evaluation Net Realization Rate‡	45%	40%	50%	46%

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INDUSTRIAL AND AGRICULTURAL: SUPPLEMENT – EVALUATION SOURCE DATA

2006-2008 Evaluation Report for PG&E Fabrication, Process and, Manufacturing Contract Group, California Public Utilities Commission. Itron, Inc. February 3, 2010. CALMAC Study ID: CPU0017.01 at CALMAC

Table 1-2: Comparison of Evaluation-Estimated Net Savings with the Final			
Program-Claimed Net Savings: All Projects			
	Electric Savings		Gas savings
	kWh/year	Avg. peak kW	Therms/year
b. Claimed NTG Ratio	0.79	0.79	0.76
d. Evaluation Gross Realization Rate	0.49	0.46	0.68
f. Evaluation NTG Ratio**	0.53	0.52	0.31
h. Evaluation Net Realization Rate (h = d xf)	0.26	0.236	0.21
i. Evaluated Net Savings as a Fraction of Claimed Net Savings (i = g / c)	0.33	0.30	0.27

2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group, California Public Utilities Commission. Itron, Inc. February 3, 2010, CALMAC Study ID: CPU0018.01 at CALMAC

Table 1-5: Comparison of First-Year Evaluation-Based Net Savings with the	
Final Program-Claimed Net Savings: SCE2509 Industrial Projects	
	Electric Savings
	kWh/year
b. Claimed Realization Rate	0.89
d. Claimed NTG Ratio	0.80
f. Evaluation Gross Realization Rate	0.72
h. Evaluation NTGRatio*	0.63
j. Evaluation Net Realization Rate (h = d xf)	0.46
k. Evaluated Net Savings as a Fraction of Claimed Net Savings (k = i / e)	0.57

INDUSTRIAL AND AGRICULTURAL: SUPPLEMENT – EVALUATION SOURCE DATA

2010-12 WO033 Custom Impact Evaluation Final Report. California Public Utilities Commission. Itron, Inc. July 14, 2014. 2010-12 WO033 at CALMAC

Energy Metric	Mean Gross Realization Rate
PG&E Electric	
kWh*	0.59
kW	0.46
PG&E Gas	
Therms*	0.67
SCE Electric	
kWh*	0.61
kW	0.57
SDGE Electric	
kWh*	0.64
kW	0.82

Results	Electric NTGRs	Gas NTGRs
	Statewide	**Statewide**
Weighted NTGR	0.47	0.53
Final NTGR	0.48	0.53

INDUSTRIAL AND AGRICULTURAL: SUPPLEMENT – EVALUATION SOURCE DATA

Final Report 2013 Custom Impact Evaluation, Industrial, Agricultural, and Large Commercial Submitted to California Public Utilities Commission. Itron, Inc. July 17, 2015 at CALMAC

Table 1-4: PG&E Lifecycle Net Realization Rate Estimates and Comparisons

Impact Element	LC Electric Savings		LC Gas Savings
	kWh	Avg. Peak kW	Therms
b. Claimed GRR	0.91	0.90	0.90
f. Claimed Net Realization Rate (f = b x d)	0.59	0.58	0.56
g. Evaluation LC GRR	0.63	0.44	0.63
i. Evaluation NTG Ratio	0.55	0.55	0.55
k. Evaluation Net Realization Rate (l = g x i)	0.35	0.24	0.35
l. Evaluated Net Savings as a Fraction of Claimed Net Savings (m = k / f)	0.59	0.42	0.62

Table 1-5: SCE Lifecycle Net Realization Rate Estimates and Comparisons

Impact Element	LC Electric Savings		LC Gas Savings
	kWh	Avg. Peak kW	Therms
b. Claimed GRR	0.90	0.90	0.90
d. Claimed NTGR	0.60	0.60	0.80
f. Claimed Net Realization Rate (f = b x d)	0.54	0.55	0.72
g. Evaluation LC GRR	0.44	0.52	0.44
i. Evaluation NTG Ratio	0.57	0.57	0.57
k. Evaluation Net Realization Rate (l = g x i)	0.25	0.29	0.25
l. Evaluated Net Savings as a Fraction of Claimed Net Savings (m = k / f)	0.46	0.54	0.35

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INDUSTRIAL AND AGRICULTURAL: SUPPLEMENT – EVALUATION SOURCE DATA

Final Report 2013 Custom Impact Evaluation, Industrial, Agricultural, and Large Commercial Submitted to California Public Utilities Commission. Itron, Inc. July 17, 2015 at CALMAC

Table 1-6: SDG&E Net Realization Rate Estimates and Comparisons

Impact Element	LC Electric Savings		LC Gas Savings
	kWh	Avg. Peak kW	Therms
b. Claimed GRR	0.90	0.90	0.90
d. Claimed NTGR	0.61	0.60	0.64
f. Claimed Net Realization Rate (f = b x d)	0.55	0.55	0.57
g. Evaluation LC GRR	0.49	0.76	0.49
i. Evaluation NTG Ratio	0.59	0.59	0.59
k. Evaluation Net Realization Rate (l = g x i)	0.29	0.45	0.29
l. Evaluated Net Savings as a Fraction of Claimed Net Savings (m = k / f)	0.54	0.83	0.51

