



Codes & Standards Program PY2006-2008 Impact Evaluation

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The New Construction/Codes & Standards Evaluation Team

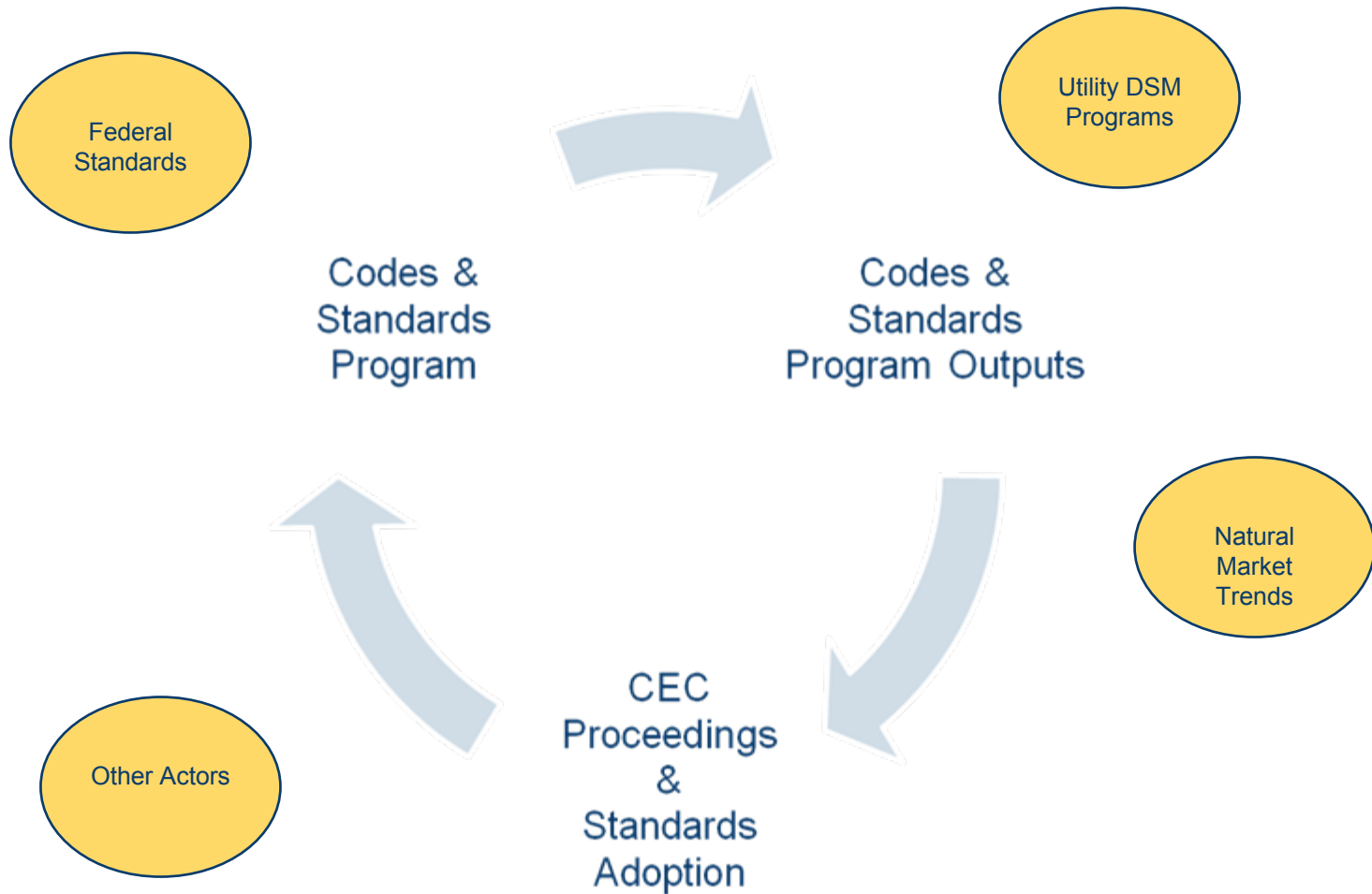
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- The Cadmus Group, Inc.
- Ehrlich Natural Resources Group
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Meeting Purpose and Introductions



California Codes & Standards Process Overview



Utility Codes & Standards (C&S) Program Description

- Integrated, statewide investor owned utility Program
- Supported Title 20 (appliance) Standards and Title 24 (building) Standards
- Held workshops and meetings to identify promising candidates for new standards
- Targeted research to set stage for development of new standards
- Worked with California Energy Commission (CEC) to resolve specific issues, generate data, and facilitate adoption

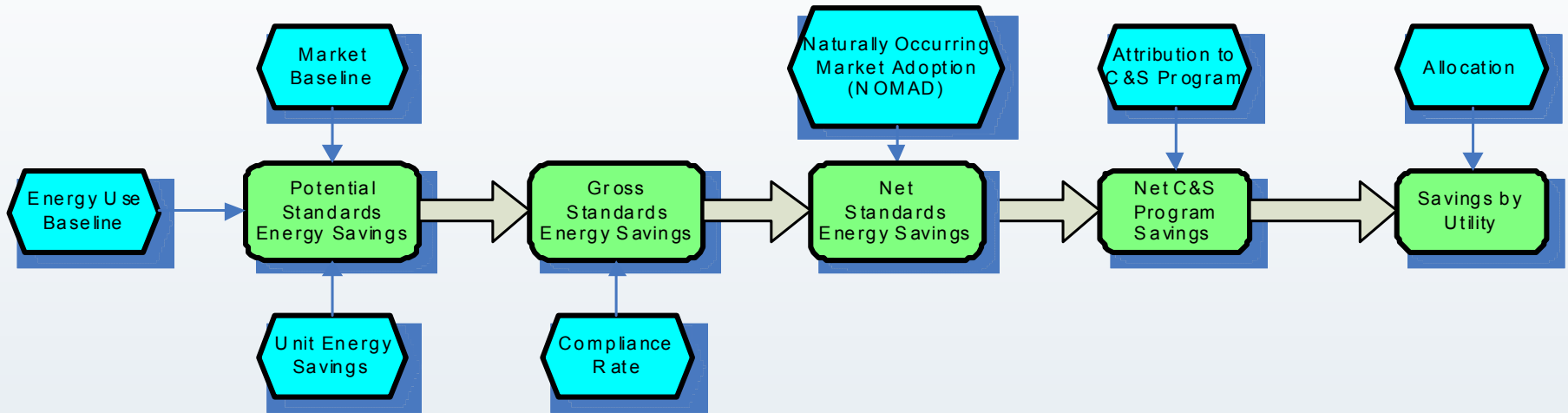
C&S Program Description (cont.)

