CONSULTANT REPORT

California Statewide Codes and Standards Program Impact Evaluation Report: Phase One Appliances

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California Public Utilities Commission
505 Van Ness Avenue
San Francisco, California 94102

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Prepared by:
Cadmus / Energy Services Sector
720 SW Washington Street, Suite 400
Portland, OR 97205

DNV GL / Sustainable Energy Use
155 Grand Avenue, Suite 500
Oakland, CA 94612

Prepared for:
California Public Utilities Commission
Paula Gruendling
Contract Manager

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Finally, we appreciate the comments and questions from other groups and individuals that are not closely involved but who still took an interest in this evaluation.

Project Contacts

Organization / Role	Name	Address	E-mail	Phone
Energy Division, California Public Utilities Commission (CPUC)	Paula Gruendling	Energy Division, CPUC 505 Van Ness Avenue San Francisco, CA 94102	paula.gruendling@cpuc.ca.gov	(415) 703-1925
EM&V Advisor to staff of CPUC	Nikhil Gandhi	Strategic Energy Technologies, Inc. 17 Willis Holden Drive Acton, MA 01720	nikhilvgandhi@gmail.com	(978) 264-0511
EM&V Advisor to staff of CPUC	Jim McMahon	Better Climate Research and Policy Analysis 138 Brookfield Drive Moraga, CA 94556	jim@betterclimate.info	(510) 520-8026
DNV GL	John Stoops, Ph.D.	155 Grand Avenue, Suite 500 Oakland, CA 94612	john.stoops@dnvgl.com	(510) 290-5054
Cadmus	Allen Lee, Ph.D.	720 SW Washington, Suite 400 Portland, OR 97205	allen.lee@cadmusgroup.com	(503) 467-7127
Cadmus	Dan Groshans	720 SW Washington, Suite 400 Portland, OR 97205	dan.groshans@cadmusgroup.com	(503) 467-7182

Abstract

This report presents results from the impact evaluation of the California statewide Codes and Standards Program (the Program) for program years 2013 through 2015. The evaluation was conducted for the California Public Utilities Commission (CPUC). The Program implemented jointly by PG&E, SDG&E, SCE, and SCG provides technical, cost, and market studies that support the adoption of standards by the California Energy Commission (CEC) and the federal government. This report on the first phase of the evaluation covered energy, demand, and natural gas impacts from the adoption of Title 20 and Federal appliance standards that became effective in 2013 and 2014. Evaluation of the 2013 Title 24 and appliance standards effective in 2015 will be included in the report on the second phase of the study.

The evaluation methodology followed the California protocol. First, we estimated potential savings that would result if all new appliances met code. Next, we adjusted for compliance to determine gross savings. We then determined net savings by adjusting—with the help of many industry experts—for naturally occurring market adoption (NOMAD) of energy-efficient units. To determine net Program savings an attribution adjustment was made by a panel of independent experts to account for the Program's effect on standard adoption. Finally, net savings were allocated to IOUs based on their share of California electricity and gas sales.

For the Phase One Title 20 standards, the evaluation found statewide realization rates relative to the IOU Estimated savings of 88% (503 GWh) and 46% (39 MW), respectively, for cumulative electricity and demand savings over the three-year period.

Keywords: impact evaluation, codes and standards

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Executive Summary

Introduction

Energy-efficiency standards set minimum efficiency levels that new appliances and buildings must meet or exceed. Because they eliminate low-efficiency products from the market, these standards are an important component of reducing energy consumption.

Starting in the late 1990s, California's Investor-Owned Utilities (IOUs) have taken a significant role in researching, proposing, and promoting efficiency standards through what has become the statewide utility Codes and Standards (C&S) Program. Each IOU has a C&S program. These individual programs provide a place within each utility for funding the program activities and recording the C&S savings claimed in the IOU energy-efficiency portfolios.

Scope

This is the third impact evaluation of the statewide C&S program and it includes the program years 2013, 2014, and 2015.[1] As in the 2010-2012 evaluation, savings claimed by the statewide C&S Program were produced by California codes and standards (Title 20 and Title 24) and savings produced by federal regulations.

The statewide C&S Program is organized into five distinct subprograms: Building Codes Advocacy, Appliance Standards Advocacy, Compliance Improvement, Reach Codes, and Planning and Coordination. The advocacy and reach codes subprograms are resource programs where the other two are not. In this evaluation we focus on the Building Codes and Appliance Standards advocacy subprograms since these two subprograms are responsible for nearly all of the energy and gas savings.

As shown in Table ES-1, we are conducting the evaluation in two distinct phases. Working with the CPUC staff and advisors, we decided on this approach for several reasons. When the initial plan was made, the scope included only program years 2013 and 2014. We considered the CPUC objective to report evaluation results in Q1 2016. Our plan also reflects the dynamics of evaluation: appliance standards can be evaluated in a shorter time period than building codes. The plan reached its current state when the evaluation scope was extended to include program year 2015 and evaluation of all Title 24 codes were then included in Phase Two.

Table ES-1. C&S Groups, Evaluation Phases, and Expected Reports

Description	Effective Date	Evaluation Phase	Report Expected
Title 20 and Federal Appliance Standards	2013, 2014	Phase One	Q2 2016
Federal Appliance Standards	2015	Phase Two	Q1 2017
2013 Title 24: Nonresidential and Residential	7/1/2014		

[1] The first impact evaluation covered 2006-2008 and the second covered 2010-2012.

New Construction and Alterations			

We present the IOU estimate of savings from new C&S in Table ES-2. This report delivers the Phase One evaluation results for all of the Title 20 and federal appliance standards that became effective in 2013 and 2014. In Section 5.4 of this document, we also include savings from previously evaluated appliance standards since they represent continuing savings.

Since the IOU estimate did not include attribution values for federal standards, we are not able to show comparisons between IOU estimates and evaluated net program savings or IOU share savings.

In the Phase Two report planned for Q1 2017, we will include evaluation results for the 2013 Title 24 and the group of federal appliance standards (shown at the bottom of the table) that became effective in 2015.

Throughout this report, all savings values shown are statewide unless they are explicitly labelled as "IOU Share" or identified with a specific IOU as in Table ES-3.

Table ES-2. IOU Estimate of Total Energy and Demand Savings for 2013-2015 by Project Phase

	Total Savings for 2013-2015	GWh		MW		MTherms	
	Category	Potential	IOU Share	Potential	IOU Share	Potential	IOU Share
Phase One	2006-2009 T-20 Std 28b (TVs Tier 2)	1,072	197	119	22	-21	-4
	2011 T-20 (Battery chargers)	1,303	372	220	63	-25	-7
	All Phase One C&S (except federal)	**2,375**	**569**	**339**	**85**	**-46**	**-11**
	2013 Federal Appliance standards*	108		40		0	
Phase Two							
	2013 T-24 Nonres. Alterations	1,226	417	321	107	2	0
	2013 T-24 Nonres. New Construction	670	271	139	56	4	2
	2013 T-24 Residential	76	26	87	27	4	2
	All Phase Two C&S (except federal)	**1,972**	**714**	**547**	**190**	**10**	**4**
	2015 Federal Appliance standards	495		348		0	

* Excludes Fed 8 Commercial Clothes Washers since compliance for this standard will be evaluated in Phase Two

Findings

In Table ES-3, we summarize the electric energy savings (in GWh) from the Phase One Title 20 standards for each IOU. In the last row of the table, we provide a comparison of the total evaluated savings to the IOU Estimate. As shown, evaluated net program savings were found to be 88% of the value included in the IOU Estimate.

Table ES-3. Evaluated vs. IOU Estimate: IOU Share of 2013-2015 PY
Phase One Title 20 Electricity Savings (GWh)

GWh	Percentage of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	31.6%	750	634	366	251	843	792	376	222
SCE	32.6%	774	654	377	259	870	817	388	229
SDG&E	7.4%	176	148	86	59	197	185	88	52
All IOUs	**71.6%**	**1,699**	**1,437**	**829**	**569**	**1,911**	**1,794**	**853**	**503**
					Evaluated/IOU Estimated	**112%**	**125%**	**103%**	**88%**

In Table ES-4, we summarize the electric energy savings (in GWh) from the Phase One federal standards for each IOU. In the last row of the table, we provide a comparison of the total evaluated savings to the IOU Estimate. As shown, evaluated net savings were found to be 151% of the value included in the IOU Estimate.

Table ES-4. Evaluated vs. IOU Estimate: IOU Share of 2013-2015 PY
Phase One Federal Appliances Electricity Savings (GWh)

GWh	Percent of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	31.6%	34	30	27	-	52	47	41	17
SCE	32.6%	35	31	28	-	53	48	42	17
SDG&E	7.4%	8	7	6	-	12	11	9	4
All IOUs	**71.6%**	**77**	**69**	**61**	**-**	**117**	**106**	**92**	**38**
					Evaluated/IOU Estimated	**151%**	**153%**	**151%**	**n/a**

In Table ES-5, we present our findings in terms of demand savings from the Phase One Title 20 standards in the IOU service territories. The last row provides a comparison of the evaluated savings to the IOU Estimate. We observe that evaluated net program demand savings were found to be 46% of the IOU Estimate.

Table ES-5. Evaluated vs. IOU Estimate: IOU Share of 2013-2015 PY
Phase One Title 20 Demand Savings (MW)

MW	Percent of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	31.6%	107	91	54	37	69	66	29	17
SCE	32.6%	111	93	55	39	72	68	30	18
SDG&E	7.4%	25	21	13	9	16	15	7	4
All IOUs	**71.6%**	**243**	**205**	**121**	**85**	157	149	65	39
					Evaluated / IOU Estimated	**65%**	**72%**	**54%**	**46%**

In Table ES-6, we present our findings in terms of demand savings from the Phase One federal standards in the IOU service territories. Here again, the IOU estimate did not include net program values so no comparison is possible. The last row provides a comparison of the evaluated savings to the IOU Estimate. We observe that evaluated net demand savings were found to be 159% of the IOU Estimate.

Table ES-6. Evaluated vs. IOU Estimate: IOU Share of 2013-2015 PY
Phase One Federal Appliances Demand Savings (MW)

MW	Percent of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	31.6%	13	11	10	-	22	20	16	5
SCE	32.6%	13	12	11	-	23	21	17	5
SDG&E	7.4%	3	3	2	-	5	5	4	1
All IOUs	**71.6%**	**29**	**25**	**23**	**-**	**50**	**45**	**37**	**12**
					Evaluated / IOU Estimated	**176%**	**179%**	**159%**	**n/a**

In Table ES-7, we present our findings for gas savings from the Phase One Title 20 standards when interactive effects[2] (IEs) are included. We found there are no direct savings from the Phase One Title 20 standards so all gas impacts are the result of secondary IEs. Since there are no direct savings, we do not present a table with IEs excluded (from Title 20 standard savings) since all values are zero.

With regard to gas savings attributed to SCG, CPUC policy is for savings to be determined excluding any interactive effects. As noted above, there are no gas savings from Title 20 standards when IEs are excluded. For federal standards, the savings attributed to SCG are shown in Table ES-9 below in which IEs are excluded.

[2] The impact of each standard includes primary (direct) savings and secondary savings described as interactive effects (IEs). Specifically, IEs include negative gas savings due to increased heating when electric energy is saved indoors and positive electric IEs due to reduced cooling. IEs are discussed in Sections 3.1.2 and 4.1

Table ES-7. Evaluated vs. IOU Estimate: IOU Share of 2013-2015 PY
Phase One Title 20 Gas Savings (MTherms) Including Interactive Effects

MTherms	Percent of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	36.5%	(17)	(14)	(8)	(6)	(16)	(14)	(7)	(4)
SCG	58.4%	(27)	(23)	(13)	(9)	(25)	(23)	(12)	(7)
SDG&E	4.1%	(2)	(2)	(1)	(1)	(2)	(2)	(1)	(0)
All IOUs	**99.0%**	**(45)**	**(38)**	**(22)**	**(15)**	**(42)**	**(39)**	**(20)**	**(12)**
					Evaluated / IOU Estimated	**93%**	**102%**	**91%**	**77%**

In Table ES-8 and Table ES-9, we present our findings for gas savings from the Phase One federal standards when IEs are included and excluded, respectively. Overall, we found much greater potential and gross gas savings than were expected by the IOUs. We found net program savings near zero (or slightly negative when IEs are included) after we adjusted for NOMAD and attribution.

Table ES-8. Evaluated vs. IOU Estimate: IOU Share of 2013-2015 PY
Phase One Federal Appliances Gas Savings Including Interactive Effects (MTherms)

MTherms	Percent of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	36.5%	(0.1)	(0.1)	(0.2)	-	2.2	2.2	0.2	(0.2)
SCG	58.4%	(0.2)	(0.2)	(0.3)	-	3.5	3.5	0.4	(0.3)
SDG&E	4.1%	(0.0)	(0.0)	(0.0)	-	0.2	0.2	0.0	(0.0)
All IOUs	**99.0%**	**(0.3)**	**(0.3)**	**(0.6)**	**-**	**6.0**	**5.9**	**0.6**	**(0.6)**

Table ES-9. Evaluated vs. IOU Estimate: IOU Share of 2013-2015 PY
Phase One Federal Appliances Gas Savings Excluding Interactive Effects (MTherms)

MTherms	Percent of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	36.5%	0.4	0.4	0.2	-	2.9	2.9	0.9	0.1
SCG	58.4%	0.6	0.6	0.3	-	4.7	4.6	1.4	0.1
SDG&E	4.1%	0.0	0.0	0.0	-	0.3	0.3	0.1	0.0
All IOUs	**99.0%**	**1.1**	**1.0**	**0.5**	**-**	**8.0**	**7.8**	**2.3**	**0.1**

Conclusions and Recommendations

Conclusion: Delivery of program savings estimates, CASE reports, and CCTRs has improved but there are still significant gaps in the documentation available to evaluators.

Improvements include the following:

- Nearly all parameters (the exception was attribution values for federal standards) were provided at the start of the evaluation in the ISSM format.
- Sources of market volumes were documented as requested.
- CASE reports and CCTRs were delivered as planned and in a shorter period of time than previously.
- Although no federal attribution values were provided, attribution documentation in support of federal standard adoption was generally complete and met the requirements identified previously.

Significant gaps in documentation:

- **Product market volumes**. It was often not possible to find which specific values in the source were used. Sources were often several years old; not current market conditions.
- **Unit energy savings**. Values submitted in the IOU estimate did not match the CASE report and no other documentation was provided. The absence of documentation makes it impossible to reconcile evaluation findings to the submitted estimate.
- **Standards developed after CASE reports were completed**. For example, the Small Battery Charger, Tier 2 (Standard 30). This product category—USB chargers with greater than 20 Watt hour capacity—is not identified in the CASE report yet it was adopted by the CEC. We received no documentation of the basis for unit energy savings, market volume, or savings potential.

Recommendations:

The statewide program administrators and CPUC should resolve data gap issues before starting the next impact evaluation.

The IOUs should update the CASE reports or provide supplementary documentation that reflects the adopted standard.

Conclusion: Verification of compliance is becoming more challenging.

There are a few aspects to this issue including:

- Increasing complexity of regulations. For example, Title 20 regulations on battery charger systems have led to the CEC listing some end-use devices and some battery charger components but these listings do not include the entire battery charger system. There are similar issues with regulations on swimming pool systems which have changed from pump regulations to system regulations.
- Product proliferation. For products such as televisions and battery charger systems, the CEC listing process lags the rapidly changing set of products available in the market. To measure compliance, it requires additional research to determine compliance for the set of unlisted products.

Recommendation: The CPUC and evaluators should consider collaboration with the CEC to make efficient use of resources used to determine compliance.

Conclusion: Grouping of multiple product types / standards in a single CASE report or CCTR tends to limit the evaluators' ability to assign attribution scores to each standard

Examples include battery chargers where a single CCTR was provided for four standards. As noted earlier, the CASE report included three categories but there were no references to the Small Charger, Tier 2 USB product category. A second example is the combined documentation for water heaters, pool heaters, and direct heating equipment.

Recommendation: Dissimilar technologies not be grouped together in a CASE report or CCTR.

1 Background on the Codes and Standards Program

1.1 Description of the California Statewide Program

Efficiency codes and standards set minimum efficiency levels that new buildings and appliances must meet or exceed. Because they eliminate low-efficiency products from the market, standards are an important component of reducing energy consumption.

In the 1970s, states throughout the country began establishing regulatory frameworks for developing, adopting, and implementing efficiency standards. In 1974, the California State Legislature created the California Energy Commission (CEC), an agency with a regulatory role to adopt building and appliance efficiency standards. The California building standards are referred to as Title 24 standards and the appliance standards are referred to as Title 20 standards based on their respective locations in the California Administrative Code.[3] Both the federal government and individual states have continued developing and upgrading their efficiency standards over the past 40 years.

Starting in the late 1990s, California utilities began having a significant role in researching, proposing, and promoting efficiency standards through what has become the statewide utility codes and standards program. In recent years, the Investor Owned Utilities (IOUs) have organized the statewide program into five distinct subprograms: Building Codes Advocacy, Appliance Standards Advocacy, Compliance Improvement, Reach Codes, and Planning and Coordination. The following section includes the overall mission of the program, a brief description of each subprogram, and the program budget.

1.1.1 Program Description and Budget for the Codes and Standards Program

According to the Statewide Codes and Standards Program Implementation Plan,[4], the mission of the program is to save energy on behalf of ratepayers by influencing continuous improvements in energy efficiency regulations, improving compliance with existing codes and standards, and working with local governments to develop ordinances that exceed statewide minimum requirements.

Building Codes Advocacy Subprogram and Appliance Standards Advocacy Subprogram

These two subprograms conduct advocacy activities to improve building and appliance efficiency regulations. The principal audience is the California Energy Commission (CEC) which conducts periodic rulemakings, usually on a three-year cycle (for building regulations), to update building and appliance energy efficiency regulations. In some cases, the program may seek to influence the state legislature and other state agencies like California Air Resources Board (CARB) to influence policy regarding buildings and appliances.