Table 1-7: SCG Lifecycle Net Realization Rate Estimates and Comparisons

Impact Element	LC Gas Savings		
	Therms/year		
b. Claimed GRR	0.91		
d. Claimed NTGR	0.50		
f. Claimed Net Realization Rate (f = b x d)	0.46		
g. Evaluation LC GRR	0.60		
i. Evaluation NTG Ratio	0.66		
k. Evaluation Net Realization Rate (l = g x i)	0.39		
l. Evaluated Net Savings as a Fraction of Claimed Net Savings (m = k / f)	0.86		

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INDUSTRIAL AND AGRICULTURAL: SUPPLEMENT – EVALUATION SOURCE DATA

Final Report 2014 Custom Impact Evaluation Industrial, Agricultural, and Large Commercial. California Public Utilities Commission. Itron, Inc. April 29, 2016 at CALMAC

Table 1-2: Mean Lifecycle Gross Realization Rates by PA and Energy Metric

(MMBtu and kW)

Energy Metric	LC Mean GRR	Error Ratio**	90% Confidence Interval	FY Mean GRR
PG&E[t]				
MMBtu*	0.62	0.75	0.50 to 0.73	0.59
kW	0.74	1.67	0.34 to 1.14	0.69
SCE				
MMBtu*	0.58	0.94	0.44 to 0.71	0.64
kW	0.46	1.00	0.34 to 0.58	0.50
SDG&E				
MMBtu*	0.63	0.43	0.57 to 0.70	0.73
kW	0.63	0.45	0.54 to 0.71	0.67
SCG				
MMBtu	0.49	0.96	0.36 to 0.62	0.58

	Mean Net-to-Gross Ratios			
Results	PGE	SCE	SDG&E	SCG
Weighted NTGR	0.51	0.46	0.51	0.62
90 Percent Confidence Interval	0.47 to 0.54	0.42 to 0.49	0.47 to 0.56	0.6 to 0.65
Relative Precision	0.06	0.07	0.09	0.04
n NTGR Completes	52	57	45	42
N Sampling Units	1,244	1,161	203	236
Error ratio (ER)	0.29	0.35	0.42	0.18
Percent of Ex-Ante MMBtu Savings	37%	29%	43%	38%

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INDUSTRIAL AND AGRICULTURAL: SUPPLEMENT – ESPI CUSTOM HISTORY

ESPI - Custom Measures - Statewide - All Measures, 2013 and 2014

Life Cycle Savings	2013			2014		
	Electric (GWh)	Demand (MW)	Natural Gas (MM Therm)	Electric (GWh)	Demand (MW)	Natural Gas (MM Therm)
Overall Gross Ex-Ante Claims	9,513	1,591	483	9,349	3,140	504
Overall Gross Ex-Post Results	6,888	1,173	335	6,917	1,188	325
Gross Realization Rate	72%	74%	69%	74%	38%	64%
Overall Net Ex-Ante Claims	6,155	1,016	280	6,168	1,955	298
Ex-Post Results - NTG Update Only	5,331	872	283	4,610	1,746	280
Net Realization Rate	87%	86%	101%	75%	89%	94%
Overall Net Ex-Post Results	3,855	640	195	3,430	601	178
Overall Realization Rate	63%	63%	70%	56%	31%	60%

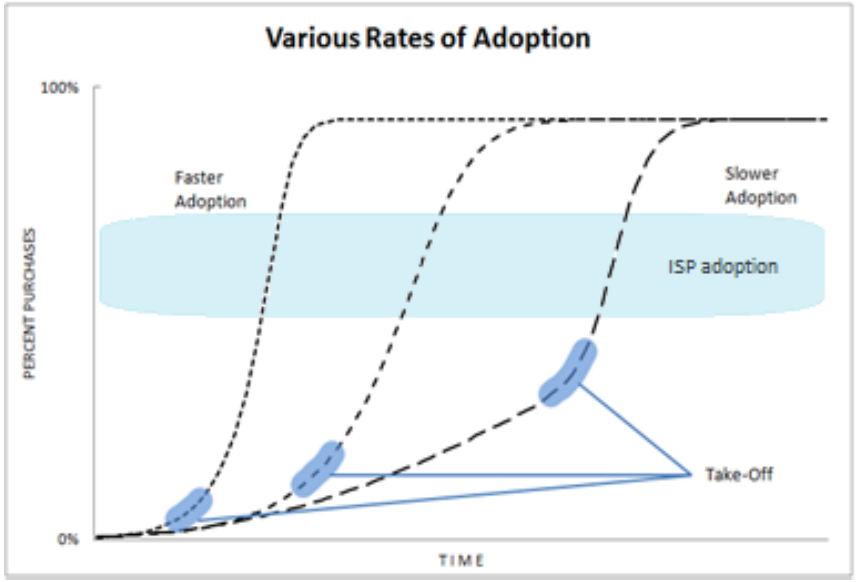
INDUSTRIAL AND AGRICULTURAL: MARKET TRANSFORMATION METRICS

ISP conversion rates are driven technology adoption rates (see next slide)