- Funded Codes and Standards Enhancement Initiative studies (CASE reports or studies) providing technical, economic, and market data
- Participated in public C&S hearings and workshops
- Identified testing needed as basis for new standards
- Worked with industry and other stakeholders to identify and promote opportunities for new standards
- Built upon acquisition programs for efficient technologies/measures

Evaluation Purpose

- Estimate verified savings during 2006-08 period attributable to C&S Program activities contributing to adoption of Title 20 and 24 standards going into effect from October 2005 through 2008

Evaluation Approach: Overview





Evaluation Approach: Potential Savings

Potential savings = maximum, unadjusted savings possible if entire market met standard

- Estimated savings possible for each appliance sold (Title 20 standards) and each building constructed or renovated (Title 24 standards)
- Multiplied unit savings by the actual quantity of appliances sold and buildings constructed, respectively—*no adjustment made here for current market penetration*



Evaluation Approach: Compliance

Gross savings = Potential savings adjusted for incomplete compliance

- Measured compliance for each measure or building
 - By measure or appliance, based on % meeting standard ($\leq 100\%$)
 - For whole building, based on energy performance (can exceed 100%)
- Estimated based on primary data collection



Evaluation Approach: NOMAD

Naturally Occurring Market Adoption (NOMAD)

- Estimate of market penetration of complying products/measures or building efficiency trend without adoption of standard
- Based on expert inputs

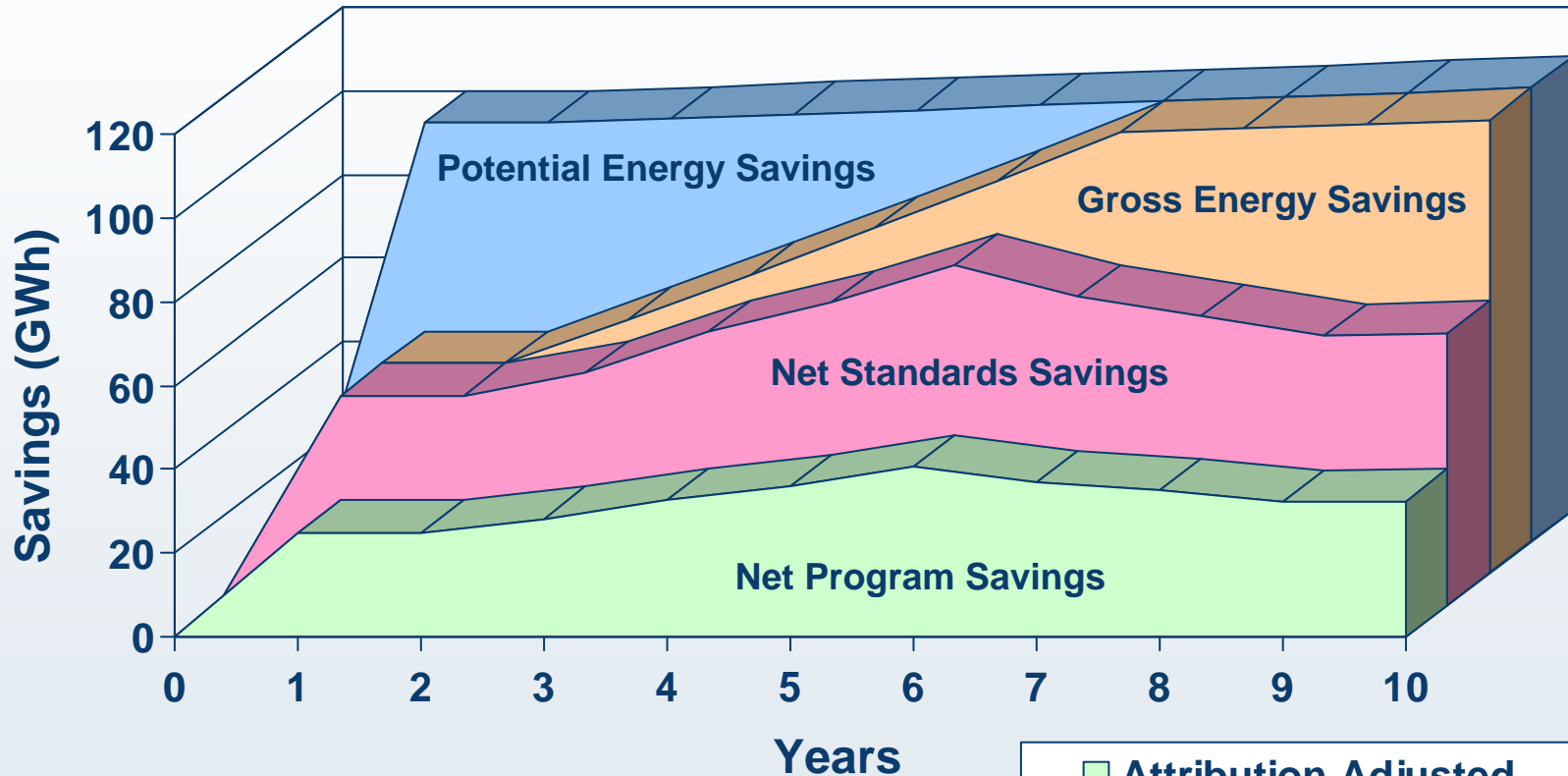


Evaluation Approach: Attribution

Attribution accounts for share of Net Standards Savings attributable to C&S Program

- Used stakeholder interview-based preponderance of evidence approach
- Used experts to estimate effort expended and independent, objective reviewers to estimate C&S Program contribution
- Relied on extensive reviews of program materials and documents

Evaluation Approach: Savings Quantification



- Attribution Adjusted
- NOMAD Adjusted
- Compliance Adjusted
- Potential Savings



Evaluation Approach: Allocation

Allocation distributes savings by IOU service area

- Used simplified approach applied in past



Evaluation Approach: Integrated Standards Savings Model (ISSM)