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[3] In general, this report refers to standards that are adopted to regulate building energy efficiency as codes and standards that apply to appliances and equipment as standards.

[4] The Program Implementation Plans (PIPs) for the statewide program can be found with the "Regulatory" documents for PY 2013-15 on the following web page: http://eestats.cpuc.ca.gov/

One of the subprogram activities is development of Codes And Standards Enhancement (CASE) studies, focused on energy efficiency improvements for promising design practices and technologies. These studies are presented to standards- and code-setting bodies. Advocacy also includes affirmative expert testimony at public workshops and hearings, participation in stakeholder meetings, ongoing communications with industry, and a variety of other support activities.

The program also works to influence the federal government and national energy policies that impact California. It does this by working with Federal partners such as the American Council for an Energy Efficient Economy (ACEEE) or Appliance Standards Awareness Project (ASAP). The program also participates in United States Department of Energy (DOE) proceedings and legislative negotiations leading to federal regulations that are passed through to California; in particular, Title 20 appliance efficiency regulations that are the same as federal regulations.

Compliance Improvement Subprogram

Following adoption, C&S supports compliance improvement with both Title 24 building codes and Title 20 appliance standards. Compliance improvement activities complement the advocacy work by maximizing verified savings from codes and standards that are realized and persist over time. The Compliance Improvement subprogram targets market actors throughout the entire compliance chain, providing education, outreach, and technical support and resources to improve compliance with both the building and appliance energy standards.

Reach Codes Subprogram

In addition to mandatory minimum-level codes, the C&S program advocates for the development and implementation of "reach codes" that exceed minimum state code requirements. Such codes have been adopted by many local jurisdictions with the subprogram's support.

Planning and Coordination Subprogram

The new Planning and Coordination subprogram expands the coordination role of the C&S program in the market adoption cycle for energy efficiency technologies and practices. As many of the measures offered through voluntary programs are adopted into the standards, this subprogram works to support portfolio planning with the objective of accelerating market acceptance and adoption of successful, cost-effective technologies or practices into code.

Table 1 shows the C&S program and subprogram budgets for 2013 through 2015, with the total allocated for each utility. Of the five subprograms, the advocacy and reach code efforts are resource programs. Historically, nearly all—over 99% in 2012—of the energy and demand savings from the C&S program have been associated with the advocacy subprograms. The other subprograms, Compliance Improvement and Planning and Coordination, are non-resource programs.

Table 1. C&S Program Budgets for 2013-2015*

Program by Utility	PG&E	Edison	SDG&E	SoCalGas	Total
Building Codes Advocacy	$8,448,762	$5,160,765	$813,357	$627,248	**$15,050,132**
Appliance Standards Advocacy	$6,508,639	$5,160,765	$638,131	$500,255	**$12,807,791**
Compliance Improvement	$3,593,615	$3,444,109	$979,210	$750,335	**$8,767,268**
Reach Codes	$1,106,918	$1,362,738	$284,502	$255,026	**$3,009,183**
Planning and Coordination	$2,460,777	$2,610,952	$450,226	$383,956	**$5,905,911**
Total Budget by Utility	**$22,118,711**	**$17,739,329**	**$3,165,426**	**$2,516,820**	**$45,540,284**

*We obtained budget information from the PIPs which can be found through the footnote in Section 1.1.1

1.1.2 Context for Program Impact Evaluation

In 2006, California adopted an evaluation protocol that included a methodology for evaluating C&S programs. That methodology was fully implemented for the first time during the 2006-2008 program evaluation cycle. The original protocol and the methods developed in prior evaluations have now established a basis for evaluating and verifying savings from the program to be used in the regulatory process, modified or supplemented thereafter as needed by the CPUC staff guidance. One modification to the original protocol was the decision to eliminate a component called Naturally Occurring Standards Adoption (NOSAD). Reasons for this were documented in the impact evaluation report for PY 2006-2008[5]. The evaluation team also supplemented the evaluation process when we began using the current three-factor method to determine attribution in the course of the 2006-2008 evaluation. A very similar method was then incorporated by the team into the federal attribution policy approach during the 2010-2012 evaluation[6]. Another notable part of the prior evaluations was the development of the Integrated Standards Savings Model (ISSM), a flexible Microsoft Excel-based model for calculating energy and demand savings.

1.1.3 C&S Grouping and Evaluation Scope: Phase One and Phase Two

In the California Statewide Codes and Standards Program Impact Evaluation Plan: Phase One,[7] we discussed the reasons for the decision to conduct the evaluation into two phases. Initially, the evaluation scope and budget was defined to evaluate the impact—in 2013 and 2014—of codes and standards that took effect in 2013 or 2014. Under these conditions, the scope did not include appliance

[5] Volume III Codes & Standards (C&S) Programs Impact Evaluation California Investor Owned Utilities' Codes and Standards Program Evaluation for Program Years 2006-2008, April 9, 2010. This report can be found at http://calmac.org/ and has CALMAC Study ID: CPU0030.06

[6] This was the subject of a panel study at the 2015 IEPEC. The paper can be found online: http://www.iepec.org/wp-content/uploads/2015/papers/002.pdf

[7] California Statewide Codes and Standards Program Impact Evaluation Plan: Phase One. Available online: http://www.energydataweb.com/cpucFiles/pdaDocs/1306/CPUC%20CS%20Evaluation%20Plan%20Phase%20One%20DRAFT%2005282015.pdf

standards that took effect in 2015. And it only included nonresidential alterations (NRAs) under the 2013 Title 24 since the code became effective in July 2014. No impact was expected from new construction under the assumed nine-month lag between the code effective date and the completion of nonresidential buildings under the new code.

Another important consideration in the project planning was the CPUC objective to report evaluated savings annually beginning in the first quarter of 2016. For this reason, as shown in Table **2**, we structured the phases such that we could complete the initial reporting on Phase One appliance standards in that timeframe.

It was apparent in the initial planning that evaluation of NRAs under the 2013 Title 24 would not be completed until sometime in the second quarter of 2016. Subsequently, we also learned that the CPUC authorized the extension of the 2013-2014 cycle to include 2015 for EM&V purposes and authorized funds to cover the extended scope.

As planning proceeded for Phase Two of the project, the project management team agreed that it would be better to report all of the 2013 Title 24 results at one time rather than in separate reports. For this reason, all of the 2013 Title 24 is now included in Phase Two (where the NRAs were included in Phase One in the evaluation plan) as shown in Table **2**.

Table 2. C&S Groups, Evaluation Phases, and Expected Reports

Description	Effective Date	Evaluation Phase	Report Expected
Title 20 and Federal Appliance Standards	2013, 2014	Phase One	Q1 2016
Federal Appliance Standards	2015	Phase Two	Q1 2017
2013 Title 24: Nonresidential and Residential New Construction and Alterations	7/1/2014		

1.1.4 Scope for 2013-2015 Impact Evaluation: Phase One[8]

Table 3 summarizes the evaluation plan for Phase One for all of the appliance standards within the overall project scope. In the table, shaded cells indicate that evaluation activity is not planned as part of Phase One. We used the following codes to identify situations where a parameter is not evaluated:

- **PE:** The parameter was *previously evaluated* and we have no reason to re-evaluate it (e.g., NOMAD for Standard 28b).
- **n/a:** Evaluation is *not applicable* since the code has not yet taken effect (e.g., Std 31) or the fuel is out of scope (e.g., Fed 22).
- **Phase 2:** We plan to evaluate the parameter in Phase 2 (e.g., Compliance for Federal standards 18 through 21).

Table 3. Evaluation Scope for Phase One Appliance Standards

Group	Standard	Description	C&S Start Year	2013-15 Potential Energy Savings GWh	2013-15 Potential Gas Savings MTherms	Potential*	Compliance*	NOMAD*	Attribution*
2006-2009 Title 20	Std 28b	Televisions Tier 2	1/1/2013	1,073	(21)	1	1	PE	PE
2011 Title 20	Std 29	Small Battery Chargers – Tier 1	2/1/2013	1,179	(23)	1	1	PE	1
	Std 30	Small Battery Chargers – Tier 2	1/1/2014	65	(1)	1	1	1	1
	Std 31	Small Battery Chargers – Tier 3	1/1/2017	-	-	n/a	n/a	PE	1
	Std 32	Large Battery Chargers	1/1/2014	59	-	1	1	1	1
2013 Fed Appliance	Fed 8	Commercial Clothes Washers	1/8/2013	1	0	1	2	1	1
	Fed 9	Residential Pool Heaters	4/16/2013	-	0	1	1	1	1
	Fed 10	Residential Direct Heating Equipment	4/16/2013	(0)	1	1	1	1	1
	Fed 11	Residential Refrigerators & Freezers	9/15/2014	41	(1)	1	1	1	1
	Fed 12	Residential Room AC	6/1/2014	14	-	1	1	1	1
	Fed 13	Fluorescent Ballasts	11/14/2014	51	(1)	1	1	1	1
	Fed 14	Small Comm. Package ACs	6/1/2013	0	-	1	1	1	1
	Fed 15	Large Comm. Package ACs	6/1/2014	0	-	1	1	1	1
	Fed 16	Computer Room ACs	10/29/2013	0	-	1	1	1	1
	Fed 17	Res. Dishwashers	5/30/2013	3	0	1	1	1	1
2015 Fed Appliance	Fed 18	Res. Clothes Dryers	1/15/2015	28	(1)	1	2	1	1
	Fed 19	Res. Gas-fired water heater	4/15/2015	-	0	1	2	1	1
	Fed 20	Res. Electric storage water heater	4/15/2015	77	-	1	2	1	1

[8] In the program impact evaluation plan, the scope for appliance standards included compliance for the General Service Fluorescent Lamp standard (Fed 7). The correct standard is the Incandescent Reflector Lamp standard (Fed 6) for which compliance was found to be 6%. We expect to complete the compliance evaluation as part of Phase Two of the project.

Group	Standard	Description	C&S Start Year	2013-15 Potential Energy Savings GWh	2013-15 Potential Gas Savings MTherms	Potential*	Compliance*	NOMAD*	Attribution*
	Fed 21	Res. Gas-fired instant. water heater	4/15/2015	(3)	1	1	2	1	1
	Fed 22	Res. Oil-fired storage water heater	4/15/2015	0	-	n/a	n/a	n/a	n/a
	Fed 23	Small Electric Motors	3/15/2015	164	-	1	2	1	1
	Fed 24	Res. Clothes Washers (Front Load)	3/15/2015	2	(0)	1	2	1	1
	Fed 25	Res. Clothes Washers (Top Load)	3/15/2015	44	(1)	1	2	1	1
	Fed 26	Res. Central AC, HPs, Furnaces	1/15/2015	183	-	1	2	1	1

*Key: 1 = Evaluation is planned for Phase One; 2 = Evaluation is planned for Phase Two; PE = Previously Evaluated; NA = Not Applicable

Regarding the previously evaluated parameters, we collected expert input for NOMAD for the battery charger standards (29, 30, and 32) because the effective dates were originally earlier than shown above. Even with the new dates, the NOMAD data was collected for standards 29 and 30 several months after the standard became effective. Ideally, NOMAD data is collected shortly—less than one year—after a standard becomes effective. We assume that the experts are most knowledgeable about the market share of the newly regulated product at the time the standard was adopted or shortly after adoption. For this reason, we expect the estimate to be more accurate when NOMAD data is collected within the first year after adoption.

Similarly, we believe the best time to evaluate attribution is shortly after the standard has been adopted. In the case of the television standards 28a and 28b, these standards were adopted at the same time. Since standard 28a became effective at the beginning of 2011, we evaluated attribution for both parts of the adopted standard during the 2010-2012 impact evaluation.

In this Phase One report, we present evaluation results for four of the five Title 20 standards listed. Standard 31 was adopted along with the other 2011 Title 20 standards, but does not take effect until 2017. We evaluated attribution for this standard, but will not evaluate potential and compliance until after the standard's effective date. So the report will include results for these Title 20 standards: 28b, 29, 30, and 32.

As shown in Table 3, the 2013 federal appliance standard group includes those standards that became effective in 2013 and 2014 (Federal standards 8 through 17). As noted in the evaluation plan for the commercial clothes washer standard (Fed 8), we expect to measure compliance in Phase Two since we may be able to conduct site visits during Title 24 field data collection. Therefore, this Phase One report includes our findings for Federal standards 9 through 17. Complete results for Fed 8 will be included in the Phase Two report.

The 2015 federal appliance group includes those that became effective in 2015 (Federal standards 18 through 26). We will report evaluation results for these standards in Phase Two.

1.2 IOU Estimate of Savings During 2013 to 2015

The IOUs provided an estimate of savings from the statewide C&S program in response to a data request from Commission staff. The IOU estimate includes the primary energy savings from each code or standard and secondary savings that are often described as interactive effects (IEs). Specifically, the IOU estimate includes negative gas savings due to increased heating when electric energy is saved indoors and positive electric IEs due to reduced cooling. In this report, all of the values shown for the IOU estimate and evaluated savings include both primary energy savings and secondary IEs unless otherwise noted.

Throughout this report, we present the IOU estimate and the evaluation results based on the framework defined by the California Evaluation Protocols. We include a brief review of the evaluation protocol in Section 2.1 to define the terminology and methods used to describe and calculate savings from the program.

Table 4 summarizes the IOU estimate for savings from new codes and standards during the years 2013, 2014, and 2015. In this table, and generally throughout this report, all values represent savings for the entire state of California unless they are values for a specific IOU or identified as "IOU Share." The IOU designation means that savings have been scaled to one utility's service territory or the cumulative total for all four IOU service territories.

Values labelled "IOU Share" in the tables are savings within the IOU service territories.

The IOU estimate of potential savings from the two groups of Federal Appliance standards is also included in Table 4. Since the IOUs did not provide attribution values for these standards, there is no IOU estimated value for the IOU Share of savings. We report the Title 20 and Federal standards separately in this report because we frequently compare IOU estimated savings to evaluated savings and meaningful comparisons are not possible for the two groups combined.

Throughout this report, all savings values shown are statewide unless they are explicitly labelled as "IOU Share" or identified with a specific IOU.

Table 4. IOU Estimate of Total Energy and Demand Savings for 2013-2015 by Project Phase

	Total Savings for 2013-2015	GWh		MW		MTherms	
	Category	Potential	IOU Share	Potential	IOU Share	Potential	IOU Share
Phase One	2006-2009 T-20 Std 28b (TVs Tier 2)	1,072	197	119	22	-21	-4
	2011 T-20 (Battery chargers)	1,303	372	220	63	-25	-7
	All Phase One C&S (except federal)	**2,375**	**569**	**339**	**85**	**-46**	**-11**
	2013 Federal Appliance standards*	108	-	40	-	0	-
Phase Two							
	2013 T-24 Nonres. Alterations	1,226	417	321	107	2	0
	2013 T-24 Nonres. New Construction	670	271	139	56	4	2
	2013 T-24 Residential	76	26	87	27	4	2
	All Phase Two C&S (except federal)	**1,972**	**714**	**547**	**190**	**10**	**4**
	2015 Federal Appliance standards	495	-	348	-	0	-

* Excludes Fed 8 Commercial Clothes Washers since compliance for this standard will be evaluated in Phase Two

1.2.1 Title 20 Standards

Table 5, Table 6, and Table 7 present the IOU estimates of energy (GWh), demand (MW), and gas (Mtherms) savings from the new Title 20 standards in the Phase One scope. In Table 7, all gas savings shown are negative because they represent interactive effects of electric measures on the space heating end use and there are no direct positive gas savings from these Title 20 standards that offset the interactive effects.

Table 5. IOU Estimate of Energy Savings for Title 20 Standards

Electric Energy (GWh)		Phase One Title 20				
		Potential Savings	Gross Savings	Net Savings	Net Program Savings	IOU Share Program Savings
IOU Estimate	2013	719	608	381	258	185
	2014	821	694	401	276	198
	2015	836	707	377	261	187
	Total	**2,375**	**2,009**	**1,158**	**796**	**569**

We note that the total potential savings of 2,375 GWh and the total IOU Share (net savings) of 569 GWh in Table 5 are also shown in Table 4. These values are the sum of savings from the Title 20 standards defined as the Phase One scope for the evaluation.

Table 6. IOU Estimate of Demand Savings for Title 20 Standards

Demand (MW)		Phase One Title 20				
		Potential Savings	Gross Savings	Net Savings	Net Program Savings	IOU Share Program Savings
IOU Estimate	2013	101	86	55	38	27
	2014	118	100	59	41	30
	2015	120	102	56	39	28
	Total	**339**	**287**	**170**	**119**	**85**

Table 7. IOU Estimate of Gas Savings for Title 20 Standards

Gas (MTherms)		Phase One Title 20				
		Potential Savings	Gross Savings	Net Savings	Net Program Savings	IOU Share Program Savings
IOU Estimate	2013	(14)	(12)	(8)	(5)	(5)
	2014	(16)	(13)	(8)	(5)	(5)
	2015	(16)	(13)	(7)	(5)	(5)
	Total	**(46)**	**(39)**	**(22)**	**(15)**	**(15)**

1.2.2 Federal Standards

Table 8, Table 9, and Table 10 present the IOU estimates of energy (GWh), demand (MW), and gas (Mtherms) savings from the new federal appliance standards in the Phase One scope. As noted above, the IOUs did not estimate attribution values for federal standards. Since attribution is the factor needed to calculate net program savings and the IOU share of net program savings, neither of these values are included in the tables in this section.

These estimates also include interactive effects, but for this group of standards, positive gas savings are roughly equal to the negative interactive effects as can be seen in Table 10.