Market Transformation Metrics (forecast influencers)	Model Default Assumptions (trends over analysis period)
Saturation levels	Increasing
NTG	Decreasing
Industry Standard Practice (ISP)	Increasing conversion Rate similar to codes and standards trends[1]
Codes & Standards (C&S)	Trends on commercial measures where applicable to the Industrial / Agricultural sectors

1. Studies and guidance at http://www.cpuc.ca.gov/General.aspx?id=4133

ISP Guide Version 1.2A: Adoption Rate Example



Source: http://www.cpuc.ca.gov/General.aspx?id=4133

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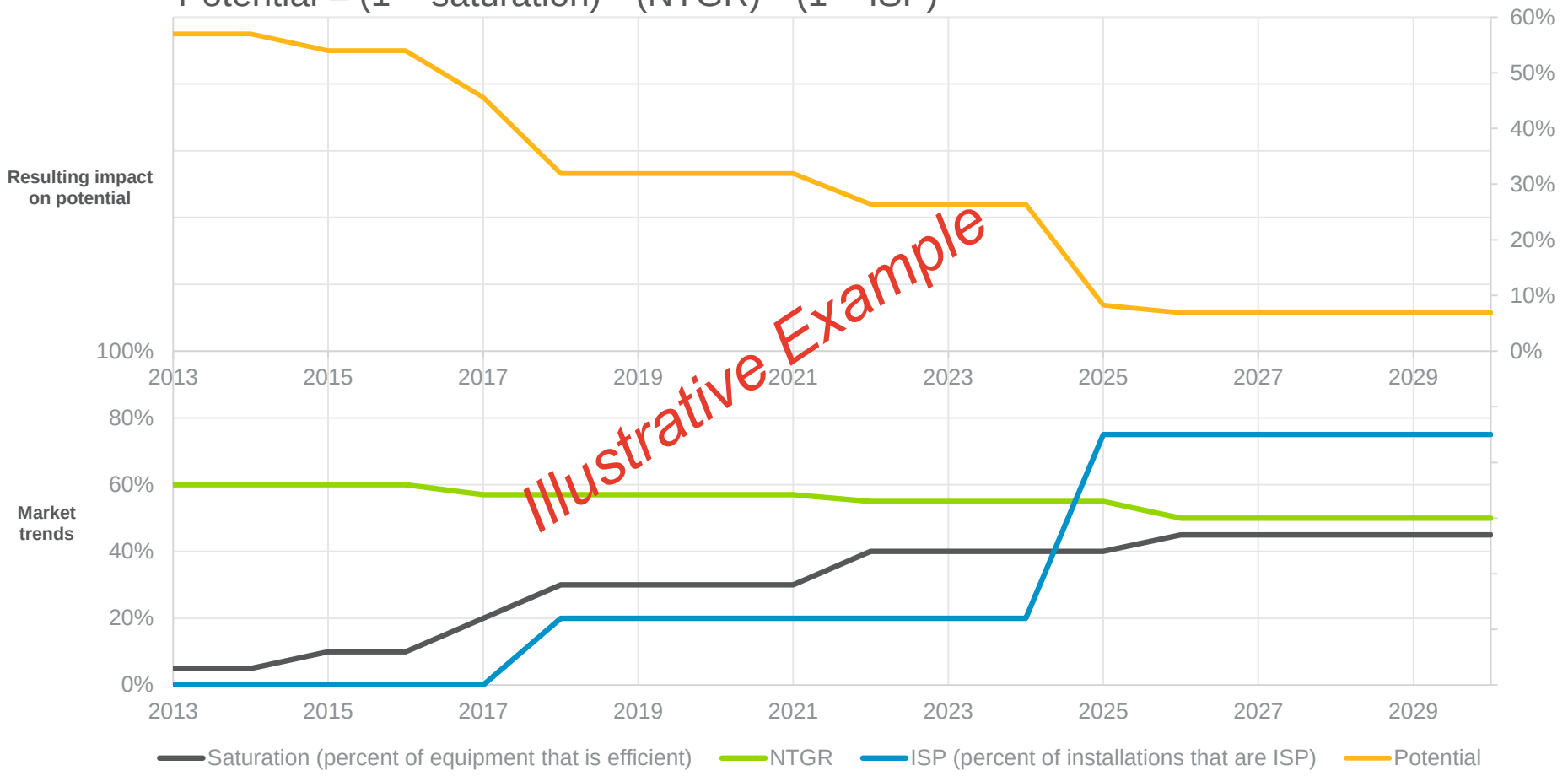
INDUSTRIAL AND AGRICULTURAL: MARKET TRANSFORMATION METRICS (CONTINUED)

Potential is a function of saturation, NTG, and ISP

Potential = (1 – saturation) * (NTGR) * (1 – ISP)



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