- Based on Savings Estimate Spreadsheet (SES) created by Heschong Mahone Group (HMG)
- ISSM combines all factors to estimate Net Program Savings attributable to each utility
- Covers period 2006-2020
- Provides great flexibility and incorporates uncertainty and sensitivity analyses

Major Changes from Original Protocol and Methodology

- Eliminated adjustment for possible adoption of standard without C&S Program (NOSAD)
- No effect of initial market penetration accounted for in Potential Standards Energy Savings
- Developed whole-building analysis approach
- Took utility DSM program effects into account in market trends
- Added flexibility and features to spreadsheet analysis tool

Q/A on C&S Methodology



Title 20: Appliance Standards



Title 20: Standards and Implementation Dates

Appliance Standard I.D.	Appliance Standard Name	Implementation Date
Std1	Commercial Refrigeration Equipment, Solid Door	Jan-06
Std2	Commercial Refrigeration Equipment, Transparent Door	Jan-07
Std3	Commercial Ice Maker Equipment	Jan-08
Std4	Walk-In Refrigerators / Freezers	Jan-06
Std5	Refrigerated Beverage Vending Machines	Jan-06
Std6	Large Packaged Commercial Air-Conditioners, Tier 1	Oct-06
Std7	Large Packaged Commercial Air-Conditioners, Tier 2	Jan-10
Std8	Residential Pool Pumps, High Efficient Tier 1	Jan-06
Std9	Residential Pool Pumps, 2-speed Motors, Tier 2	Jan-08
Std10	Portable Electric Spas	Jan-06
Std11a	General Service Incandescent Lamps, Tier 1	Jan-06
Std11b	General Service Incandescent Lamps, Tier 2	Jan-08
Std12a	Pulse Start Metal Halide (MH) HID Luminaires (Vertical, Base-Up only) 1	Jan-06
Std 12b	Pulse Start Metal Halide (MH) HID Luminaires (All)	Jan-08
Std13	Modular Furniture Task Lighting Fixtures	Jan-06
Std14	Hot Food Holding Cabinets	Jan-06
Std15a	External Power Supplies, Tier 1 ¹	Jan-07
Std15b	External Power Supplies, Tier 1 ²	July-07
Std16	External Power Supplies, Tier 2	Jul-08
Std17	Consumer Electronics – Audio Players	Jan-07
Std18a	Consumer Electronics – TVs	Jan-06
Std18b	Consumer Electronics – DVDs	Jan-06
Std19	Water Dispensers	Jan-06
Std20	Unit Heaters and Duct Furnaces	Jan-06
Std21	Commercial Dishwasher Pre-Rinse Spray Valves	Jan-06
¹ External Power Supplies for laptop computers, mobile phones, printers, print servers, PDAs and digital cameras		
² External Power Supplies for wire line telephones and all other devices		

Title 20: Methodology Overview

- Potential Savings
- Compliance
- NOMAD
- Attribution



Title 20: Potential First-Year Energy Savings

- Savings estimates per unit
 - Consumption of baseline compared to new standards
- Sales data
- All original inputs reviewed and updated as needed

$$\text{Potential Energy Savings in year 1} = \text{Unit Energy Savings} * \text{Unit Sales}$$

Title 20: Potential Savings

Consumption and Savings for Solid Door Refrigerators and Freezers					
Type (Size)	Federal Standard, kWh/day	California Standard, kWh/day	Federal Standard, kWh/year	California Standard, kWh/year	Energy Savings, kWh/year
Refrigerators (24)	5.76	4.44	2102	1621	482
Freezers (24)	11.83	10.98	4319	4008	311
Refrigerators (48)	8.76	6.84	3197	2497	701
Freezers (48)	21.38	20.58	7805	7512	293
Refrigerators (72)	11.76	9.24	4292	3373	920
Freezers (72)	30.94	30.18	11292	11016	276

Title 20: Potential Savings

Unit Sales of Solid Door Refrigerators/Freezer—Revised Methodology			
Type Size	Sales Per Year National	Percent of Units in California	Sales Per Year California
Refrigerator 24	43,333	12%	5,200
Refrigerator 48	93,889	12%	11,267
Refrigerator 72	7,222	12%	867
Commercial Refrigeration Equipment, Refrigerators Solid Door	144,444	12%	17,333
Freezers 24	48,889	12%	5,867
Freezers 48	35,556	12%	4,267
Freezers 72	4,444	12%	533
Commercial Refrigeration Equipment, Freezers Solid Door	88,889	12%	10,667

Title 20: Potential Savings

Standard	SES Gross Energy Savings (GWh, unless Mtherms)	Updated Potential Savings		
		GWh	MW	Mtherms
STD 1: Commercial Refrigeration, Solid Door	9.54	9.1	1.2	0
STD 2: Commercial Refrigeration, Transparent Door	8.36	12.2	1.6	0
STD 3: Commercial Ice Maker Equipment	6.60	6.5	0.9	0
STD 4: Walk-In Refrigerators / Freezers	47.97	72.1	9.5	0
STD 5: Refrigerated Beverage Vending Machines	12.63	15.1	2.0	0
STD 6: Large Packaged Commercial Air-Conditioners, Tier 1	13.47	13.5	7.0	0
STD 7: Large Packaged Commercial Air-Conditioners, Tier 2	10.05 (incremental) 23.52 (total)	0 (incremental) 13.5 (total)	0 (incremental) 7.0 (total)	0

Title 20: Potential Savings Key Findings

- Largest potential electricity savings:
 - Tier 2 General Service Incandescents
 - Metal Halide standards
 - Tier 2 Residential Pool Pump and Motor standard produced the next largest potential electricity savings
- Smallest potential electricity savings:
 - Tier 2 Large Packaged Commercial Air Conditioners and Pre-rinse Spray Valves were estimated to be zero because federal standards established a new baseline

Title 20: Compliance Methodology

- Collected primary data on appliances for which estimated energy savings were the largest
 - Developed statewide, stratified sampling plan for vendor site visits
 - Site visits were preferred method
 - Supplemented with calls, Web searches, etc. as needed
- Compliance assessed based on two methods
 - Listing in CEC database
 - Independent assessment relative to requirements
- Assessment for walk-in refrigerators and freezers required special approach
- Compliance based on weighted data

Title 20: Compliance Example

- Pool Pumps

Pool Pump Compliance Results

Sample Data Details					Compliance Results		
# of Stores Visited	# of Unique Models	Total Units Sampled	% of Sample Omitted	# of Units for Analysis	% Compliant with CEC	% Compliant - Unlisted	% Non-Compliant
12	86	152	28.9%	108	89.8%	3.8%	6.4%