Table 8. IOU Estimate of Energy Savings for Federal Standards

Electric Energy (GWh)		Phase One Federal Appliance				
		Potential Savings	Gross Savings	Net Savings	Net Program Savings	IOU Share Program Savings
IOU Estimate	2013	0	0	0	n/a	n/a
	2014	21	19	16		
	2015	87	77	68		
	Total	**108**	**96**	**85**		

We note that the total potential savings of 108 GWh in Table 8 is also shown in Table 4. These values are the sum of savings from the 2013 Federal standards defined as the Phase One scope for the evaluation.

Table 9. IOU Estimate of Demand Savings for Federal Standards

Demand (MW)		Phase One Federal Appliance				
		Potential Savings	Gross Savings	Net Savings	Net Program Savings	IOU Share Program Savings
IOU Estimate	2013	0	0	0	n/a	n/a
	2014	11	10	9		
	2015	29	25	23		
	Total	**40**	**36**	**32**		

Table 10. IOU Estimate of Gas Savings for Federal Standards

Gas (MTherms)		Phase One Federal				
		Potential Savings	Gross Savings	Net Savings	Net Program Savings	IOU Share Program Savings
IOU Estimate	2013	0	0	0	n/a	n/a
	2014	0	0	0		
	2015	(1)	(1)	(1)		
	Total	**(0)**	**(0)**	**(1)**		

2 Overview of Evaluation Approach

2.1 Protocol

As described in Section 1.1.2 above, in each C&S program evaluation, the evaluation team applies the California Evaluation Protocols with documented modifications during the evaluation process.[9] Figure 1 shows a flowchart of the evaluation process we used for the current evaluation (also used in the 2006-2008 and 2010-2012 program year evaluations).

Figure 1. C&S Advocacy Program Evaluation Protocol

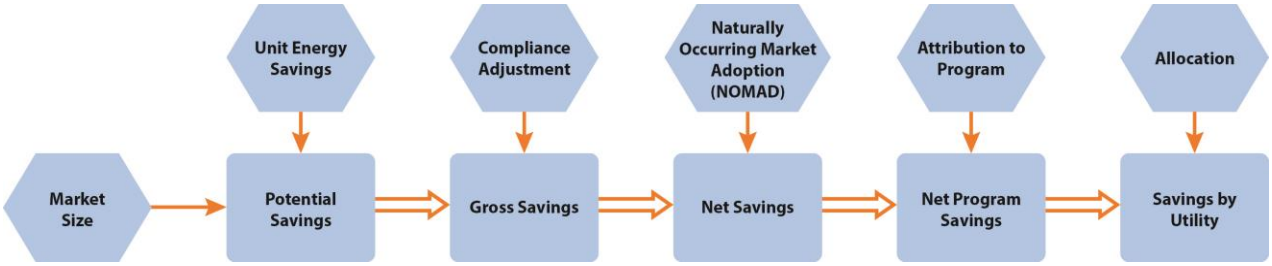

Figure 1 shows the major factors used to determine savings under the protocol. We based the potential energy savings attributable to the C&S program on the estimated unit energy savings and the number of those units (measures or appliances) entering the market each year. We applied the compliance adjustment to potential savings to derive gross energy savings. Net savings result from adjusting the gross savings by the naturally occurring market adoption (NOMAD) of measures or appliances meeting the code or standard that would have occurred in the absence of the code or standard. We determined the net program savings that are credited to the statewide C&S program by applying an attribution score. We then allocated to each utility these net savings attributable to the program, based on each utility's share of the statewide energy market (for electricity or gas).

We implemented the analysis using the Integrated Standards Savings Model (ISSM)—developed by the evaluators specifically for the prior C&S program evaluations and modified for this evaluation—that incorporates all the input data from the evaluation, measurement, and verification (EM&V) activities. Modifications made for this evaluation are described in Section 2.3 below. To help ensure transparency, the evaluation team implemented the model in an Excel workbook. The IOUs use a similar model to calculate their estimate of C&S program savings.

2.2 Objectives

The primary objective of this evaluation is to verify the savings estimates for the advocacy subprograms of the statewide C&S program during the years 2013, 2014, and 2015.

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[9] Hall, Nick, J. Roth, C. Best (TecMarket Works). *California Energy Efficiency Evaluation Protocols.* Prepared for the California Public Utilities Commission. 2006.

In this evaluation, we have prioritized activities based on the magnitude of savings associated with each code or standard and also on the uncertainty of the values used to compute savings. In short, we are focusing activities on C&S with large savings or significant uncertainty.

In the evaluation plan (Section 3.5), we described the approach and expected outcome of a number of smaller, targeted studies planned to address specific research questions. In most of these cases, we expect that the result will inform the calculation of savings using the parameters defined by the evaluation protocol. We expect that the effort to characterize the construction of multifamily housing will be completed during Phase Two of the project. In the Savings Methods research, Cadmus will examine the pros and cons of various approaches to the definition of baseline efficiency and the efficiency level used to determine savings. This project will be completed over the next several months which makes it possible to incorporate key findings into Phase Two of the evaluation.

2.3 Revisions to Integrated Standards and Savings Model (ISSM)

The evaluation team made revisions to the functionality of the existing ISSM to accomplish the following:

- Eliminate the need for maintenance of multiple versions;
- Track and document changes to inputs;
- Allow for scenario analysis; and
- Enhance reporting capabilities.

In the previous version, the model, inputs, and outputs were all included in a single Excel workbook. Each new scenario required the user to make changes to the inputs and then save the ISSM file that also included the new outputs. All comparative analysis had to be done externally.

In the new version, we separated the input files from the ISSM computation engine. The computation workbook is also able to save all outputs to a separate file.

We designed the new ISSM to allow the user to select from various input files via a new interface accessible from the dashboard. The new interface prompts the user to navigate to a folder structure in the directory within which ISSM is stored. This folder structure can be used to manage input files for various scenarios (e.g., IOU estimates, evaluation scenarios or stages, etc.). The new ISSM functionality copies data from the selected input sheets into the model, and lists the sheets chosen by the user on a new tab in the model. The folder name from which sheets are chosen is used to define a scenario, with which ISSM output is tagged. When the user elects to generate output, ISSM creates a file containing: the tab listing the input files, the complete “Standards” tab and the “SummarybyStandard” tab. This file is saved in an Output folder in the same directory and tagged with a scenario and date stamp. (Note that only values, not formulas, are included in the output generated from ISSM.)

2.4 Federal Pre-Emption

In some product categories, a federal regulation is adopted for a product type that was already regulated by the state of California. In these cases, the federal regulation becomes the law and supersedes the state regulation. Once the federal government establishes an energy-efficiency standard, no state may have a regulation different from the federal standard. This is referred to as federal pre-emption.

The standards with potential savings in the evaluation period that are pre-empted by federal regulations are shown in Table 11. We note that none of the new standards included in Phase One are directly affected by federal pre-emption. Adjustments have been made to savings from the previously evaluated lighting standards 11b, 26, and 27 as a result of pre-emption by the federal EISA law. The impact can be summarized as follows:

- Savings from standard 26 in 2012 do not continue in 2013 when it is pre-empted by EISA.
- Savings from standard 27 are included in 2013 but do not continue in 2014 when it is pre-empted by EISA.
- Savings from standard 11b—California's earlier requirement that incandescent lamps reduce energy use by ~5%—decrease in 2012, 2013, and 2014 due to EISA pre-emption of specific lumen ranges.

The effect of pre-emption on the previously evaluated standards is reflected in the summaries included in section 5.4 below.

Table 11. Pre-Empted Standards

Title 20 Standard		Pre-Empted By
Std 1	Commercial Refrigeration Equipment, Solid Door	Fed 3
Std 2	Commercial Refrigeration Equipment, Transparent Door	
Std 3	Commercial Ice Maker Equipment	
Std 5	Refrigerated Beverage Vending Machines	Fed 2
Std 11b	General-Service Incandescent Lamps, Tier 2	EISA
Std 25	General-Purpose Lighting - 100 watt	
Std 26	General-Purpose Lighting - 75 watt	
Std 27	General-Purpose Lighting - 40 and 60 watt	
Std 22a	BR, ER and R20 Incandescent Reflector Lamps: Residential	Fed 6
Std 22b	BR, ER and R20 Incandescent Reflector Lamps: Commercial	

2.5 California Standards Superseded by Later California Standards (Layering)

In the 2010-2012 impact evaluation report, we documented the impact when some of the new California standards superseded efficiency levels set by earlier California standards. In these cases, the

IOU Estimate typically shows savings for each standard in each year. In this model, the first standard produces the first "layer" of savings and each later standard adds another layer of savings.

In D. 10-04-029, the CPUC determined that savings from earlier superseded standards end when a new, more stringent standard takes effect. However, according to Commission staff, portfolio savings targets for 2013-2015 were set assuming layering of superseded standards. Beginning in 2016, potential studies and IOU saving goals will be set with layered savings excluded.

We found no instances where the standards evaluated in Phase One are superseded by another California standard. Nor do the Phase One standards supersede any earlier standards. However, there are layered savings within the previously evaluated standards and savings in the 2013-2015 evaluation period change when depending on whether layered savings are included or excluded. Specifically, savings from standard 11b are lower in 2013 since the 310-749 lumen range (corresponding to 40 and 60 watt lamps) are superseded by Standard 27.

We present the Title 20 standards that have been superseded in Table 12. Specific savings totals with layering included or excluded are presented in section 5.4 below.

Table 12. Superseded California Standards

Earlier Standard		Later Superseding Standard(s)	
Std 11b	General Service Incandescent Lamps, Tier 2	Std 25	General Purpose Lighting, 100 watt
		Std 26	General Purpose Lighting, 75 watt
		Std 27	General Purpose Lighting, 40, 60 watt
Std 18a	Consumer Electronics: Televisions	Std 28a	Televisions, Tier 1

3 Methodology

This chapter provides brief descriptions of the methods used to evaluate the parameters that determine energy savings under the evaluation protocol. We include additional detail on methods in the appendices to this report.

3.1 Potential Savings

Potential savings refers to the maximum theoretical savings of a code or standard in the first full year that it takes effect. The evaluation team calculated these savings by multiplying the annual unit sales in California by the unit energy or demand savings.

3.1.1 Methodology

We used a two-step process for determining potential savings. First, we identified the market impacted by each standard and segmented the market based on the standard's requirements or energy use characteristics. For example, we know the commercial clothes washer standard (Fed 8) has different energy use requirements based on whether the product is a top-loading or front-loading washer. Additional market research revealed the two main applications for commercial clothes washers are laundromats and multifamily dwellings. Therefore, we not only needed to determine the number of commercial clothes washers sold in California each year, we also needed to assign market shares to each of the four categories (top-loading laundromat, front-loading laundromat, top-loading multifamily, and front-loading multifamily).

After we characterized the annual California sales for each market segment, we estimated unit energy savings for products in each market segment. We based the unit energy savings on the following definitions:

- **Baseline**: if there is a previous standard, the previous standard serves as the baseline. If there is no previous standard, we set the baseline as the market-segment-level average efficiency of products that are not compliant with the new standard.
- **Efficient**: this is set as the minimum efficiency level that complies with the standard.

Although we developed unit savings for multiple market segments in our analysis, we reported results at the standard level. ISSM is structured to use a single unit savings value and a single market volume to calculate potential for each standard. When we combine multiple segments into values that represent the total impact of the standard, we refer to the values calculated for use in ISSM as standard level. We used the market shares to develop weighted unit savings at the standard level. Then we multiplied the unit savings by the market size to get the potential savings.

The evaluation team also used fuel weights where applicable. This was pertinent to standards like clothes washers and dishwashers where the fuel affected can vary.

Demand savings are based on peak watt/kWh factors from DEER or IOU work papers.

3.1.2 Interactive effects

As noted above, interactive effects (IEs) are secondary energy impacts that may result from saving energy on a particular end-use. For codes and standards, IEs are associated with savings in total electricity usage and end-uses that are within conditioned space. When energy for a particular end use such as lighting is reduced, the evaluators identify two types of IEs: negative gas savings due to increased heating and positive electric savings due to reduced cooling.

We reviewed the IE factors used in the IOU estimate of savings for the Phase One appliance standards. In almost every case, the IOUs used IE values identified in the previous evaluation and applied them to the new standards. For our evaluation, we checked basic assumptions about whether a measure is located in conditioned space or is outside and whether indoor measures are located in residential or commercial space.

We obtained updated interactive effect values from the most recent Database for Energy Efficient Resources[10] (DEER) and replaced older values with current ones. These values are summarized in the following chapter.

3.1.3 Data Sources

As described in the evaluation plan, the evaluators estimated the potential energy (GWh and MTherms) and demand (MW) savings using a variety of sources including the following:

- DEER;
- IOU Interim Approved Work Papers for 2013 and 2014;
- CASE reports (for Title 20 standards);
- Technical Support Documents published by the DOE (for Federal standards);
- Industry statistics published by product-manufacturing trade organizations;
- Publicly available market characterization reports;
- California evaluation reports or studies;
- Data purchased from market research firms; and
- U.S. Census and U.S. Energy Information Administration data (used to scale national numbers to California-specific values).

After discussion with CPUC staff and advisors, we agreed on the following guidelines to select data to use for the evaluation (if more than one source was available):

- Calculation of unit savings should use California-specific characteristics where available (e.g., number of cycles per year); and

[10] DEER2014-Lighting-IE_and_Adjustment-Factor-Tables-17Feb2014.xlsx

- DEER is preferable to all other sources, however, not all products are available in DEER (e.g., room air conditioning is no longer a DEER measure).

The evaluation team checked all of the data sources used for reasonableness and applicability and documented these data sources in Appendix A.

3.1.4 Findings

We include detailed findings and discussion for potential savings with the overall evaluation results for individual standards in Chapter 4.

3.2 Gross Savings / Compliance

Within the context of energy-efficiency programs, the meaning of compliance varies significantly. For example, in some cases, compliance is defined as a true or false test for a given energy-efficiency measure, while in other instances, compliance is defined as a continuous variable based on energy consumption. For this evaluation, we need a value for compliance that is consistent with the protocol which requires that it be an adjustment of potential savings to gross savings. For this reason, in Table 13 we provide the definitions of compliance terms (used in the 2010-2012 evaluation) that we will continue to use in this study.

Table 13. Definition of Compliance Rate and Adjustment Factor

Term	Definition	Methods
Compliance Rate	A measurement of the total installed building measures or equipment that comply with current code requirements.	**Appliances** Ratio: (equipment that meets the current standard) / (total market volume)
		Buildings *Prescriptive* Ratio: (equipment that meets the current standard) / (total market volume) *Performance* Ratio: (annual energy consumption of building that just meets the current standard) / (annual energy consumption of building as built)
Compliance Adjustment Factor	Measurement used to adjust IOU savings claims	**Appliances** Ratio: (equipment that meets the current standard) / (total market volume)
		Buildings Ratio: (gross savings) / (potential savings) calculated as: $CAF = \frac{(2008 - AsBuilt)}{(2008\text{-}2013)}$

To determine gross savings then, we apply a compliance rate or compliance adjustment factor (CAF) to the potential energy savings. For appliance standards, these terms are interchangeable and both are used in this report.

3.2.1 Methodology

For a state-regulated or federally regulated product to be compliant with the California appliance efficiency regulations, its manufacturer must not only demonstrate that the product meets the performance requirements of the regulations, but also must certify the product's performance with the CEC. The CEC maintains an online database of certified products at the model level.

Ideally, we would determine the compliance rate for each standard based on the sales-weighted percentage of products sampled found in the CEC database. However, this approach is not always feasible for the following reasons:

- Product sales data at the model level are difficult or expensive to obtain.
- The product is often sold as a component of other products (e.g., battery charger systems).

Where feasible, we estimated the listed compliance rate based on the market share of appliances listed in the CEC database.

Assuming that manufacturer product specifications are accurate, it is possible that some products not listed in the CEC database still meet the efficiency regulation requirements. For purposes of consistency across all standards in this evaluation, we based our definition of compliance on the share of the market sampled that meets the efficiency requirements regardless of whether an individual product is listed in the CEC database.

Where data at the model level were available, we weighted the compliance rate based on its market share (percentage of annual sales) using the equation below. The specific model is denoted by the subscript *i* in the equation.

$$Compliance\ Rate = \sum_i \begin{cases} 1\ if\ model_i\ is\ compliant \\ 0\ if\ model_i\ is\ not\ compliant \end{cases} \times [market\ share]_i$$

Where data at the model level were not available or too expensive to gather, we estimated the compliance rate through interviews with industry experts, retailers, distributors, or manufacturers. We scored the interviews based on the interviewee's market share, awareness of the standard and CEC database, and compliance of products sold/distributed/manufactured.

In summary, we used three main methods, depending on data availability, to assess appliance compliance. We list these methods in order of most preferable (and expensive) to least preferable:

- **Analysis of point-of-sale (POS) data:** we purchased California specific sales data for appliances (e.g., TV and certain battery charger products) sold during the 2013 to 2015 time period. This POS data includes unit sales at the model level and covers approximately 75% of sales.[11]
- **Analysis of website data:** we selected stores (preferably across California) that also have websites. At each store, we took a sample of models offered and then assessed the compliance of those models sampled. First, we checked if the model was on the CEC list, then we checked if remaining models were ENERGY STAR certified,[12] and finally, we checked if product performance specifications met the standard requirements. If any of those criteria were satisfied, we counted that model as compliant.
- **Interviews with vendors or manufacturers:** for certain products where compliance was difficult to verify using other methods (e.g., fluorescent ballasts), we used information from interviews conducted with vendors or manufactures.

In some instances, we used a combination of methods to ensure more robust results. For example, we were unable to fully assess compliance for fluorescent ballasts found in distributors' online catalogues using the ballast luminous efficiency (BLE) criterion because the BLE is a new industry-specific term and not yet listed in customer-facing product specification sheets. [13] Instead, we assessed compliance using the CEC list and conducted interviews with manufacturers to better understand the market.

We initially considered conducting store visits to assess compliance, but instead conducted online research for these reasons:

- We could achieve greater sample sizes for the same budget and schedule;
- The shelf stock would only be available for smaller products (not large appliances like refrigerators) and we do not have data showing a relationship between shelf stock and unit sales; and
- Manufacture date, a potential advantage of doing store visits, is not always provided on product packaging or labels. Cadmus staff went to a local retail store and examined a handful of TVs, clothes washers and dryers, laptop computers and mobile phones/fitness trackers, dishwashers, and refrigerators. When we were able to locate product manufacture date, this information was

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11 The data only include sales through vendors who have agreements in place with the market research firm. Sales through smaller stores are not captured through POS data.

12 The latest ENERGY STAR specifications are designed to be more stringent than federal standard requirements. For Title 20 appliances, we check that the ENERGY STAR specification meets or exceeds those required by the California standard.

13 Fluorescent ballasts must meet minimum power factor and BLE requirements in order to comply with the standard.

typically found on a sticker affixed to the store demo product (Figure 2). In the case of TVs and other large appliances (i.e., refrigerator, clothes washer), this sticker was located on an area of the appliance that was difficult to reach, such as behind the TV (which is mounted on a wall or displayed high on a shelf) or on the inside of the refrigerator, dishwasher or clothes dryer. Nearly every TV that we were able to examine up close had a sticker with manufacture date. Computers and refrigerators sometimes had manufacture date available, while dishwashers, clothes washers, mobile phones/fitness trackers, and clothes dryer labels did not provide manufacture date.

Figure 2. Labels showing manufacture date

3.3 Net Savings/NOMAD

This section presents the methodology the evaluation team used to estimate the Naturally Occurring Market Adoption (NOMAD) trend for each of the products or technologies regulated by the Title 20 and federal appliance standards. As noted in the evaluation protocol discussion in Section 2.1 above, the NOMAD value is used to adjust gross savings with the result being net savings.

It is important to understand what is meant by NOMAD, or naturally occurring market adoption. NOMAD is a projection of what the annual sales or installations of items meeting the standards would have been if the standards had not been adopted. It is an estimate of energy-efficient product sales over time. Once the standard is in effect, the natural market no longer exists. However, the evaluation methodology requires that the naturally occurring market trend—the counterfactual—be estimated to derive the net savings for each standard.

3.3.1 Methodology Evaluation Approach

To determine ISSM model coefficients necessary to calculate net energy savings for each Title 20 and federal standard, the evaluation team used a market adoption estimation approach in a Delphi panel framework developed and applied in the two preceding C&S program evaluations. The Delphi panel approach is a structured, interactive technique for obtaining expert group inputs, usually to develop forecasts. Each expert answers a questionnaire that provides a forecast and the expert's rationale in two or more rounds. After each round, a facilitator provides the group with an anonymous summary of the experts' forecasts and their supporting arguments for the forecasts. The experts are given an opportunity to revise their forecasts and again provide their supporting arguments. The process ends after a number of rounds with the intention of reaching consensus or stability. The market adoption

estimation approach uses a convenient, flexible, web-based data-collection application developed by Cadmus, which allows the experts to provide their input when convenient, view the anonymous responses of the other experts, and revise their input. The Cadmus Market Adoption Tool (CMAT), as configured for this study, assumes that market adoption over time can be characterized with an exponential diffusion curve (the S-shaped Bass curve). This way of representing market diffusion of technologies and products has been used widely in market studies.

The evaluation team assembled expert panels for the Title 20 and federal appliance standards. Due to practical limits on time available to recruit experts and other real-world constraints, we dedicated more evaluation resources to the standards with the greatest estimated energy savings, designating them as priority standards as shown in Table 14.

Table 14. List of Priority Standards

Standard	Description
Std 28b	Televisions Tier 2
Std 29	Small Battery Chargers – Tier 1
Std 30	Small Battery Chargers – Tier 2
Std 32	Large Battery Chargers
Fed 9	Residential Pool Heaters
Fed 10	Res. Direct Heating Equip.
Fed 11	Res. Refrig./ Freezers
Fed 12	Residential Room AC
Fed 13	Fluorescent Ballasts
Fed 14	Small Comm. Package ACs
Fed 15	Large Comm. Package ACs
Fed 16	Computer Room ACs
Fed 17	Res. Dishwashers

The evaluation team prioritized data collection for these standards by requiring input from a minimum of five expert panelists for each standard. The remaining standards were also evaluated by multiple experts but the minimum threshold of five expert inputs was not a requirement.

3.3.2 Prior Program Adjustment

The IOUs often implement resource acquisition programs for energy efficiency measures or efficient appliances that may be adopted as requirements in subsequent codes or standards. Such programs sometimes can have an effect on the market adoption of product or measure over time; therefore, we chose to regard them as a part of the naturally occurring market when we solicited expert opinions on the market trends. While we could have asked the expert panelists to estimate market trends in the absence of these programs, we determined in previous evaluation work that it would introduce complexity and too much uncertainty to try to estimate market trends under this assumption.

Therefore, we instructed the expert panelists to estimate the natural market (in the absence of the standard) based on the market they observe prior to the standard taking effect.

Including the market penetration effects of prior IOU programs in the NOMAD estimate raises the issue of how prior programs affect projections into the future of the naturally occurring market. In cases where the programs had a significant impact on the market, it seems likely that the natural market estimates would reflect this program effect. Since NOMAD constitutes a savings deduction, the upward shift in the adoption curve due to programs run in previous years means that net savings would be underestimated.

To correct for the possible inappropriate deduction due to the effects of prior IOU programs, we made an adjustment to the NOMAD estimate when prior programs affected the market. As part of the data-collection process, we requested the IOUs to provide data from their records on every program that affected the product volumes of appliances and measures regulated by the codes and standards being evaluated.

In the course of implementing this adjustment during the two earlier C&S impact evaluations, we modeled the adjustment as a value that is greatest shortly after the programs were active and then it is gradually reduced each year. We used a reduction of 10% of the initial value each year. Under this model, the adjustment will reach zero after 10 years.

Since we have not received prior program information from the IOUs, no adjustments have been made to the NOMAD estimates.

3.4 Net Program Savings/Attribution

Attribution refers to the portion of energy savings that can be credited to the utilities' C&S program efforts for enabling or assisting the adoption of each appliance or building standard. The attribution analysis results in an attribution score (a percentage between 0% and 100%) that represents the relative contribution of the program to adoption of the standard. The evaluation team calculated attribution for both state and federal appliance standards and state building codes in the 2013-2015 program cycle. We used the same evaluation approach as the 2006-2008 and 2010-2012 program cycles.[14]

The process of determining attribution entailed the following steps:

1. We collected data on stakeholder activities from a range of sources, including rulemaking dockets, Code Change Theory Reports (CCTR) (written by the IOUs), and stakeholder interviews.

[14] The Cadmus Group. March 9, 2009. **"**The Proposed Cadmus Attribution Methodology (Revised)." This document can be found online at this site: http://www.energydataweb.com/cpuc/search.aspx . Search for the text "attribution methodology (revised)" to access this document.

2. A panel of independent codes and standards experts assessed the program's contributions to the adoption of each standard based on a careful and systematic review of the evidence and determined an attribution score.

The evaluation team estimated the relative effort required to adopt a new code or standard in three factor areas, described in more detail in the next subsection. We applied each estimate of relative effort as a weight to the factor score to calculate an overall attribution score.

The following sections provide a description of our attribution model, data collection, and attribution analysis for both the state and federal codes and standards.

3.4.1 Methodology: The Attribution Model

The model sets forth specific criteria for evaluating the contributions of the C&S program to standards development and adoption. It applies to both federal and California rulemaking. Our team conducted attribution analysis for 23 appliance and nine building standards, including the following:

- 2011 T20 Battery Chargers (four standards)
- 2013 Federal Appliance (10 standards)
- 2015 Federal Appliance (nine standards)
- 2013 T24 Nonresidential Alteration Building (nine standards)

The model focuses on three areas of activity representing the fundamental requirements that must be met for the California Energy Commission (for state standards), the U.S. Department of Energy (for federal administrative rulemaking), or the U.S. Congress (for federal legislative rulemaking) to adopt a standard; these are referred to as factors in the model and are described below:

The Development of Compliance Determination Methods and Other Special Analytic Techniques

End users must be able to determine that they are in compliance with the standards. Similarly, code officials (in the case of building standards) or manufacturers (for appliance standards) and regulators must have the tools and methods that allow them to verify compliance with the standards. In some cases, determining compliance entails having a reliable test method. In other cases, it involves having an analytical tool that produces results indicating whether compliance is achieved. In addition, some standards require the development of new analytic methods to estimate energy and demand savings.

The Development of Code Language and Technical, Scientific, and Economic Information in Support of the Standard

The standard must be defined in careful technical language that spells out covered products, effective dates, and required efficiency levels. Also, significant scientific, engineering, and economic research must be completed before a standard can be adopted. This research typically concerns estimates of energy and peak demand savings and the cost-effectiveness of measures. Since implementation of the C&S program began, much of this research and development at the state level has been summarized in

CASE reports funded by the utilities for codes and standards in which they played a significant role. At the federal level, the research completed through CASE reports can be adapted for the federal standards; however, the C&S program often conducts additional research or teams with other stakeholders who have conducted their own technical research in support of the federal rulemaking process.

Demonstrating the Feasibility or Market Acceptance of Standard Adoption

An implicit requirement for adopting a new standard is that compliance with the standard be practical and feasible. Supporters of the standard must address stakeholder concerns and demonstrate through market research that stakeholders can comply with the standard. Three conditions must be met to satisfy this requirement. First, the market must be capable of supplying the products and services necessary to comply with the standard. If a product is not readily available in the marketplace, the technology must be well developed and manufacturers capable of increasing supply before the standard goes into effect. Second, the standard must not impose unreasonable and avoidable costs on end users, manufacturers, and other stakeholders. Third, the standard must not create significant negative externalities related to human health or the environment.

3.4.2 Data Collection Activities

The evaluators based the determination of C&S program credit on a systematic and thorough review of available evidence about program activities. The evaluation team collected information from a variety of sources, including documents provided by the C&S program (CCTR, CASE reports, etc.), public documents (transcripts, public comments, etc.), and stakeholder interviews. This following section describes the sources.

Review of public and C&S program documents. The evaluation team collected information about C&S program and other stakeholder contributions to development and adoption of each standard from a large number of primary and secondary public sources, including CASE reports, Advanced Notice of Public Rulemaking announcements (federal standards only), transcripts of CEC and DOE hearings and workshops, and stakeholder letters, and comments to the CEC and DOE. We also reviewed documents provided by the C&S program including CCTRs and email logs. We carefully read these sources, and extracted information about C&S program and other stakeholder activities and entered it into a spreadsheet for future reference in determining C&S program credit.

Stakeholder interviews. The evaluation team conducted interviews with key stakeholders to fill remaining gaps in its understanding of the development of standards. Although the focus of each interview varied, we generally asked about the stakeholder's involvement in the rulemaking process, their impression of the C&S program's involvement, key issues that arose during the rulemaking, and the stakeholders' assessment of the C&S program's contributions.

3.4.3 Estimation of Factor Scores

The following three principles guided the determination of credit:

1. Attribution would be determined by disinterested third-party technical experts who did not have a stake in the amount of credit that was awarded.
2. Credit would be awarded on the basis of evidence about C&S Program activities obtained from written sources and interviews.
3. The scoring process would be transparent, documented, and repeatable.

To adhere to these three principles, we convened a panel of independent codes and standards experts to determine the C&S program credit. The panel consisted of four experts: one represented the Midwest Energy Efficiency Alliance, one represented the Northwest Energy Efficiency Alliance, one represented the Institute of Market Transformation, and one was an independent consultant who is on the board of several energy efficiency organizations. Three of the four panel members were participants in the 2010-2012 program cycle attribution panel.

The panel convened in Cadmus' Portland offices for a two-day session in December 2015. At this meeting, we explained the attribution model and the scoring protocol and instructed the panelists about the kinds of evidence they should consider and the determination of the factor scores. We told the panelists that the contribution of the program to each factor was to be judged relative to the contributions of other stakeholders such as industry member, efficiency advocated, the CEC, and the DOE. In addition, we told the panelists that the amount of effort required for a factor should not influence the determination of the factor score.

The deliberations of the panel began with a presentation by Cadmus. We explained the development of the standard, including the prescriptive or performance requirements, the key stakeholders, and the history of the development of the standard. We then presented evidence about the C&S program contributions within each factor area. The panel members discussed their thoughts on the three factors for each code or standard and considered the inputs of all stakeholders including the C&S program. The discussion often included the members expressing an opinion on each factor score, asking our team questions about the rulemaking activities, and discussing any issues or thoughts among themselves. After this discussion, the panel could come to a mutual agreement on the factor scores, vote on the scores as individuals, or ask our team for more information and reach agreement at a later time in light of new information. If the panel could not agree on factor scores, the final score would be an average of the preferred factor scores of the members.

To ensure that the panel had the time necessary to fully evaluate the codes and standards presented, Cadmus only presented 14 of the 23 standards to the panel. These standards were prioritized based on total savings. Standards with greater than 40 GWh of savings were included in the panel presentation, accounting for 97% of the estimated savings for all standards evaluated. The codes and standards with estimated savings of 40GWh or less were evaluated by Cadmus. In sessions that followed the outline of the panel sessions, a Cadmus evaluator responsible for the standard presented the standard

development, stakeholders, history, and evidence to the other members of the attribution evaluation team. We discussed the factors internally, expressed opinions on each factor score, and developed an attribution score.

3.4.4 Estimation of Factor Weights

The evaluation team developed factor weights, internally, for each code or standard for this program cycle. We based the factor weights on our understanding of how resources were allocated across the factor areas for each code or standard. This assessment was based on the data collected through our review of rulemaking documents and stakeholder interviews.

As a check against our factor weights, we asked the IOUs to provide their estimates of the factor weights for each standard. We distributed to the IOUs a survey similar to that used in the previous evaluations. For each state and federal code and standard, we asked, "What was the percentage allocation of total stakeholder resources across the factor areas in the development of the standard, where resources are defined in terms of budgets?" We also asked the IOUs to provide a brief explanation as to the reasoning behind their weights.

We compared our weights to those provided by the IOUs. If the weights were relatively close, we used the weights developed internally. If large discrepancies existed between our and the IOUs (generally 10% or more), we reviewed the justification provided by the IOUs, conducted additional research, and then made adjustments to the weights as necessary. For example, if we gave a low weight to factor two based on the assumption that a data collection activity described in the CCTR required minimal resources, but the IOUs weighted factor two very highly, we reviewed the IOUs' explanation as well as the supporting documentation and, if the additional detail was convincing, adjusted the weight upward.

3.4.5 Estimation of the Attribution Scores

As a final step in the process, we calculated the attribution score for each state or federal code or standard. The attribution score measures the contribution of the C&S program to adoption of a standard and multiplies net energy savings to determine the amount attributable to the C&S Program. We calculated the attribution score by multiplying the factor weight and factor score for each factor within a standard, then summing those weighted scores.

4 Findings for Protocol Parameters

In this chapter, we present the parameter value findings for each standard. We made an exception in the case of the parameters that determine overall potential: unit energy savings, market volumes, and total energy or demand. Since these details of potential savings are helpful to understanding the overall findings, we include them with the overall summary for each standard in the following chapter. We do not also present them here to avoid redundancy.

We begin the chapter with our findings on the interactive component of potential savings. We then present the evaluation results for compliance, NOMAD, and attribution.

4.1 Potential Savings/Interactive Effects

In Table 15, we present the IE values included in the IOU estimate and the new values assigned for this evaluation. As noted earlier, the IOU estimate used the same DEER-based values as the 2010-2012 impact evaluation. We based the new values on the more recent 2014 DEER Lighting Measures Energy Impacts and HVAC Interactive Effects table.

Table 15. Summary of Interactive Effect Values for Phase One Standards

Standard	Description	Measures in Conditioned Space?	IE in IOU Estimate			IE Evaluated Values		
			kWh/kWh	kW/kW	Therms/ kWh	kWh/kWh	kW/kW	Therms/ kWh
Std 28b	Televisions Tier 2	Yes	1.0500	1.3200	-0.0207	1.0700	1.2970	-0.0130
Std 29	Small Battery Chargers – Tier 1	Yes	1.0400	1.3200	-0.0207	1.0470	1.3600	-0.0210
Std 30	Small Battery Chargers – Tier 2	Yes	1.0400	1.3200	-0.0207	1.0470	1.3600	-0.0210
Std 32	Large Battery Chargers	No	1.0000	1.0000	0.0000	1.0000	1.0000	0.0000
Fed 9	Residential Pool Heaters	No	1.0000	1.0000	0.0000	1.0000	1.0000	0.0000
Fed 10	Res. Direct Heating Equip.	No	1.0000	1.0000	-0.0177	1.0000	1.0000	0.0000
Fed 11	Res. Refrig./ Freezers	Yes	1.0400	1.3200	-0.0207	1.0470	1.3600	-0.0210
Fed 12	Residential Room AC	No	1.0000	1.0000	0.0000	1.0000	1.0000	0.0000
Fed 13	Fluorescent Ballasts	Yes	1.1000	1.2267	-0.0119	1.0920	1.2350	-0.0050
Fed 14	Small Comm. Package ACs	No	1.0000	1.0000	0.0000	1.0000	1.0000	0.0000
Fed 15	Large Comm. Package ACs	No	1.0000	1.0000	0.0000	1.0000	1.0000	0.0000
Fed 16	Computer Room ACs	No	1.0000	1.0000	0.0000	1.0000	1.0000	0.0000
Fed 17	Res. Dishwashers	Yes	1.0400	1.3200	-0.0207	1.0470	1.3600	-0.0210

Our first step was to identify whether the measures governed by each standard were generally located in conditioned space or not. In cases where measures are not in conditioned space, there are no interactions with HVAC energy consumption. We recorded our finding in the column labelled “Measures in Conditioned Space.” We shaded the rows in the table where measures were not found to be in

conditioned space. The values shown for these standards are the inputs used to the ISSM when there are no interactive effects.