Total Compliance Rate	90% Confidence Intervals
93.6% ± 4.0%	89.6% - 97.6%

Title 20: Compliance

Illustrative Compliance Rates

Appliance	Total Compliance Rate	90% Confidence Intervals
Pool Pumps	93.6% ± 4.0%	89.6% - 97.6%
Metal Halide Luminaires	51.9% ± 11.8%	40.1% - 63.7%
GS Incandescent Lamps	43.6% ± 7.6%	36.0% - 51.2%
Pre-Rinse Spray Valves *	100% ± 0%	100%
Audio Players	100% ± 0%	100%
Televisions	96.1% ± 1.2%	94.9% - 97.3%
External Power Supplies	98.7% ± 1.1%	97.6% - 99.8%
Duct and Unit Heaters	100% ± 0%	100%



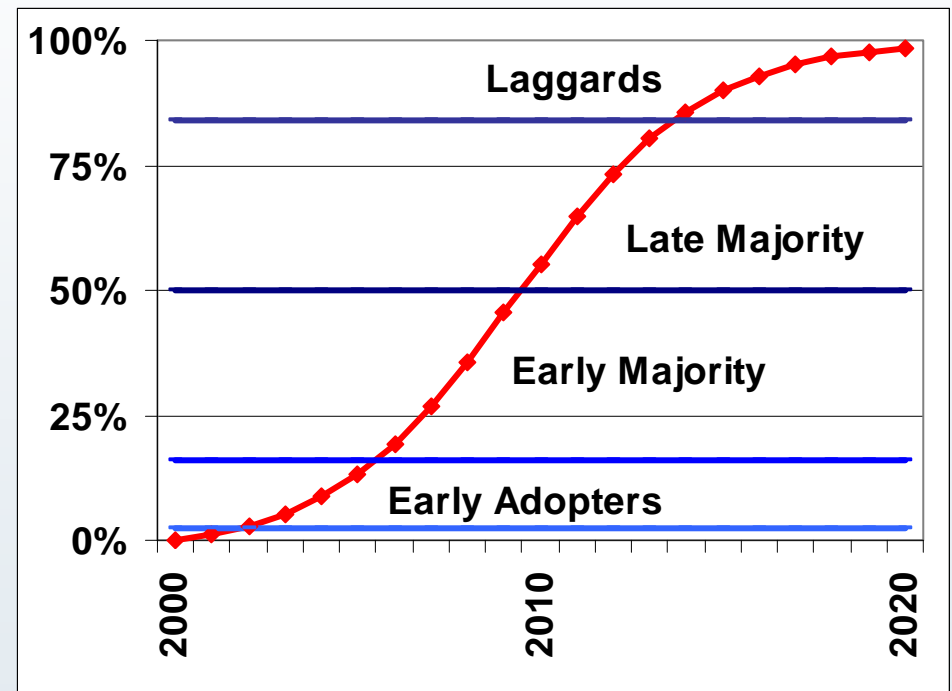
Title 20: Compliance Summary

- Compliance $\geq 93\%$ for:
 - Residential Pool Pumps and Motors
 - Pre-rinse Spray Valves
 - Televisions
 - External Power Supplies
 - Duct Furnaces/Unit Heaters
- For most major energy saving appliance standards, $\geq 64\%$ of models were in CEC compliance databases
- Lighting equipment (General Service Incandescents and Metal Halides) exhibited lowest compliance rates of major energy savers
 - Most were not listed in CEC databases
 - Compliance was low even after including those that met the technical specifications but were not listed

Title 20: Naturally Occurring Market Adoption (NOMAD)

- Definition: Estimated annual penetration of efficient appliance or measure if standard had not been adopted
- Market penetration assumed to follow classic S-curve
- Adjusts gross savings to provide net savings

Bass Diffusion Model





Title 20: NOMAD Estimation

- Use Delphi method: group communication process among panel of experts
 1. Structured information flow
 2. Feedback to participants
 - Iterative process
 3. Anonymity for participants
- Produces a consensus prediction



Title 20: NOMAD Data Collection

- Cadmus developed an online application that enabled a Delphi process
 - Instructions included request for reason or data for each input
 - Built in requirement to provide a comment to save results
- Recruiting the experts
 - Raw list created from CEC dockets, CASE reports, and Cadmus' staff knowledge
 - For 21 appliance standards, 233 experts on raw list
- Prioritized according to energy savings
- Established target of 4 or more experts for the standards with the greatest savings impact

Title 20: NOMAD Example—Walk-In Refrigerators/Freezers

- Title 20 standard governs two features: high efficiency motors and specified levels of insulation
- Evaluation team provided direction: NOMAD curve represents adoption of both measures
- Five experts provided first round input
 - Four were in a fairly narrow band; fifth moved to consensus average in second round
 - Comments indicated consistent perspective: efficient motors alone would be adopted at a high rate but insulation is expensive and has longer payback
- Natural market estimated to be growing slowly from 17% in 2006 to 22% 2008 eventually reaching 40% of the market
 - Some experts stated that regulation had potential to increase efficiency of these appliances

Title 20 NOMAD: Example Results

Standard Number	Title 20 Appliance Standard	Market Intro	Natural Market Adoption		
			2006	2008	Maximum Penetration
Std1	Commercial Refrigeration Equipment, Solid Door	1995	56.8%	68.0%	78.7%
Std2	Commercial Refrigeration Equip., Transparent Door	1995	27.4%	38.3%	49.5%
Std3	Commercial Ice Maker Equipment	1995	19.6%	22.8%	24.8%
Std4	Walk-In Refrigerators / Freezers	1995	17.1%	22.7%	41.3%
Std5	Refrigerated Beverage Vending Machines	1998	70.6%	86.4%	95.7%
Std6	Large Packaged Comm. Air-Conditioners, Tier 1	1990	20.9%	28.1%	35.0%
Std7	Large Packaged Comm. Air-Conditioners, Tier 2	1990	8.5%	9.3%	10.2%