To obtain values for measures that are located in conditioned space, we obtained the appropriate values for each of the IOU service territories. We then weighted them according to the relative size of each territory to determine an appropriate statewide value. In addition we made the following assumptions for each standard to arrive at the final values:

- For Standard 28b, Televisions, Tier 2 we assumed that half of the televisions are in commercial space and half are in residential space. The final value is the average of the statewide commercial and residential values.
- We used statewide residential values for the two small (consumer) battery charger standards (29 and 30), the residential refrigerator/freezer standard (Fed 11), and the residential dishwasher standard (Fed 17)
- We used statewide commercial values for the fluorescent ballast standard (Fed 13)

These were the same assumptions used in the 2010-2012 evaluation and the final values are only slightly different than those based on the earlier DEER data.

4.2 Gross Savings/Compliance

Table 16 shows the method(s) used and compliance rate by standard. Overall, the evaluation team found compliance was quite high.

Table 16. Summary of Compliance Methods and Findings

Group	Standard	Description	Compliance Method	IOU Compliance Estimate	2015 Evaluated Compliance Rate
2006-2009 Title 20	Std 28b	Televisions – Tier 2	POS	85%	99%
2011 Title 20	Std 29	Small Battery Chargers – Tier 1	POS	85%	90%
	Std 30	Small Battery Chargers – Tier 2	POS	85%	88%
	Std 32	Large Battery Chargers (≥2kW rated input)	Websites/ Interviews	85%	78%
2013 Federal Appliance	Fed 9	Residential Pool Heaters	Websites	89%	95%
	Fed 10	Residential Direct Heating Equipment	Websites	89%	95%
	Fed 11	Residential Refrigerators & Freezers	Websites	89%	95%

Group	Standard	Description	Compliance Method	IOU Compliance Estimate	2015 Evaluated Compliance Rate
	Fed 12	Residential Room AC	Websites	89%	91%
	Fed 13	Fluorescent Ballasts	Websites/ Interviews	89%	80%
	Fed 14	Small Comm. Package ACs	Websites	89%	100%
	Fed 15	Large / Very Large Comm. Package ACs	Websites	89%	100%
	Fed 16	Computer Room ACs	Websites	89%	100%
	Fed 17	Residential Dishwashers	Websites	89%	99%

4.2.1 Limitations

The evaluation team encountered the following challenges to measuring compliance:

- Based on previous evaluation experience and from a preliminary store visit, we found the manufacture date of products was often not available online or even on the physical product itself. Since vendors are allowed to sell noncompliant stock manufactured prior to the effective date, we delayed measurement of compliance for at least a year after a standard's effective date.
- The CEC list was sometimes the only indicator we had of compliance. For products such as battery chargers or fluorescent ballasts, required product performance specifications are often not published, so we had no way to tell if a product complied with the standard short of doing testing on the product ourselves.
- Furthermore, the CEC list may not be comprehensive. For instance, we found ENERGY STAR appliances that were not in the CEC database.

4.3 Net Savings/NOMAD

Table 17 presents the evaluated NOMAD values and the values estimated by the IOUs for 2013 through 2015. The evaluated values represent the results of the complete NOMAD estimation process described in the methodology section above. Additional details on the NOMAD process are included in Appendix B to this report.

We evaluated the Title 20 standards for Televisions, Tier 2 (Std 28b) and Small Battery Chargers Tier 1 (Std 29) as part of the 2010-2012 study.

The IOU estimate for Standard 28b uses the previously evaluated net NOMAD estimate for Standard 28a. These values include large prior program adjustments that lower the net NOMAD values.

We are not including these adjustments in the evaluated net NOMAD estimate for Standard 28b. The adjustment made to net NOMAD for standard 28a (Tier 1) is based on programs that were operating

prior to the 2011 effective date of Standard 28a. This adjustment continues to be included in the ongoing savings from the Standard 28a. Using the same program volume in an adjustment for Standard 28b (Tier 2) would mean that we were adjusting twice for the same units.

Although the IOU Business Consumer Electronics program continued to provide incentives for efficient televisions[15] up to the 2013 effective date of the Tier 2 standard the adjustment for Standard 28a already accounts for the effect of the program.

Exclusion of the prior program adjustment is the reason the evaluated NOMAD estimate differs from the IOU estimate for Standard 28b.

Table 17. . Net NOMAD Adjustment Evaluated and IOU Estimate

Group	Standard	Description	Evaluated Net NOMAD Adjustment			IOU Estimated Net NOMAD Adjustment		
			2013	2014	2015	2013	2014	2015
2006-2009 Title 20	Std 28b	Televisions – Tier 2	-64%	-69%	-73%	-43%	-50%	-56%
2011 Title 20	Std 29	Small Battery Chargers – Tier 1	-32%	-36%	-40%	-32%	-36%	-40%
	Std 30	Small Battery Chargers – Tier 2	n/a	-37%	-41%	n/a	-36%	-40%
	Std 32	Large Battery Chargers (≥2kW rated input)	n/a	-13%	-15%	n/a	-38%	-40%
2013 Federal Appliance	Fed 9	Residential Pool Heaters	-50%	-50%	-50%	-50%	-50%	-50%
	Fed 10	Residential Direct Heating Equipment	-49%	-51%	-53%	-41%	-41%	-41%
	Fed 11	Residential Refrigerators & Freezers	n/a	-27%	-29%	n/a	-12%	-14%
	Fed 12	Residential Room AC	n/a	-35%	-38%	n/a	-4%	-5%
	Fed 13	Fluorescent Ballasts	n/a	-25%	-27%	n/a	-9%	-10%
	Fed 14	Small Comm. Package ACs	-93%	-93%	-93%	-93%	-93%	-93%
	Fed 15	Large / Very Large Comm. Package ACs	n/a	-75%	-76%	n/a	-75%	-76%
	Fed 16	Computer Room ACs	-99%	-99%	-99%	-99%	-99%	-99%
	Fed 17	Residential Dishwashers	-52%	-56%	-60%	-65%	-66%	-67%

Note: The entry "n/a" indicates that the standard had not yet become effective.

4.4 Net Savings/Attribution

Table 18 reports the factor scores, factor weights, and final attribution score for each of the selected 2012-2013 federal appliance standards. The factor scores indicate the percentage contributions of the C&S program to the development of the standards in each factor area. The final attribution score is the weighted average of the factor scores.

[15] Impact Evaluation Report Business and Consumer Electronics Program (WO34), KEMA, April 15, 2013 This report can be found at http://calmac.org/ and has CALMAC Study ID: CPU0060.01

Table 18. Phase One Federal Appliance Standards – Attribution Scores

2012-2013 Federal Appliance Standards		Factor Score			Weight			Final Attribution Score
		Compliance	Technical	Feasibility	Compliance	Technical	Feasibility	
Std 28b	Televisions, Tier 2	50%	65%	65%	30%	20%	50%	61%
Std 29	Small Battery Chargers – Tier 1	45%	50%	85%	25%	50%	25%	58%
Std 30	Small Battery Chargers – Tier 2	45%	50%	85%	25%	50%	25%	58%
Std 32	Large Battery Chargers (≥2kW)	90%	90%	90%	40%	40%	20%	90%
Fed 8	Commercial Clothes Washers	5%	15%	30%	5%	50%	45%	21%
Fed 9	Residential Pool Heaters	5%	5%	0%	35%	60%	5%	5%
Fed 10	Residential Direct Heating Equipment	5%	10%	0%	30%	65%	5%	8%
Fed 11	Residential Refrig. and Freezers	60%	30%	20%	30%	50%	20%	37%
Fed 12	Residential Room AC	40%	25%	15%	20%	40%	40%	24%
Fed 13	Fluorescent Ballasts	80%	65%	80%	30%	40%	30%	74%
Fed 14	Small Commercial Package ACs	10%	10%	10%	40%	30%	30%	10%
Fed 15	Large/Very Large Package ACs	10%	10%	10%	40%	30%	30%	10%
Fed 16	Computer Room ACs	10%	10%	10%	40%	30%	30%	10%
Fed 17	Residential Dishwashers	5%	5%	5%	50%	30%	20%	5%

The attribution panel determined each high priority attribution score coming to consensus based on discussions of the data collected by the attribution team. The panel discussed some standards, as a group as the rulemaking process may have covered multiple products in one rulemaking such heat pumps, central ACs and residential furnaces. However, the panel also considered differences in the standards when there was evidence to support a different level of advocacy for one standard over another (e.g. small versus large battery chargers).

While the panel did not create the weights, they discussed what they thought potential weights would be while deciding on their scores. For example, the standard for residential refrigeration and freezers was on its third update and had an established test procedure. The panel felt like the factor 1 weight would be relatively small compared to the effort needed to contribute to the other factors for that standard.

5 Results for the Statewide Program

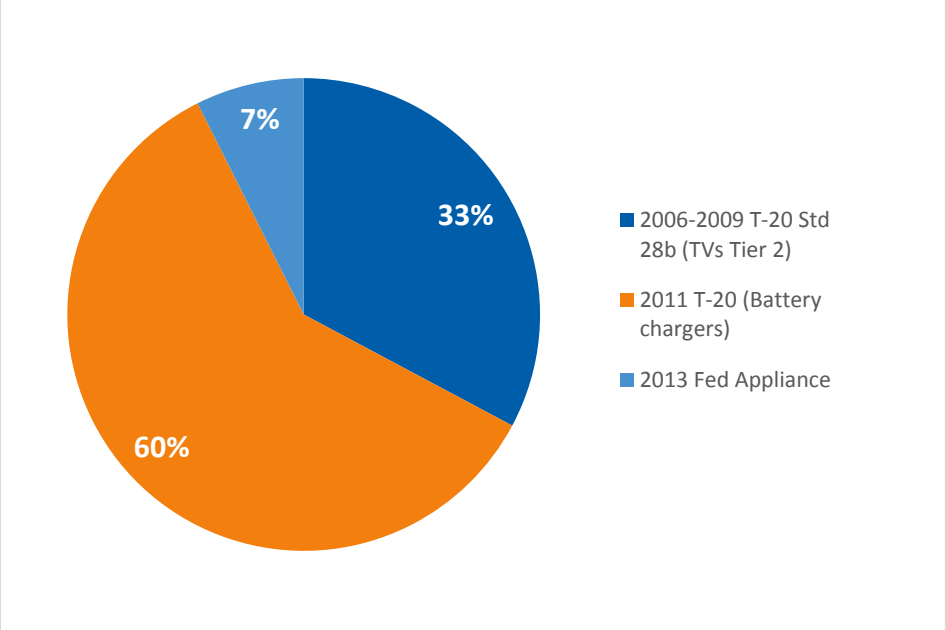
5.1 Findings for the Program and Groups

In this section, we present the aggregate results of the evaluation.

As noted earlier, results can be reported on a statewide basis or in terms of savings allocated to the IOUs. For electric energy and demand, the IOUs represent about 72% of the statewide total and so the total of the savings allocated to the IOUs is also about 72% of the statewide total. For gas savings, the IOUs represent 99% of the gas supplied and so the statewide and IOU totals are practically the same. We have noted that all values are statewide unless otherwise indicated. Due to the potential for confusion, we will indicate whether results are statewide or IOU-specific in most cases.

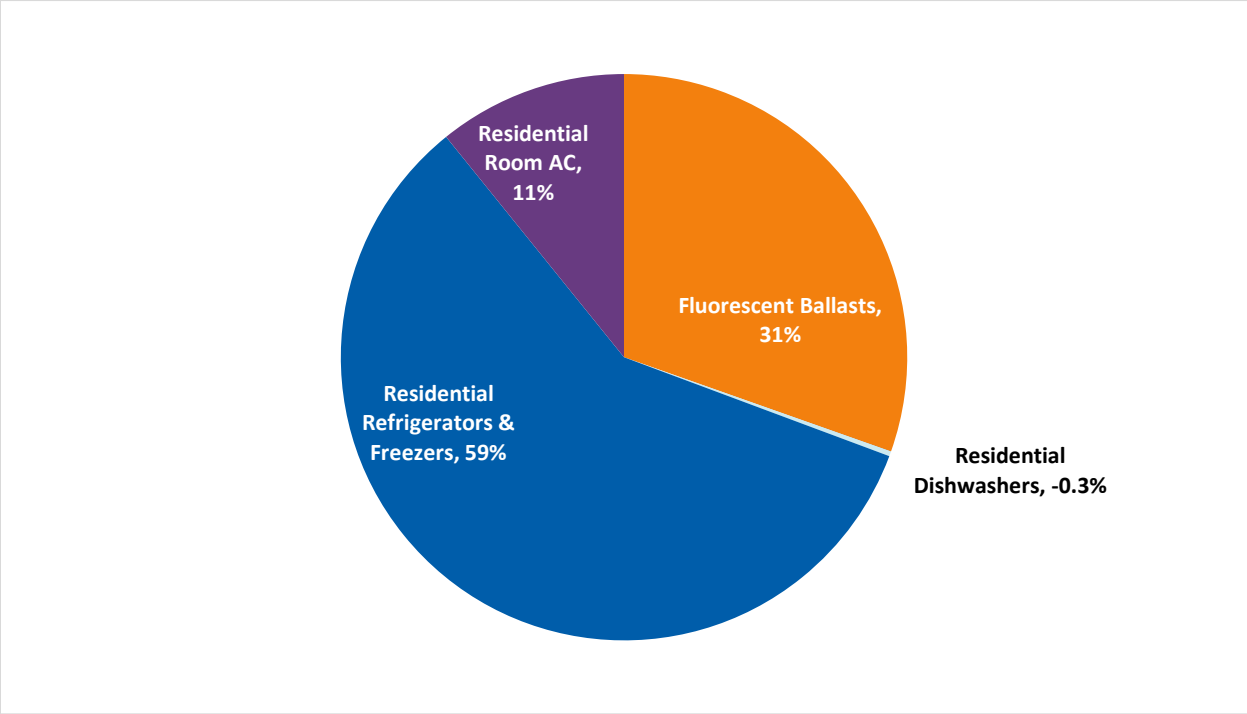
As shown in Figure 3, the bulk of program net electricity savings for standards evaluated in Phase One are attributable to the Title 20 standards.

Figure 3. Distribution of 2013-2015 PY Statewide Net Program Savings (746 GWh) for Phase One Standards



Most of the savings from the Federal Appliance standards (7% of total shown) are from residential refrigerators/freezers. The distribution of electricity savings, by standard, for the Federal Appliance standards evaluated in Phase One, is shown in Figure 4. The federal dishwasher standard has a negative impact on electric energy and demand savings since the primary impact is a reduction in gas usage as shown later in Section 5.3.9.

Figure 4. Distribution of 2013-2015 PY Statewide Net Program Savings (44 GWh) for Phase One Federal Appliance Standards



The proportion of program net demand savings from Phase One 2013 Federal Appliance standards is significantly larger than the energy savings, with 24% attributable to the Federal standards, as shown in Figure 5.

Figure 5. Distribution of 2013-2015 PY Statewide Net Program Demand Reduction (77 MW) for Phase One Standards

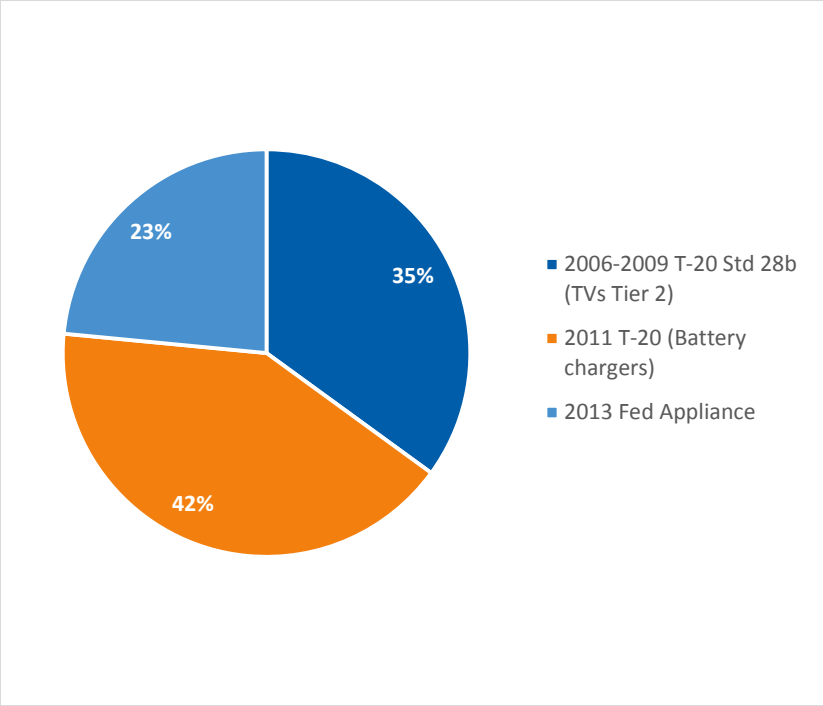
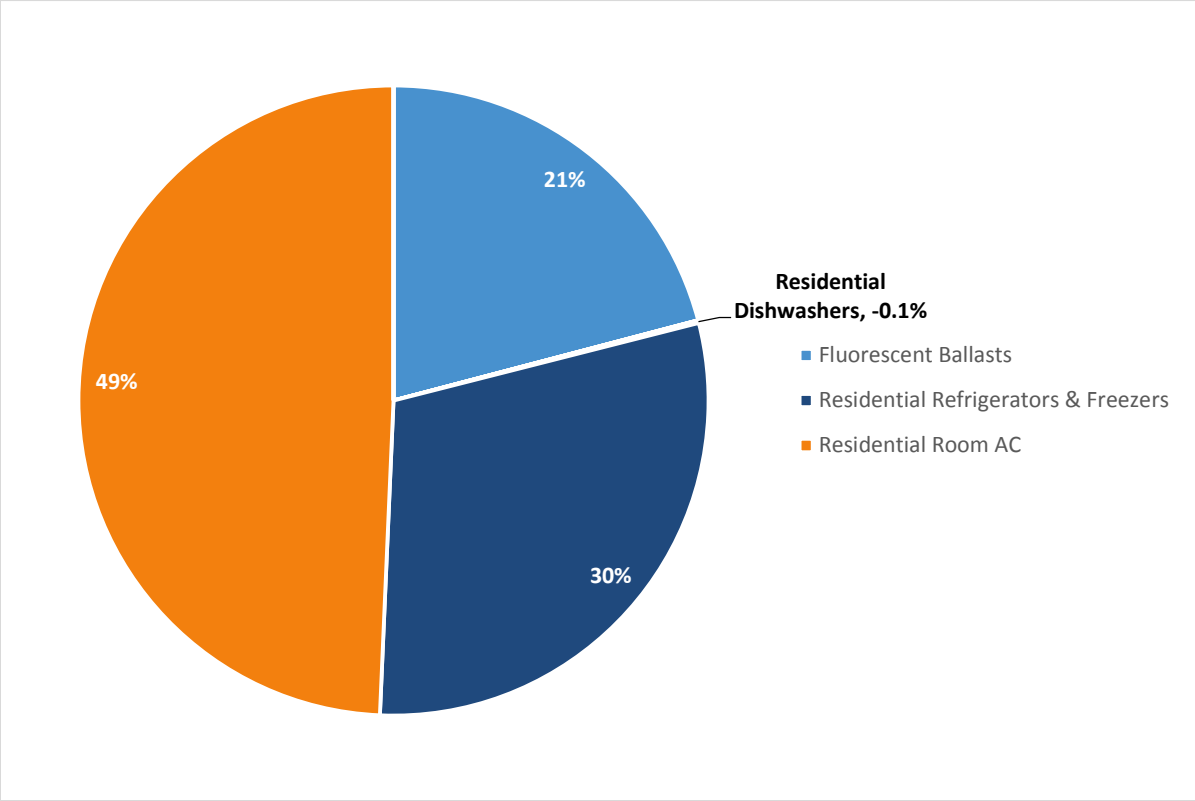


Figure 6 shows the distribution of demand reduction, by standard, for the Federal Appliance standards evaluated in Phase One.

Figure 6. Distribution of 2013-2015 PY Statewide Net Program Demand Reduction (15 MW) for Phase One Federal Appliance Standards



In Table 19 through Table 32, we show both the IOU estimate of savings and evaluated savings for electricity, demand and gas, by group and by IOU share. Due to the absence of IOU-estimated attribution values for Federal standards, the Title 20 results and Federal results are presented separately.

Table 19. Evaluated vs. IOU Estimate: 2013-2015 PY Statewide Total Savings for Phase One Title 20 (GWh)

GWh	IOU Estimated Savings				Evaluated Savings			
	Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
2006-2009 T-20 Std 28b (TVs Tier 2)	1,072	907	456	276	1,322	1,296	412	249
2011 T-20 (Battery chargers)	1,303	1,102	703	520	1,349	1,211	780	454
2013-2015 Total	**2,375**	**2,009**	**1,158**	**796**	**2,671**	**2,507**	**1,192**	**703**
				Evaluated/IOU Estimated	**112%**	**125%**	**103%**	**88%**

Table 20. Evaluated vs. IOU Estimate: IOU Share of 2013-2015 PY Phase One Title 20 (GWh)

GWh	Percentage of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	31.6%	750	634	366	251	843	792	376	222
SCE	32.6%	774	654	377	259	870	817	388	229
SDG&E	7.4%	176	148	86	59	197	185	88	52
All IOUs	**71.6%**	**1,699**	**1,437**	**829**	**569**	**1,911**	**1,794**	**853**	**503**
					Evaluated/IOU Estimated	**112%**	**125%**	**103%**	**88%**

Table 21 and Table 22 summarize our findings for demand savings from Title 20 standards. We found less than half the demand savings for the battery charger standard than was included in the IOU estimate.

Table 21. Evaluated vs. IOU Estimate: 2013-2015 PY Statewide Total Demand Reduction for Phase One Title 20 (MW)

MW	IOU Estimated Savings				Evaluated Savings			
	Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
2006-2009 T-20 Std 28b (TVs Tier 2)	119	101	51	31	131	129	41	25
2011 T-20 (Battery chargers)	220	186	119	88	89	79	51	29
2013-2015 Total	**339**	**287**	**170**	**119**	**220**	**208**	**91**	**54**
				Evaluated / IOU Estimated	**65%**	**72%**	**54%**	**46%**

Table 22. Evaluated vs. IOU Estimate: IOU Share of 2013-2015 PY Phase One Title 20 (MW)

MW	Percent of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	31.6%	107	91	54	37	69	66	29	17
SCE	32.6%	111	93	55	39	72	68	30	18
SDG&E	7.4%	25	21	13	9	16	15	7	4
All IOUs	**71.6%**	**243**	**205**	**121**	**85**	157	149	65	39
					Evaluated / IOU Estimated	**65%**	**72%**	**54%**	**46%**

Title 20 standards do not produce gas savings directly, but have a negative impact on total gas savings due to interactive effects, as shown in Table 23 and Table 24.

With regard to gas savings attributed to SCG, CPUC policy is for savings to be determined excluding any interactive effects. As noted earlier, there are no gas savings from Title 20 standards when IEs are excluded. For federal standards, the savings attributed to SCG are shown later in Table 32 in which IEs are excluded.

Table 23. Evaluated vs. IOU Estimate: 2013-2015 PY Statewide Total Gas Savings for Phase One Title 20 Including Interactive Effects (MTherms)

MTherms	IOU Estimated Savings				Evaluated Savings			
	Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
2006-2009 T-20 Std 28b (TVs Tier 2)	(21)	(18)	(9)	(5)	(16)	(16)	(5)	(3)
2011 T-20 (Battery chargers)	(25)	(21)	(13)	(10)	(27)	(24)	(15)	(9)
2013-2015 Total	**(46)**	**(39)**	**(22)**	**(15)**	**(43)**	**(40)**	**(20)**	**(12)**
Evaluated / IOU Estimated					**93%**	**102%**	**91%**	**77%**

Table 24. Evaluated vs. IOU Estimate: IOU Share of 2013-2015 PY Phase One Title 20 Gas Savings Including Interactive Effects (MTherms)

MTherms	Percent of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	36.5%	(17)	(14)	(8)	(6)	(16)	(14)	(7)	(4)
SCG	58.4%	(27)	(23)	(13)	(9)	(25)	(23)	(12)	(7)
SDG&E	4.1%	(2)	(2)	(1)	(1)	(2)	(2)	(1)	(0)
All IOUs	99.0%	(45)	(38)	(22)	(15)	(42)	(39)	(20)	(12)
Evaluated / IOU Estimated						**93%**	**102%**	**91%**	**77%**

Table 25 shows the evaluated and IOU estimates for the phase one federal appliances. The difference between the evaluated potential and IOU estimate is primarily driven by the residential refrigerator and freezer standard (Fed 11). Although the evaluation found lower unit energy savings (Table 45), it also found the market size was an order of magnitude larger (1.3 million units vs. IOU estimate of 0.2 million units).

Table 25. Evaluated vs. IOU Estimate: 2013-2015 PY Statewide Total Savings for Phase One Federal Appliances (GWh)

GWh	IOU Estimated Savings				Evaluated Savings			
	Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
2013 Fed Appliance	108	96	85	-	163	148	128	53
Evaluated/IOU Estimated					**151%**	**153%**	**151%**	**n/a**

Table 26. Evaluated vs. IOU Estimate: IOU Share of 2013-2015 PY Phase One Federal Appliances (GWh)

GWh	Percent of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	31.6%	34	30	27	-	52	47	41	17
SCE	32.6%	35	31	28	-	53	48	42	17
SDG&E	7.4%	8	7	6	-	12	11	9	4
All IOUs	**71.6%**	**77**	**69**	**61**	**-**	**117**	**106**	**92**	**38**
					Evaluated/IOU Estimated	**151%**	**153%**	**151%**	**n/a**

Table 27. Evaluated vs. IOU Estimate: 2013-2015 PY Statewide Total Savings for Phase One Federal Appliances (MW)

MW	IOU Estimated Savings				Evaluated Savings			
	Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
2013 Fed Appliance	40	36	32	-	70	63	52	17
				Evaluated / IOU Estimated	**176%**	**179%**	**159%**	**n/a**

Table 28. Evaluated vs. IOU Estimate: IOU Share of 2013-2015 PY Phase One Federal Appliances (MW)

MW	Percent of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	31.6%	13	11	10	-	22	20	16	5
SCE	32.6%	13	12	11	-	23	21	17	5
SDG&E	7.4%	3	3	2	-	5	5	4	1
All IOUs	**71.6%**	29	25	23	-	**50**	**45**	**37**	**12**
					Evaluated / IOU Estimated	**176%**	**179%**	**159%**	**n/a**

The Federal appliance standards produce gas savings directly, but also include negative adjustments to gas via interactive effects. Therefore, the total gas impact is shown with and without interactive effects. The bulk of direct gas savings are attributable to the Residential Dishwashers and Residential Direct Heating Equipment standards; however, after adjusting for NOMAD and attribution, the net program savings for these standards become insignificant, and total net program gas savings is negative.

Table 29. Evaluated vs. IOU Estimate: 2013-2015 PY Statewide Total Savings for Phase One Federal Appliances (MTherms), Including Interactive Effects

MTherms	IOU Estimated Savings				Evaluated Savings			
	Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
2013 Fed Appliance	(0.3)	(0.3)	(0.6)	-	6.0	6.0	0.6	(0.6)

Table 30. Evaluated vs. IOU Estimate:
IOU Share of 2013-2015 PY Phase One Federal Appliances Including Interactive Effects (MTherms)

MTherms	Percent of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	36.5%	(0.1)	(0.1)	(0.2)	-	2.2	2.2	0.2	(0.2)
SCG	58.4%	(0.2)	(0.2)	(0.3)	-	3.5	3.5	0.4	(0.3)
SDG&E	4.1%	(0.0)	(0.0)	(0.0)	-	0.2	0.2	0.0	(0.0)
All IOUs	99.0%	(0.3)	(0.3)	(0.6)	-	**6.0**	**5.9**	**0.6**	**(0.6)**

Table 31. Evaluated vs. IOU Estimate: 2013-2015 PY Statewide Total Savings
for Phase One Federal Appliances Excluding Interactive Effects (MTherms)

MTherms	IOU Estimated Savings				Evaluated Savings			
	Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
2013 Fed Appliance	1.1	1.0	0.5	-	8.0	7.8	2.4	0.1
Evaluated / IOU Estimated					**740%**	**811%**	**480%**	**n/a**

Table 32. Evaluated vs. IOU Estimate:
IOU Share of 2013-2015 PY Phase One Federal Appliances Excluding Interactive Effects (Therms)

MTherms	Percent of Statewide Sales	IOU Estimated Savings				Evaluated Savings			
IOU		Potential	Gross	Net	Net Program	Potential	Gross	Net	Net Program
PG&E	36.5%	0.4	0.4	0.2	-	2.9	2.9	0.9	0.1
SCG	58.4%	0.6	0.6	0.3	-	4.7	4.6	1.4	0.1
SDG&E	4.1%	0.0	0.0	0.0	-	0.3	0.3	0.1	0.0
All IOUs	99.0%	1.1	1.0	0.5	-	8.0	7.8	2.3	0.1
Evaluated / IOU Estimated						**740%**	**811%**	**480%**	**n/a**

5.2 Findings for Title 20 Appliance Standards, Phase One

5.2.1 Standard 28b, Televisions Tier 2, Effective January 1, 2013

As shown in Table 33 and Table 34, we found higher potential energy savings for Tier 2 Televisions than the IOUs estimated, driven by both higher unit energy savings and larger market size. We also found a

higher compliance rate than estimated by the IOUs. However, evaluated net and program savings are lower because the evaluation team excluded the prior program adjustment to NOMAD, as discussed in section 4.3 above.

Table 33. Evaluated vs. IOU Estimated Unit Savings for Standard 28b Televisions Tier 2

Televisions Tier 2	Unit Savings		
	Electricity (kWh)	Demand (kW)	Gas (Therms)
IOU Estimate	102.00	0.0090	0.00
Evaluated	110.00	0.0090	0.00

Table 34. Evaluated vs. IOU Estimated Market Size and Savings for Standard 28b Televisions Tier 2

Televisions Tier 2	Year	Units	GWh							MW	Mtherms
			Potential Energy Savings	CAF	Gross Energy Savings	NOMAD Adjustment	Net Energy Savings	Attrib.	Program Net Energy Savings	Program Net Demand Savings	Program Net Gas Savings
IOU Estimate	2013	3,338,000	357.5	85%	302.3	-43%	172.2	61%	104.2	11.6	(2.1)
	2014	3,338,000	357.5	85%	302.3	-50%	150.7	61%	91.2	10.1	(1.8)
	2015	3,338,000	357.5	85%	302.3	-56%	132.7	61%	80.3	8.9	(1.6)
	Total		**1,072.5**		**907.0**		**455.7**		**275.7**	**30.6**	**(5.4)**
Evaluated	2013	3,744,138	440.7	97%	428.3	-64%	156.2	61%	94.5	9.37	(1.15)
	2014	3,744,138	440.7	99%	434.1	-69%	136.3	61%	82.5	8.18	(1.00)
	2015	3,744,138	440.7	99%	434.1	-73%	119.4	61%	72.2	7.16	(0.88)
	Total		**1,322.1**		**1,296.5**		**411.8**		**249.2**	**24.7**	**(3.0)**

5.2.2 Standard 29, Small Battery Chargers – Tier 1, Effective 2/1/2013

This standard covers consumer battery charger systems that are either not-USB chargers or USB chargers under 20 watt-hours.

To estimate market size, the evaluation team used sales data purchased from NPD Group for certain products or available in the Technical Support Document[16] (TSD) issued by the U.S. DOE[17], depending on the product category. For product categories where data were unavailable from the sources we examined, we used the values provided in the CASE report.

[16] For evaluation of some Title 20 standards, we use TSD documents because they provide high quality research on a market or products at no cost.

[17] http://www.regulations.gov/contentStreamer?documentId=EERE-2008-BT-STD-0005-0230&attachmentNumber=1&disposition=attachment&contentType=pdf

To assess energy and demand savings, the evaluation team evaluated the reasonableness of the assumptions (baseline and compliant wattages, duty cycle) used in the CASE report and made adjustments to values we found unreasonable or erroneous. We also examined the CASE report calculations of annual energy consumption (AEC), but could not reproduce baseline and compliant AEC values for certain product categories. Further details regarding our adjustments can be found in the appendices. While the evaluation team found the unit energy savings to be almost twice that estimated by the IOUs, we found a significantly smaller market size (Table 35). Our compliance findings were 5% higher than those estimated by the IOUs. Conversely, our unit demand reduction was almost half that estimated by the IOUs, which is amplified by the smaller evaluated market size (Table 36).

Table 35. Evaluated vs. IOU Estimated Unit Savings for Standard 29 Small Battery Chargers – Tier 1

Small Battery Chargers Tier 1	Unit Savings		
	Electricity (kWh)	Demand (kW)	Gas (Therms)
IOU Estimate	5.00	0.0007	0.00
Evaluated	9.90	0.0004	0.00

Table 36. Evaluated vs. IOU Estimated Market Size and Savings for Std. 29 Small Battery Chargers – T1

Small Battery Chargers Tier 1	Year	Units	GWh							MW	Mtherms
			Potential Energy Savings	CAF	Gross Energy Savings	NOMAD Adjustment	Net Energy Savings	Attrib.	Program Net Energy Savings	Program Net Demand Savings	Program Net Gas Savings
IOU Estimate	2013	69,466,624	361.4	85%	305.7	-32%	208.4	74%	154.2	26.4	(3.1)
	2014	77,636,054	404.0	85%	341.6	-36%	218.8	74%	161.9	27.7	(3.2)
	2015	79,463,721	413.5	85%	349.7	-40%	211.0	74%	156.1	26.7	(3.1)
	Total		**1,178.9**		**996.9**		**638.2**		**472.3**	**80.7**	**(9.4)**
Evaluated	2013	40,049,717	415.1	90%	373.6	-32%	254.8	58%	146.5	7.5	(2.9)
	2014	43,766,906	453.7	90%	408.3	-36%	261.5	58%	150.4	7.7	(3.0)
	2015	43,766,906	453.7	90%	408.3	-40%	246.4	58%	141.7	7.2	(2.8)
	Total		**1,322.4**		**1,190.2**		**762.6**		**438.5**	**22.4**	**(8.8)**

5.2.3 Standard 30, Small Battery Chargers – Tier 2, Effective January 1, 2014

Standard 30 covers USB chargers with a capacity of 20 watt-hours or more, which the evaluation team could attribute to only one consumer product class: media tablets. As shown in Table 37 and Table 38, the evaluation team found that no savings resulted from this standard due to the lack of documentation of a baseline level of efficiency. The evaluation team did find a compliance rate of 88% for this standard.