Title 20 NOMAD: Example Results

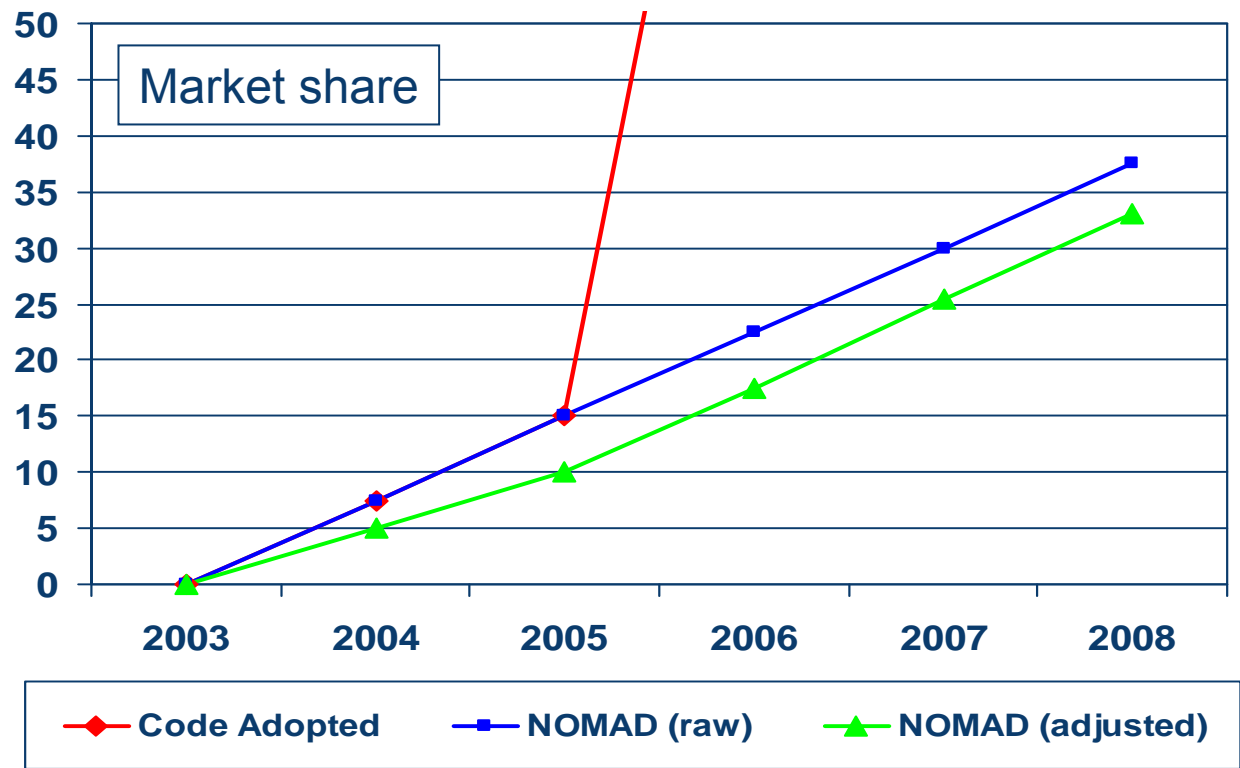
Standard Number	Title 20 Appliance Standard	Market Intro	Natural Market Adoption		
			2006	2008	Maximum Penetration
Std8	Residential Pool Pumps, High Eff Motor, Tier 1	1965	12.2%	13.5%	22.9%
Std9	Residential Pool Pumps, 2-speed Motors, Tier 2	1975	5.7%	6.7%	10.7%
Std11	General Service Incandescent Lamps, Tier 2	1970	3.5%	4.4%	8.6%
Std12	Pulse Start Metal Halide HID Luminaires, Tier 1	1992	16.3%	26.8%	73.7%
Std13	Modular Furniture Task Lighting Fixtures	2000	67.1%	78.8%	94.0%
Std14	Hot Food Holding Cabinets	2000	19.8%	38.8%	86.0%
Std15	External Power Supplies, Tier 1	2000	24.9%	38.4%	67.0%

Title 20 NOMAD: Key Findings

- Natural market adoption of efficient appliances was estimated to be high in 2006 for
 - Commercial Refrigeration Equipment (Solid Door)
 - Refrigerated Beverage Vending Machines
 - Modular Furniture Task Lighting Fixtures
 - Televisions
- Natural market adoption of efficient appliances was estimated to be low in 2006 for
 - General Service Incandescents (Tier 2)
 - Residential Pool Pumps with Two-speed Motors (Tier 2)
 - Large Packaged Commercial Air Conditioners (Tier 2)
- Several efficient products were expected to have very low ultimate natural market adoption
 - Large Packaged Commercial Air Conditioners (Tier 2)
 - Two-speed Residential Pool Pumps
 - Tier 2 General Service Incandescents

Title 20 NOMAD:

Adjusting for prior
utility programs



- Utilities provided data on measures incented through efficiency programs prior to 2005 but governed by standards in 2006
- NOMAD (raw) data based on expert inputs includes the market impact of prior utility programs
- Raw estimate was adjusted based on the unit volume reported by utilities
- Adjustment was estimated to have ten-year life. Our model has this value decline linearly over ten years.



Title 20: Attribution

- Answers question: To what extent can adoption of a standard be ***attributed*** to statewide C&S Program?
- C&S Program net savings =
(attribution %) X (Net Standards Savings)
- Original method presented in 2005 HMG report
- Cadmus revised attribution methodology
 - Credit based on efforts to meet CEC adoption requirements
 - Review public records; supplement with utility information
 - Independent third parties assess C&S Program's contributions
 - Document process



Title 20: Attribution Methodology

- Accounts for 3 factors related to adoption
 1. Compliance methods and special analytic techniques
 2. Technical, cost information and language for the standard
 3. Demonstrating feasibility of the proposed standard
- Factor weight = percentage of all stakeholder resources dedicated to each of 3 factors in adoption process
 - Weights sum to 100%
- Factor score = C&S Program's contribution to each factor
 - Can vary from 0% to 100%
- Attribution = Sum of product of weights and scores