Table 37. Evaluated vs. IOU Estimated Unit Savings for Standard 30 Small Battery Chargers – Tier 2

Small Battery Chargers Tier 2	Unit Savings		
	Electricity (kWh)	Demand (kW)	Gas (Therms)
IOU Estimate	10.50	0.0014	0.00
Evaluated	0.00	0.0000	0.00

Table 38. IOU Estimated Market Size and Savings for Standard 30 Small Battery Chargers – Tier 2

Small Battery Chargers Tier 2	Year	Units	GWh							MW	Mtherms
			Potential Energy Savings	CAF	Gross Energy Savings	NOMAD Adjustment	Net Energy Savings	Attrib.	Program Net Energy Savings	Program Net Demand Savings	Program Net Gas Savings
IOU Estimate	2013	0	0.0	n/a	0.0	n/a	0.0	n/a	0.0	0.0	0.0
	2014	2,760,000	30.1	85%	25.5	-36%	16.3	74%	12.1	2.1	(0.2)
	2015	3,174,000	34.7	85%	29.3	-40%	17.7	74%	13.1	2.2	(0.3)

Note: Standard 31, Small Battery Chargers – Tier 3, Effective 1/1/2017 does not produce savings during the 2013-2015 evaluation period.

5.2.4 Standard 32, Large Battery Chargers, Effective January 1, 2014

Standard 32 covers large battery charger systems, defined as having a rated input power of more than 2kW (e.g., lift trucks).[18] As shown in Table 39 and Table 40, the evaluation team found both smaller unit energy savings and slightly smaller unit sales compared to those estimated by the IOUs. Details can be found in the appendix. Overall, program net savings are similar to the IOU estimate.

Table 39. Evaluated vs. IOU Estimated Unit Energy Savings for Standard 32 Large Battery Chargers

Large Battery Chargers	Unit Savings		
	Electricity (kWh)	Demand (kW)	Gas (Therms)
IOU Estimate	3,323	0.4481	0.00
Evaluated	1,782	0.0800	0.00

[18] Electric vehicles are exempt from this standard

Table 40. Evaluated vs. IOU Estimated Market Size and Savings for Standard 32 Large Battery Chargers

Large Battery Chargers	Year	Units	GWh							MW	Mtherms
			Potential Energy Savings	CAF	Gross Energy Savings	NOMAD Adjustment	Net Energy Savings	Attrib.	Program Net Energy Savings	Program Net Demand Savings	Program Net Gas Savings
IOU Estimate	2014	8,757	29.1	85%	24.6	-38%	15.2	74%	11.3	1.5	0.0
	2015	9,020	30.0	85%	25.3	-40%	15.3	74%	11.3	1.5	0.0
	Total		**59.1**		**50.0**		**30.5**		**22.6**	**3.0**	**0.0**
Evaluated	2014	7,334	13.1	78%	10.2	-13%	8.9	90%	8.0	0.4	-
	2015	7,334	13.1	78%	10.2	-15%	8.6	90%	7.8	0.3	-
	Total		**26.1**		**20.4**		**17.5**		**15.8**	**0.7**	**-**

5.3 Findings for Federal Appliance Standards, Phase One

5.3.1 Federal 9, Residential Pool Heaters, Effective 4/16/2013

No electric savings were claimed or found. As shown in Table 41, evaluated per-unit gas savings were similar to the IOU estimate.

Table 41. Evaluated vs. IOU Estimated Unit Savings for Federal 9 Residential Pool Heaters

Residential Pool Heaters	Unit Savings		
	Electricty (kWh)	Demand (kW)	Gas (Therms)
IOU Estimate	0	0	16
Evaluated	0	0	18

As shown in Table 42, the evaluation team found a larger market size than the IOUs estimated. We also found a high compliance rate. However, the NOMAD and attribution adjustments resulted in negligible total program net gas savings.

Table 42. Evaluated vs. IOU Estimated Market Size and Savings for Federal 9 Residential Pool Heaters

Residential Pool Heaters	Year	Units	Mtherms							GWh	MW
			Potential Gas Savings	CAF	Gross Gas Savings	NOMAD Adjust.	Net Gas Savings	Attrib.	Program Net Gas Savings	Program Net Energy Savings	Program Net Demand Savings
IOU Estimate	2013	1,589	0.03	89%	0.02	-50%	0.01	-	-	-	-
	2014	2,782	0.04	89%	0.04	-50%	0.02	-	-	-	-
	2015	2,800	0.04	89%	0.04	-50%	0.02	-	-	-	-
	Total		**0.11**		**0.10**		**0.05**		**-**	**-**	**-**
Evaluated	2013	11,572	0.21	95%	0.20	-50%	0.10	5%	0.00	-	-
	2014	16,246	0.29	95%	0.28	-50%	0.14	5%	0.01	-	-
	2015	16,246	0.29	95%	0.28	-50%	0.14	5%	0.01	-	-
	Total		**0.79**		**0.75**		**0.38**		**0.02**	**-**	**-**

5.3.2 Federal 10, Residential Direct Heating Equipment, Effective 4/16/2013

No electric savings were claimed or found. As shown in Table 43, evaluated per-unit gas savings were somewhat smaller than the IOU estimate.

Table 43. Evaluated vs. IOU Estimated Unit Savings for Federal 10 Res. Direct Heating Equipment

Residential Direct Heating Equipment	Unit Savings		
	Electricity (kWh)	Demand (kW)	Gas (Therms)
IOU Estimate	-13	0	19
Evaluated	0	0	13

As shown in Table 44, the evaluation team found a larger market size than the IOUs estimated. We also found a high compliance rate. However, the NOMAD and attribution adjustments resulted in small total program net gas savings.

Table 44. Evaluated vs. IOU Estimated Market Size and Savings for Federal 10 Residential Direct Heating Equipment

Residential Direct Heating Equipment	Year	Units	Mtherms							GWh	MW
			Potential Standards Gas Savings	CAF	Gross Standards Gas Savings	NOMAD Adjust.	Net Standards Gas Savings	Attrib.	Program Net Standards Gas Savings	Program Net Standards Energy Savings	Program Net Standards Demand Savings
IOU Estimate	2013	9,700	0.18	89%	0.16	-41%	0.09	-	-	-	-
	2014	13,426	0.25	89%	0.22	-41%	0.13	-	-	-	-
	2015	13,491	0.25	89%	0.22	-42%	0.13	-	-	-	-
	Total		**0.68**		**0.61**		**0.35**		**-**	**-**	**-**
Evaluated	2013	43,174	0.56	95%	0.53	-58%	0.22	8%	0.02	-	-
	2014	60,610	0.79	95%	0.75	-58%	0.31	8%	0.02	-	-
	2015	60,610	0.79	95%	0.75	-58%	0.31	8%	0.02	-	-
	Total		**2.14**		**2.03**		**0.84**		**0.07**		

5.3.3 Federal 11, Residential Refrigerators and Freezers, Effective September 9, 2014

As shown in Table 45 and Table 46, the evaluation team found unit energy savings and demand reduction to be significantly lower than those estimated by the IOUs. However, we found a much larger market size,[19] leading to higher potential, gross and net savings.

Our estimated attribution for this standard is 37%; the IOUs did not provide attribution estimates for the Federal appliance standards.

Table 45. Evaluated vs. IOU Estimated Unit Savings for Federal 11 Residential Refrigerators and Freezers

Residential Refrigerators & Freezers	Unit Savings		
	Electricity (kWh)	Demand (kW)	Gas (Therms)
IOU Estimate	149	0.0200	0.00
Evaluated	58	0.0070	0.00

[19] Evaluated market size is based on 2014 AHAM distributor sales for California

Table 46. Evaluated vs. IOU Estimated Market Size and Savings for Federal 11 Residential Refrigerators and Freezers

Residential Refrigerators & Freezers	Year	Units	GWh							MW	Mtherms
			Potential Energy Savings	CAF	Gross Energy Savings	NOMAD Adjustment	Net Energy Savings	Attrib.	Program Net Energy Savings	Program Net Demand Savings	Program Net Gas Savings
IOU Estimate	2014	59,636	9.2	89%	8.2	-12%	7.2	-	0.0	0.0	0.0
	2015	206,213	32.0	89%	28.4	-14%	24.5	-	0.0	0.0	0.0
	Total		**41.2**		**36.7**		**31.7**		**0.0**	**0.0**	**0.0**
Evaluated	2014	393,136	23.9	95%	22.7	-12%	19.9	37%	7.3	1.2	(0.1)
	2015	1,328,654	80.7	95%	76.6	-15%	65.1	37%	24.1	3.8	(0.5)
	Total		**104.6**		**99.3**		**84.9**		**31.4**	**4.9**	**(0.6)**

5.3.4 Federal 12, Residential Room Air Conditioners, Effective June 1, 2014

As shown in Table 47 and Table 48, the evaluation team found similar energy and demand unit savings to the IOU estimates, but a larger market size, at least doubling the potential, gross, and net savings.[20]

Our estimated attribution for this standard is 24%; the IOUs did not provide attribution estimates for the Federal appliance standards.

Table 47. Evaluated vs. IOU Estimated Unit Savings for Federal 12 Residential Room Air Conditioners

Residential Room AC	Unit Savings		
	Electricity (kWh)	Demand (kW)	Gas (Therms)
IOU Estimate	71	0.1160	0.00
Evaluated	73	0.1030	0.00

[20] Evaluated market size is based on 2014 AHAM distributor sales for California

Table 48. Evaluated vs. IOU Estimated Market Size and Savings for Federal 12 Residential Room Air Conditioners

Residential Room AC	Year	Units	GWh							MW	Mtherms
			Potential Energy Savings	CAF	Gross Energy Savings	NOMAD Adjustment	Net Energy Savings	Attrib.	Program Net Energy Savings	Program Net Demand Savings	Program Net Gas Savings
IOU Estimate	2014	71,150	5.1	89%	4.5	-4%	4.3	-	0.0	0.0	0.0
	2015	121,637	8.6	89%	7.7	-5%	7.3	-	0.0	0.0	0.0
	Total		**13.7**		**12.2**		**11.6**		**0.0**	**0.0**	**0.0**
Evaluated	2014	170,260	12.4	91%	11.3	-19%	9.2	24%	2.2	3.1	-
	2015	290,397	21.2	91%	19.3	-22%	15.0	24%	3.6	5.1	-
	Total		**33.6**		**30.6**		**24.2**		**5.8**	**8.2**	**-**

5.3.5 Federal 13, Fluorescent Ballasts, Effective November 11, 2014

As shown in Table 49 and Table 50, the evaluation team found smaller energy and demand unit savings than the IOU estimates, but a larger market size, leading to an overall finding that evaluated savings are 60-80% of the estimated potential, gross, and net savings.

The fluorescent ballast standard (Fed 13) led to a change in the method of calculating the efficiency of fluorescent ballasts. The Department of Energy (DOE) developed a new metric, ballast luminous efficiency (BLE), which has replaced the commonly used ballast efficacy factor (BEF) that was the primary metric in calculating and comparing efficiency. The DOE developed the new metric because BEF relies on the full system of the ballast and the installed linear fluorescent lamp and, therefore, cannot be used to calculate the efficiency of the ballast only, whereas BLE can be used for this purpose.

Although BLE is a better metric for assessing fluorescent ballast energy savings, a baseline did not exist, which makes it difficult to calculate per-unit fluorescent ballast savings using BLE because a comparison cannot be made to a previous standard. As a result, we determined that using data from DOE's Technical Support Document (TSD) and final ruling to assess potential energy savings was the best approach, and we used these data to determine the baseline and the energy saving level (ESL) that new ballasts must meet to be sold in the U.S. after this standard took effect. We then multiplied the savings by the market share to get the weighted average unit savings.

The steps involved in this process, as well as data sources used, are detailed in the appendices.

Our estimated attribution for this standard is high for a federal standard, at 74%; the IOUs did not provide attribution estimates for the Federal appliance standards. Our finding is based on factor scores of 80% for compliance and feasibility.

Table 49. Evaluated vs. IOU Estimated Unit Savings for Federal 13 Fluorescent Ballasts

Fluorescent Ballasts	Unit Savings		
	Electricity (kWh)	Demand (kW)	Gas (Therms)
IOU Estimate	23	0.0040	0.00
Evaluated	15	0.0029	0.00

Table 50. Evaluated vs. IOU Estimated Market Size and Savings for Federal 13 Fluorescent Ballasts

Fluorescent Ballasts	Year	Units	GWh							MW	Mtherms
			Potential Energy Savings	CAF	Gross Energy Savings	NOMAD Adjustment	Net Energy Savings	Attrib.	Program Net Energy Savings	Program Net Demand Savings	Program Net Gas Savings
IOU Estimate	2014	223,752	5.7	89%	5.0	-9%	4.6	-	-	-	-
	2015	1,795,746	45.4	89%	40.4	-10%	36.3	-	-	-	-
	Total		**51.1**		**45.5**		**40.8**		**-**	**-**	**-**
Evaluated	2014	309,726	4.4	80%	3.5	-25%	2.6	74%	2.0	0.4	(0.01)
	2015	2,355,210	33.4	80%	26.7	-27%	19.4	74%	14.4	3.1	(0.07)
	Total		**37.7**		**30.2**		**22.1**		**16.3**	**3.5**	**(0.07)**

5.3.6 Federal 14, Small Commercial Package ACs, Effective June 1, 2013

As shown in Table 51, the evaluation team found significantly smaller energy and demand savings than estimated by the IOUs. However, as shown in Table 52, the market size for this standard is so small, savings are negligible in either case.

Table 51. Evaluated vs. IOU Estimated Unit Savings for Federal 14 Small Commercial Package ACs

Small Commercial Package Air-Conditioners ≥65 and <135 kBtu/h	Unit Energy Savings		
	Energy (kWh)	Demand (kW)	Gas (Therms)
IOU Estimate	345	0.1791	0
Evaluated	23	0.0060	0

Table 52. Evaluated vs. IOU Estimated Market Size and Savings for Federal 14 Small Commercial Package ACs

Small Commercial Package Air-Conditioners ≥65 and <135 kBtu/h	Year	Units	GWh							MW	Mtherms
			Potential Energy Savings	CAF	Gross Energy Savings	NOMAD Adjustment	Net Energy Savings	Attrib.	Program Net Energy Savings	Program Net Demand Savings	Program Net Gas Savings
IOU Estimate	2013	1	0.0	89%	0.0	-93%	0.0	-	-	-	-
	2014	2	0.0	89%	0.0	-93%	0.0	-	-	-	-
	2015	2	0.0	89%	0.0	-93%	0.0	-	-	-	-
	Total		**0.0**		**0.0**		**0.0**		**-**	**-**	**-**
Evaluated	2013	9	0.0	100%	0.0	-93%	0.0	10%	0.0	0.00	-
	2014	16	0.0	100%	0.0	-93%	0.0	10%	0.0	0.00	-
	2015	16	0.0	100%	0.0	-93%	0.0	10%	0.0	0.00	-
	Total		**0.0**		**0.0**		**0.0**		**0.0**	**0.0**	**-**

5.3.7 Federal 15, Large Commercial Package ACs, Effective June 1, 2014

As shown in Table 53, the evaluation team found significantly smaller energy and demand savings than estimated by the IOUs. However, as shown in Table 54, the market size for this standard is so small, savings are negligible in either case.

Table 53. Evaluated vs. IOU Estimated Unit Savings for Federal 15 Large Commercial Package ACs

Large and Very Large Commercial Package Air-Conditioners ≥135 kBtu/h	Unit Savings		
	Electricity (kWh)	Demand (kW)	Gas (Therms)
IOU Estimate	3,225	1.6736	0
Evaluated	688	0.2730	0

Table 54. Evaluated vs. IOU Estimated Market Size and Savings for Federal 15 Large Commercial Package ACs

Large and Very Large Commercial Package Air-Conditioners ≥135 kBtu/h	Year	Units	GWh							MW	Mtherms
			Potential Energy Savings	CAF	Gross Energy Savings	NOMAD Adjustment	Net Energy Savings	Attrib.	Program Net Energy Savings	Program Net Demand Savings	Program Net Gas Savings
IOU Estimate	2013	0	-	n/a	-	n/a	-	-	-	-	-
	2014	12	0.0	89%	0.0	-75%	0.0	-	-	-	-
	2015	20	0.1	89%	0.1	-76%	0.0	-	-	-	-
	Total		**0.1**		**0.1**		**0.0**		**-**	**-**	**-**
Evaluated	2013	0	-	n/a	-	n/a	-	n/a	-	-	-
	2014	97	0.1	100%	0.1	-75%	0.0	10%	0.0	0.00	-
	2015	166	0.1	100%	0.1	-76%	0.0	10%	0.0	0.00	-
	Total		**0.2**		**0.2**		**0.0**		**0.0**	**0.0**	**-**

5.3.8 Federal 16, Computer Room ACs, Effective October 29, 2013

As shown in Table 55 and Table 56, the evaluation team found similar unit energy savings, but lower demand reduction than the IOU estimates. We found a larger, but still very small market size, resulting in negligible potential savings. We found compliance to be 100%. However we also found, based on our experts' input that 99% of the market would have adopted this level of efficiency in the absence of the standard.

Our estimated attribution for this standard is 10%; the IOUs did not provide attribution estimates for the Federal appliance standards.