Title 20: Attribution Example Results

Standard Number	Appliance Standard	Factor score: Compliance	Factor score: Technical	Factor score: Feasibility	Weight: Compliance	Weight: Technical	Weight: Feasibility	Final attribution score
Std1	Commercial Refrigeration Equipment, Solid Door	50.0%	80.0%	85.0%	5.9%	56.7%	37.4%	80.1%
Std2	Commercial Refrigeration Equipment, Transparent Door	50.0%	80.0%	85.0%	5.9%	57.3%	36.8%	80.1%
Std3	Commercial Ice Maker Equipment	90.0%	75.0%	85.0%	11.5%	57.4%	31.1%	79.8%
Std4	Walk-In Refrigerators / Freezers	10.0%	90.0%	75.0%	7.1%	69.8%	23.1%	80.9%
Std5	Refrigerated Beverage Vending Machines	90.0%	60.0%	55.0%	12.9%	59.8%	27.3%	62.5%
Std6	Large Packaged Commercial Air-Conditioners, Tier 1	10.0%	75.0%	85.0%	3.0%	61.7%	35.3%	76.6%
Std7	Large Packaged Commercial Air-	10.0%	75.0%	85.0%	4.8%	65.0%	30.3%	74.9%



Title 20: Attribution Key Findings

- For all but four standards, overall factor score calculated for Program was at least 70% and over 80% in several cases
- Program received lowest factor scores for
 - Commercial Dishwasher Pre-rinse Spray Valves
 - External Power Supplies Tier 1 and 2
 - Refrigerated Beverage Vending Machines

Title 20: Results

Evaluated Appliance Standards			
	Electricity Savings, GWh/year*	Demand Savings, MW*	Natural Gas Savings, Mtherms*
2006	190.4	31.2	1.3
2007	434.6	69.8	2.7
2008	832	135.4	4
SES 2006	150.6	23.3	3

*Savings include non-IOU areas and are not adjusted for CPUC 50%.

Q/A on Title 20 Results



Lunch Break

Title 24: Building Standards



Title 24: Methodology Overview

- Potential Savings
- Compliance
- NOMAD
- Attribution

Title 24: List of Standards

Building Standard ID	Building Standard Name	Implementation Date
StdB1	Time Dependent Valuation, Residential	Oct-05
StdB2	Time Dependent Valuation, Nonresidential	Oct-05
StdB3	Residential Hardwired Lighting	Oct-05
StdB4	Duct Sealing Requirement Upon Residential HVAC or Duct-System Replacement	Oct-05
StdB5	Window Efficiency Requirements Upon Window Replacement Final Report	Oct-05
StdB6	Updates to Title 24 Treatment of Skylights	Oct-05
StdB7	Air Distributing Systems – Retrofit Commercial Ducting	Oct-05
StdB8	Cool Roof	Oct-05
StdB9	High Performance Relocatable Classrooms	Oct-05
StdB10	Lighting Controls – Bi-Level Lighting	Oct-05
StdB11	Air Distributing Systems – New Construction Ducting	Oct-05
StdB12	Cooling Towers	Oct-05
StdB13	Multifamily Water Heating	Oct-05
StdB14	Composite for Remainder	Oct-05



Title 24: Potential First Year Energy Savings

- Reviewed gross savings in SES by examining CASE report for each building standard and information presented in HMG SES report
- Located source of savings estimate
- Recreated energy savings equation found in CASE report
- Revised savings estimates, as needed
- Revised construction statistics
 - Obtained permit data
 - Estimated permit-completion lag time
 - Estimated building completions

Title 24 Potential First Year Energy Savings: Lagged Res Construction Starts

- Building starts reported from Construction Industry Research Board (CIRB)
- Building official interviews provided estimated lag time between permit issue date and completed construction
 - Single-family lag period → 6 months
 - Multifamily lag period → 8 months
 - Nonresidential lag period → 9 months

Title 24 Potential First Year Energy Savings: Analysis & Results

Standard	SES Gross Savings		Updated Potential Savings		
	GWh	MTherms	GWh	MW	MTherms
STD B1: Time Dependent Valuation, Residential	6.7 27.2 MW	0	0	0	0
STD B2: Time Dependent Valuation, Nonresidential	4.3 18.7 MW	0	0	0	0

Potential energy or demand savings were determined to be zero for the two Time Dependent Valuation (TDV) standards because the evaluation team could find no evidence that the standards would drive building design toward more on-peak savings to meet the requirements of the standards.

Title 24 Potential First Year Energy Savings: Example Results

Standard	SES Gross Savings		Updated Potential Savings		
	GWh	MTherms	GWh	MW	MTherms
STD B3: Residential Hardwired Lighting	64.6	0	67.5	3.1	0
STD B4: Ducts in Existing Residential Buildings	5.7	1.1	6.3	9.4	1.2
STD B5: Window Replacement	6.3	0.3	15.2	5.8	0.72
STD B6: Lighting Controls Under Skylights	25.5	0	12.73	0	0
STD B7: Ducts in Existing Commercial Buildings	9.7	1	11.45	8.7	1.22

The Residential Hardwired Lighting standard was the single measure with the largest electricity savings in both the original gross savings analysis and in this analysis of potential savings.



Title 24: Compliance Overview

- Goal of analysis was to determine compliance with Title 24 nonresidential and residential building standards
- Analysis was conducted at the measure and whole-building level for residential and nonresidential buildings
- Whole-building analysis important because of prevalence of performance/ tradeoff approach
 - First time performed
 - Required new calculation procedure
 - Required modified compliance software

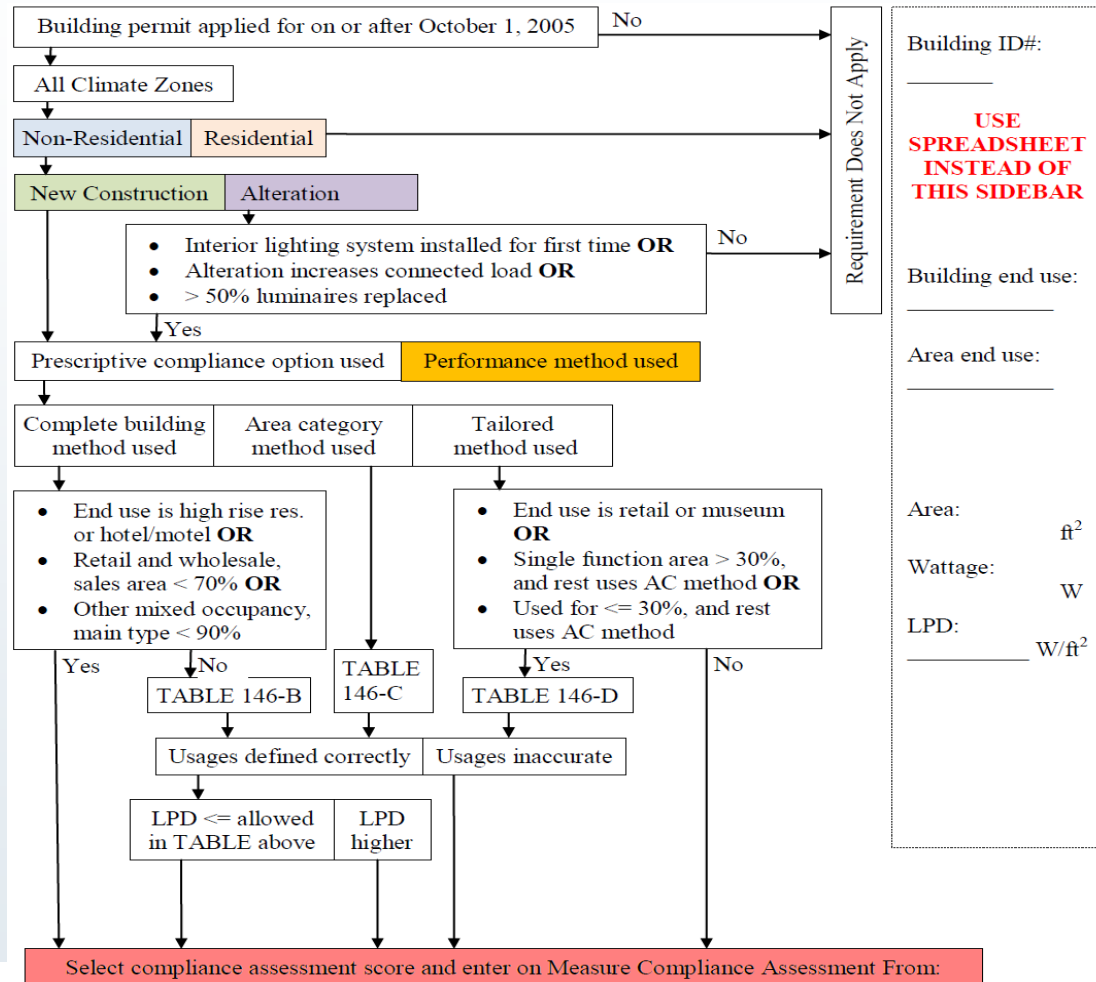
Title 24: Compliance Overview (cont.)

- Residential field data were collected and analyzed in RNC baseline study
- Nonresidential data were collected by onsite building department surveys and building field surveys
 - Representative sample of building departments selected and representative building sample process designed
 - Used utility new hook-up data to start with
 - Many adjustments were required: many lessons learned

Title 24 Compliance: Data Collection

Non-Residential

Non-Residential Indoor Lighting B14a



Building ID#: _____

USE SPREADSHEET INSTEAD OF THIS SIDEBAR

Building end use: _____

Area end use: _____

Area: _____ ft²

Wattage: _____ W

LPD: _____ W/ft²

- Measure Compliance Assessment Scoring
1. Not installed
 2. Installed but does not work
 3. Installed and works, but does not provide intended functionality
 4. Installed and works, but does could not verify correct functionality
 5. Installed correctly and works as intended



Title 24 Compliance: Analysis

- Residential retrofit:
 - Homeowner survey
 - Code official survey
- Nonresidential measures:
 - Scoring based on field observations
- Whole Building and Res Hardwired Lighting Analysis:

$$CR(t) = \frac{\sum Cons2001 - \sum ConsBuilt2005(t)}{\sum Cons2001 - \sum Cons2005}$$

Title 24 Compliance: Results (Residential)

Residential Title 24 Compliance Findings						
Analysis Type or Measure	Consumption Category	Sample Size		Method of Compliance	Site Energy Units	Compliance Rate %
Whole Building (kWh)	Space Cooling	194		Performance	kWh	120%
	Space Heating (heat pump)					
	Lighting					
Whole Building (Therms)	Space Heating	194		Performance	Therms	235%
	Domestic HW					
StdB3 Residential Hardwire Lighting	Lighting	194		Prescriptive	kWh	113%
StdB4 Duct Sealing	HVAC	Home Owner 104	Code Official 14	Prescriptive	Therms	59%
StdB5 Window Replacement	HVAC	Home Owner 110	Code Official 14	Prescriptive	Therms	80%

Whole building results are preliminary, analysis continuing

Title 24 Compliance: Results (Nonresidential)

Compliance Level for Individual Measures					
Measure ID and Description	Alteration Compliance Rate	Alteration Compliance Observations	New Construction Compliance	New Construction Compliance Observations	Total Observations
B06 NonRes Skylights	0.0%	1	8.3%	3	4
B07 NonRes Duct Sealing Alts	75.0%	2	No observations	0	2
B08 NonRes Cool Roof	75.0%	5	89.6%	24	29
B09 Relocatable Classrooms	No observations	0	0.0%	3	3
B10 Bi-level Lighting Ctrls	No observations	0	78.7%	27	27
B11 NonRes Duct Sealing NewCon	75.0%	1	81.9%	18	19
B12 NonRes Cooling Towers	75.0%	1	91.7%	3	4
B13 MF Res Water Heating	No observations	0	78.1%	8	8
B14a NonRes Indoor Lighting	80.0%	10	81.8%	37	47
B14b NonRes VAV Systems	100.0%	1	90.0%	10	11
B14c NonRes Outdoor Lighting	77.8%	9	78.8%	39	48
Total	-	32	-	179	211

Whole building analysis incomplete and analysis is continuing

Title 24: NOMAD Example

Residential Hardwired Lighting

- Title 24 requires use of high efficacy lighting and/or lighting controls in new residential construction
- Evaluation of measure included study of indirect market effects of utility programs, resulting in larger expert group
- Eight experts provided input
 - Two distinct clusters: one estimated lower natural market adoption; other was higher although still less than 50% adoption
 - NOMAD estimate = average of inputs
- NOMAD estimated penetration would have grown from 8% in 2006 to 14% in 2008, eventually reaching 30%, without standard