Table 55. Evaluated vs. IOU Estimated Unit Savings for Federal 16 Computer Room ACs

Computer Room ACs >=65,000 Btu/h and < 760,000 Btu/h	Unit Savings		
	Electricity (kWh)	Demand (kW)	Gas (Therms)
IOU Estimate	77	0.0399	0.00
Evaluated	76	0.0090	0.00

Table 56. Evaluated vs. IOU Estimated Market Size and Savings for Federal 16 Computer Room ACs

Computer Room ACs >=65,000 Btu/h and < 760,000 Btu/h	Year	Units	GWh							MW	Mtherms
			Potential Energy Savings	CAF	Gross Energy Savings	NOMAD Adjustment	Net Energy Savings	Attrib.	Program Net Energy Savings	Program Net Demand Savings	Program Net Gas Savings
IOU Estimate	2013	40	0.0	89%	0.0	-99%	0.0	-	-	-	-
	2014	234	0.0	89%	0.0	-99%	0.0	-	-	-	-
	2015	240	0.0	89%	0.0	-99%	0.0	-	-	-	-
	Total		**0.0**		**0.0**		**0.0**		**-**	**-**	**-**
Evaluated	2013	477	0.0	100%	0.0	-99%	0.0	10%	0.0	0.0	0.0
	2014	2,723	0.2	100%	0.2	-99%	0.0	10%	0.0	0.0	0.0
	2015	2,723	0.2	100%	0.2	-99%	0.0	10%	0.0	0.0	0.0
	Total		**0.5**		**0.5**		**0.0**		**0.0**	**0.0**	**0.0**

5.3.9 Federal 17, Residential Dishwashers, Effective May 5, 2013

As shown in Table 57 and Table 58, the evaluation team found positive gas and negative electric and demand savings for this standard. This result is driven by the water heating fuel shares; the 2009 Residential Appliance Saturation Survey indicates the majority of PG&E and SCE/SoCalGas customers have gas water heating. We found a significantly larger market size than that estimated by the IOUs, resulting in relatively significant negative potential and gross electric savings.

Our estimated attribution for this standard is 5%; the IOUs did not provide attribution estimates for the Federal appliance standards.

Table 57. Evaluated vs. IOU Estimated Unit Savings for Federal 17 Residential Dishwashers, Effective

Residential Dishwashers	Unit Savings		
	Electricity (kWh)	Demand (kW)	Gas (therms)
IOU Estimate	9	0.0014	1.06
Evaluated	-6	-0.0007	2.50

Table 58. Evaluated vs. IOU Estimated Market Size and Savings for Federal 17 Residential Dishwashers, Effective

Residential Dishwashers	Year	Units	GWh							MW	Mtherms
			Potential Energy Savings	CAF	Gross Energy Savings	NOMAD Adjustment	Net Energy Savings	Attrib.	Program Net Energy Savings	Program Net Demand Savings	Program Net Gas Savings
IOU Estimate	2013	64,139	0.6	89%	0.5	-65%	0.2	-	-	-	-
	2014	107,185	1.0	89%	0.9	-66%	0.3	-	-	-	-
	2015	111,179	1.0	89%	0.9	-67%	0.3	-	-	-	-
	Total		**2.6**		**2.3**		**0.8**		**-**	**-**	**-**
Evaluated	2013	466,199	(3.0)	99%	(3.0)	-78%	(0.7)	5%	(0.0)	(0.0)	0.0
	2014	787,790	(5.1)	99%	(5.1)	-78%	(1.1)	5%	(0.1)	(0.0)	0.0
	2015	787,790	(5.1)	99%	(5.1)	-78%	(1.1)	5%	(0.1)	(0.0)	0.0
	Total		**(13.3)**		**(13.1)**		**(2.9)**		**(0.1)**	**(0.0)**	**0.1**

5.4 Findings for All Appliance Standards Evaluated to Date

This section includes savings from all previously evaluated appliance standards and the Phase One standards for the years 2013-2015. All of the savings reported in this section include IEs.

The stream of first-year savings from each code or standard may change each year for a variety of reasons including:

- Increase in the estimated NOMAD value which reduces net savings.
- Reduction of the prior program adjustment in the net NOMAD value
- Updates to market volumes where more recent data is available. For example, we obtained market data for televisions and used the new market size of 3.7 million units for both of the TV standards: 28a and 28b
- Federal pre-emption of a California Title 20 standard detailed in section 2.4.

Note: Savings from previously evaluated Title 24 codes are not included here since we intend to update the 2013-2015 savings from earlier codes to reflect current construction volume.

5.4.1 Evaluated Savings with Layered Savings included

In Table 59, Table 60, and Table 61, we present the three-year total savings from all previously evaluated appliance standards and the standards in the Phase One scope. This enables us to calculate the overall totals for electricity, demand, and gas. Once again, gas savings are negative since the total IEs are greater than the direct gas savings.

These totals include the savings from California standards that were superseded by later Title 20 standards. These so-called "layered" savings were discussed and identified in section 2.4. In general, all values in this report include layered savings unless otherwise noted.

Table 59. 2013-2015 Electricity Savings for Evaluated Appliance Standards (GWh)

Standards Group	Potential Energy Savings	Gross Energy Savings	Net Energy Savings	Net Program Energy Savings
2005 T-20	1,749	1,662	683	500
2006-2009 T-20	3,093	2,845	1,820	1,278
2006-2009 T-20 Std 28b (TVs Tier 2)	1,322	1,296	412	249
2011 T-20 (Battery chargers)	1,349	1,211	780	454
2013 Fed Appliance	163	148	128	53
2010-2012 Fed Appliance	1,721	1,424	950	314
Total	**9,397**	**8,586**	**4,773**	**2,849**

Table 60. 2013-2015 Demand Savings for Evaluated Appliance Standards (MW)

Standards Group	Potential Demand Savings	Gross Demand Savings	Net Demand Savings	Net Program Demand Savings
2005 T-20	296	283	117	86
2006-2009 T-20	353	327	209	143
2006-2009 T-20 Std 28b (TVs Tier 2)	131	129	41	25
2011 T-20 (Battery chargers)	89	79	51	29
2013 Fed Appliance	70	63	52	17
2010-2012 Fed Appliance	393	328	205	58
Total	**1,332**	**1,209**	**675**	**357**

Table 61. 2013-2015 Gas Savings for Evaluated Appliance Standards (MTherms)

Standards Group	Potential Gas Savings	Gross Gas Savings	Net Gas Savings	Net Program Gas Savings
2005 T-20	(10.5)	(9.6)	0.0	0.3
2006-2009 T-20	(23.8)	(22.6)	(11.4)	(7.2)
2006-2009 T-20 Std 28b (TVs Tier 2)	(16.1)	(15.8)	(5.0)	(3.0)
2011 T-20 (Battery chargers)	(26.5)	(23.9)	(15.3)	(8.8)
2013 Fed Appliance	6.0	6.0	0.6	(0.6)
Fed Appliance (prior to 2013)	(6.5)	(3.8)	(1.9)	(0.5)
Total	**(77.4)**	**(69.7)**	**(33.0)**	**(19.7)**

5.4.2 Evaluated Savings with Layered Savings Excluded

In Table 62, Table 63, and Table 64, we again present savings from all evaluated appliance standards but in these summaries, layered savings have been excluded. As shown in section 2.4, the superseded standards are Standard 18a the consumer electronics standard and standard 11b the general service incandescent lamp standard. In terms of net program energy savings, the exclusion of layered savings reduces total electricity savings by 51 GWh and total demand savings by 8 MW. There is a small increase of about 1.1 Mtherms in gas savings due to a reduction in expected IEs.

Table 62. 2013-2015 Electricity Savings for Evaluated Appliance Standards (GWh)

Standards Group	Potential Energy Savings	Gross Energy Savings	Net Energy Savings	Net Program Energy Savings
2005 T-20	1,555	1,476	658	480
2006-2009 T-20	3,040	2,799	1,777	1,246
Federal Appliance (prior to 2013)	1,721	1,424	950	314
2006-2009 T-20 Std 28b (TVs Tier 2)	1,322	1,296	412	249
2011 T-20 (Battery chargers)	1,349	1,211	780	454
2013 Fed Appliance	163	148	128	53
Total	**9,151**	**8,354**	**4,705**	**2,797**

Table 63. 2013-2015 Demand Savings for Evaluated Appliance Standards (MW)

Standards Group	Potential Demand Savings	Gross Demand Savings	Net Demand Savings	Net Program Demand Savings
`2005 T-20	268	256	114	83
2006-2009 T-20	345	319	202	137
Fed Appliance (prior to 2013)	393	328	205	58
2006-2009 T-20 Std 28b (TVs Tier 2)	131	129	41	25
2011 T-20 (Battery chargers)	89	79	51	29
2013 Fed Appliance	70	63	52	17
Total	**1,295**	**1,174**	**664**	**349**

Table 64. 2013-2015 Gas Savings for Evaluated Appliance Standards (MTherms)

Standards Group	Potential Gas Savings	Gross Gas Savings	Net Gas Savings	Net Program Gas Savings
2005 T-20	(7)	(6)	0	1
2006-2009 T-20	(23)	(22)	(11)	(7)
Fed Appliance (prior to 2013)	(7)	(4)	(2)	(0)
2006-2009 T-20 Std 28b (TVs Tier 2)	(16)	(16)	(5)	(3)
2011 T-20 (Battery chargers)	(27)	(24)	(15)	(9)
2013 Fed Appliance	6.0	6.0	0.6	(0.6)
Total	**(73)**	**(65)**	**(32)**	**(19)**

5.5 Uncertainty Analysis

As noted in Section 2.1, we use the evaluation protocol to determine energy and demand savings attributable to the C&S Program. The protocol defines the major factors used to calculate savings. The process begins with an estimate of potential savings, a product of unit savings and market-size estimates, and continues with a series of adjustments to the potential to arrive at savings for each utility. We describe the methods used to determine the various parameters in Chapter 3.

Due to the variety of methods used, this process does not lend itself to a simple approach of developing confidence level and precision estimates based on sampling statistics, as each evaluation component is subject to different uncertainties and measurement errors that affect the confidence and precision associated with the estimated value. Therefore, Cadmus used a Monte Carlo simulation approach, built into the ISSM calculation engine, to examine the uncertainty around the estimates of cumulative savings for the years 2013 through 2015.

The Monte Carlo method uses a random selection from a defined range of values for the evaluation inputs shown in Table 65. The range was defined as a triangular distribution centered on the evaluated value with boundaries determined by the evaluators.

Table 65. Summary of Inputs to Uncertainty Analysis

Protocol Stage	Input(s)
Potential Savings	Unit savings for kWh, kW, and therms
	Annual installations (market volume)
Gross Savings (Compliance)	Compliance adjustment factors (CAF)
Net Program Savings (NOMAD)	Market adoption curve
Net Program Savings (Attribution)	Weighted attribution score

For most of these inputs, the evaluation does not have sufficient data to calculate an appropriate range for the uncertainty analysis. For this reason, we assigned initial default boundaries of plus or minus 20% to all of the inputs based on our judgement.

Since the six standards listed in Table 66 represent over 99% of the net electric energy savings, we reviewed the individual inputs for these standards to determine whether to apply the general default plus or minus 20% range or a different range for the uncertainty analysis.

Based on our review, we used the uncertainty ranges shown in Table 66 in the analysis. We based the ranges for compliance inputs on the calculated confidence and precision for the samples we evaluated. We used our judgement to assign the ranges for all other inputs. Additional detail on the sources and ranges can be found in Appendix D.

Table 66. Range of Inputs to Uncertainty Analysis for Selected Standards

REF	Standard	Unit Savings*		Market Volume	Compliance	Comments
		Energy kWh	Demand kW			
Std28b	Televisions Tier 2	± 5%	± 5%	± 10%	± 5%	We have detailed data on televisions to support the unit energy savings, market volume, and compliance value.
Std 29	Small Battery Chargers Tier 1	± 20%	± 20%	± 10%	± 10%	We have detailed data for many qualifying products and this reduces the uncertainty in market size.
Std 32	Large Battery Chargers	± 20%	± 20%	± 30%	± 10%	Data on this market was difficult to obtain so there is considerable uncertainty on market size
Fed 11	Residential Refrig./ Freezers	± 10%	± 10%	± 10%	± 10%	We have detailed data on market size and measured compliance for 185 products
Fed 12	Residential Room AC	± 20%	± 20%	± 10%	± 10%	We have detailed data on market size and measured compliance for 89 products
Fed 13	Fluorescent Ballasts	± 20%	± 20%	± 20%	± 10%	Used default levels to reflect moderate uncertainty

* For gas savings per unit, we used plus or minus 20% for all of the standards.

With the range defined for each input, we ran the model 500 times to generate a distribution of savings and adjustment estimates, shown below in Table 67.

We bolded the lines that report results for program net savings. We note that the 90% confidence interval is within 14% of the evaluated value for program net electric energy savings, within 9% for program net demand savings, and within 17% for program net gas savings based on the values input for uncertainty above.

Table 67. Uncertainty Analysis Results

3-Year Uncertainty Statistics	Mean	StdDev	Percentiles			90% Confidence Interval, Plus/Minus %	
			5%	50%	95%		
ENERGY - GWh							
Potential Energy Savings	2,856	126	2,638	2,862	3,057	7%	8%
Adjustment for Non-Compliance	(184)	54	(275)	(185)	(93)	49%	50%
Gross Energy Savings	2,673	127	2,471	2,673	2,880	8%	8%
Adjustment for Net NOMAD	(1,345)	54	(1,435)	(1,343)	(1,257)	7%	7%
Net Energy Savings	1,328	77	1,209	1,324	1,455	10%	9%
Adjustment for Attribution	(567)	54	(654)	(564)	(483)	15%	15%
Program Net Energy Savings	**760**	**61**	**662**	**757**	**868**	**14%**	**13%**
DEMAND - MW							
Potential Energy Savings	293	9	279	294	308	5%	5%
Adjustment for Non-Compliance	(19)	4	(26)	(19)	(13)	32%	35%
Gross Energy Savings	274	9	260	274	288	5%	5%
Adjustment for Net NOMAD	(130)	4	(137)	(130)	(123)	5%	5%
Net Energy Savings	144	5	136	144	153	6%	6%
Adjustment for Attribution	(73)	4	(80)	(73)	(67)	9%	9%
Program Net Demand Savings	**71**	**4**	**65**	**71**	**78**	**9%**	**9%**
GAS- Mtherms							
Potential Energy Savings	(36.9)	2.5	(41.0)	(36.8)	(32.7)	11%	11%
Adjustment for Non-Compliance	2.9	1.0	1.2	2.9	4.6	60%	59%
Gross Energy Savings	(34.0)	2.5	(38.3)	(33.7)	(30.2)	11%	13%
Adjustment for Net NOMAD	14.2	1.0	12.7	14.1	16.0	13%	10%
Net Energy Savings	(19.8)	1.5	(22.3)	(19.6)	(17.5)	12%	13%
Adjustment for Attribution	7.4	1.0	5.8	7.3	9.2	24%	21%
Program Net Gas Savings	**(12.4)**	**1.2**	**(14.5)**	**(12.3)**	**(10.5)**	**15%**	**17%**

6 Conclusions and Recommendations

This chapter summarizes the evaluation team's conclusions and recommendations regarding the evaluation process.

6.1 Evaluation topics

In the 2010-2012 evaluation, we reached the conclusion that program saving estimates are not initially well-documented in the IOU savings estimate and CCTRs.

We recognized that the statewide C&S program differs from resource-acquisition programs in that there are no participant databases that define program savings for evaluators. Evaluators generally depend on resource programs to provide documentation of estimated savings. For the C&S program however, it was necessary for the evaluation team to spend considerable effort to collect information that would ordinarily be provided by the program.

We gave the following examples of such information:

- Product market volumes. For the majority of the codes and standards, market data from around the time of the CEC approval process was used to support the IOU Estimate. Many of the product mix and annual volume values are taken from the CASE reports which are usually dated between 2004 and 2008. Their sources are necessarily somewhat older.
- Delays in the availability of CASE reports and CCTRs. It took sixteen months for the IOUs to deliver all of the CCTRs. Since the CCTRs are critical to the determination of attribution, the contents and availability of these documents had a direct impact on the evaluation.

Conclusion: Delivery of program savings estimates, CASE reports, and CCTRs has improved but there are still significant gaps in the documentation available to evaluators.

Improvements include the following:

- Nearly all parameters (the exception was attribution values for federal standards) were provided at the start of the evaluation in the ISSM format.
- Sources of market volumes were documented as requested.
- CASE reports and CCTRs were delivered as planned and in a shorter period of time than previously.
- Although no federal attribution values were provided, attribution documentation in support of federal standard adoption was generally complete and met the requirements identified previously.

Significant gaps in documentation:

- **Product market volumes**
    - Although the sources were documented by name, it was often not possible to find which specific values in the source were used.

    - As in the past, sources were often several years old and did not represent current market conditions.
- **Unit energy savings**. Values submitted in the estimate did not match the CASE report and no other documentation was provided. The absence of documentation makes it impossible to reconcile evaluation findings to the submitted estimate.
- **Standards developed after CASE reports were completed**. For example, the Small Battery Charger, Tier 2 (Standard 30). This product category—USB chargers with greater than 20 Watt hour capacity—is not identified in the CASE report yet it was adopted by the CEC. We received no documentation of the basis for unit energy savings, market volume, or savings potential.

Recommendations:

The statewide program administrators and CPUC should resolve data gap issues before starting the next impact evaluation.

The IOUs should update the CASE reports or provide supplementary documentation that reflects the adopted standard.

Conclusion: Verification of compliance is becoming more challenging.

There are a few aspects to this issue including:

- Increasing complexity of regulations. For example, title 20 regulations on battery charger systems have led to the CEC listing some end-use devices and some battery charger components but these listings do not include the entire battery charger system. There are similar issues with regulations on swimming pool systems which have changed from pump regulations to system regulations.
- Product proliferation. For products such as televisions and battery charger systems, the CEC listing process lags the rapidly changing set of products available in the market. To measure compliance, it requires additional research to determine compliance for the set of unlisted products.

Recommendation: The CPUC and evaluators should consider collaboration with the CEC to make efficient use of resources used to determine compliance.

Conclusion: Grouping of multiple product types / standards in a single CASE report or CCTR tends to limit the evaluators' ability to assign attribution scores to each standard

Examples include battery chargers where a single CCTR was provided for four standards. As noted earlier, the CASE report included three categories but there were no references to the Small Charger, Tier 2 USB product category. A second example is the combined documentation for water heaters, pool heaters, and direct heating equipment.

Recommendation: Request that unlike technologies not be grouped together