Title 24 NOMAD: Example Results

Standard Number	Title 24 Building Standard	Market Intro	Natural Market Penetration		
			2006	2008	Maximum Penetration
Std B3	Residential Hardwired Lighting	2000	8.5%	14.1%	29.5%
Std B4	Residential Duct Improvement	1990	9.6%	13.4%	17.5%
Std B5	Window Replacement	2000	29.2%	36.6%	50.5%
Std B6	Lighting controls under skylights	2000	7.5%	13.1%	50.0%
Std B7	Ducts in existing commercial buildings	1990	12.4%	15.4%	18.0%
Std B8	Cool roofs	1998	2.5%	5.6%	35.2%
Std B10	Bi-level lighting control credits	2000	4.5%	6.1%	26.5%
Std B11	Duct testing/sealing in new commercial buildings	2000	6.1%	13.2%	58.0%

Title 24 NOMAD: Whole Building Efficiency Trend

- Issue: Standards require specific measures but implementation allows builders to comply based on (simulated) whole building performance. NOMAD estimated needed to go with other whole-building estimates.
- CEC study* estimated whole-building savings going from 2001 to 2005
Title 24
- Data collection was similar to other NOMAD research
 - Except, it was not expected these improvements would follow a Bass curve since they represent the adoption of many technologies and techniques
 - Instead experts were asked to estimate improvement at three points in time relative to CEC estimate: 2006, 2012, 2018

*Impact Analysis, 2005 Update to the California Energy Efficiency Standards, Eley and Associates, 2003

Title 24 NOMAD: Whole Building Estimate

- CEC Analysis is expected improvement in energy efficiency versus the 2001 baseline

Fuel	Category New Construction	CEC Analysis 2006	NOMAD 2006	NOMAD 2008
Electric	Residential	20.4%	1.9%	2.1%
	Non-Residential	7.7%	0.9%	1.1%
Gas	Residential	9.6%	0.6%	0.8%
	Non-Residential	3.2%	0.4%	0.5%

Title 24 NOMAD: Key Findings

- None of the building standards were estimated to have significant initial market penetration without the standards
- Ultimate natural market adoption of several measures complying with the standards was projected to be less than one-third



Title 24 Attribution: Analysis & Results

Net Savings Attributable to Program
= (Gross Savings – NOMAD) *
Attribution

Title 24 Attribution: Analysis & Results

Standard Number	Standard Name	Factor	N	Mean Weight	Std Dev	Minimum	Maximum
Std B1	Time dependent valuation, Residential	Compliance	4	0.317	0.095	0.1	0.5
		Technical	4	0.385	0.034	0.3	0.45
		Feasibility	4	0.298	0.067	0.2	0.45
Std B2	Time dependent valuation, Nonresidential	Compliance	3	0.429	0.074	0.2	0.5
		Technical	3	0.379	0.049	0.3	0.45
		Feasibility	3	0.192	0.073	0.1	0.4
Std B3	Res. Hardwired lighting	Compliance	4	0.283	0.064	0.1	0.4
		Technical	4	0.383	0.018	0.33	0.4
		Feasibility	4	0.335	0.062	0.2	0.5
Std B4	Duct improvement	Compliance	2	0.350	0.050	0.3	0.4
		Technical	2	0.425	0.075	0.35	0.5
		Feasibility	2	0.225	0.025	0.2	0.25
Std B5	Window replacement	Compliance	3	0.267	0.148	0.05	0.55
		Technical	3	0.483	0.073	0.35	0.6
		Feasibility	3	0.250	0.104	0.1	0.45
Std B6	Lighting controls under skylights	Compliance	2	0.450	0.050	0.4	0.5
		Technical	2	0.325	0.075	0.25	0.4
		Feasibility	2	0.225	0.025	0.2	0.25
Std B7	Ducts in existing commercial buildings	Compliance	2	0.350	0.050	0.3	0.4
		Technical	2	0.425	0.075	0.35	0.5
		Feasibility	2	0.225	0.025	0.2	0.25

Title 24 Attribution: Analysis & Results

Standard Number	Standard Name	Factor	N	Mean Weight	Std Dev	Minimum	Maximum
Std B8	Cool roofs	Compliance	3	0.467	0.033	0.4	0.5
		Technical	3	0.367	0.033	0.3	0.4
		Feasibility	3	0.167	0.033	0.1	0.2
Std B9	Relocatable classrooms	Compliance	2	0.125	0.025	0.1	0.15
		Technical	2	0.550	0.050	0.5	0.6
		Feasibility	2	0.325	0.075	0.25	0.4
Std B10	Bi-level lighting control credits	Compliance	2	0.100	0.000	0.1	0.1
Technical		2	0.475	0.025	0.45	0.5	
Feasibility		2	0.425	0.025	0.4	0.45	
Std B11	Duct testing/sealing in new commercial buildings	Compliance	2	0.350	0.050	0.3	0.4
Technical		2	0.425	0.075	0.35	0.5	
Feasibility		2	0.225	0.025	0.2	0.25	
Std B12	Cooling tower applications	Compliance	1	0.200	.	0.2	0.2
		Technical	1	0.450	.	0.45	0.45
		Feasibility	1	0.350	.	0.35	0.35
Std B13	Multifamily Water Heating	Compliance	4	0.363	0.095	0.1	0.6
		Technical	4	0.450	0.079	0.25	0.6
		Feasibility	4	0.188	0.061	0.1	0.45
Std B14	Composite for Remainder	Compliance	3	0.310	0.059	0.2	0.4
		Technical	3	0.397	0.032	0.34	0.45
		Feasibility	3	0.293	0.047	0.2	0.35

Title 24: Summary of Results

Evaluated Building Standards			
	Electricity Savings, GWh/year*	Demand Savings, MW*	Natural Gas Savings, Mtherms*
2006	99.7	40	1.1
2007	222.3	84.6	2.6
2008	312.9	120.7	4
SES 2006	121.4	53	1.7

*Savings include non-IOU areas and are not adjusted for CPUC 50%.

Q/A on Title 24 Results





Integrated Standards Savings Model (ISSM)

- Based on SES
- Unit savings entered and multiplied by appropriate quantity (e.g., new buildings)
- Includes adjustments for
 - Compliance
 - NOMAD, with effect of utility DSM programs
 - Attribution
 - Allocation to each utility

ISSM

- Standards can be analyzed individually or grouped several ways
- Monte Carlo simulation capability added to address uncertainty associated with model inputs
 - Results sheet added to show confidence intervals and probability distributions
- Draft user's manual available with ISSM

C & S Program: Net Program Savings, PG&E

Period	Electricity (GWh)	Demand (MW)	Natural Gas (MTherms)
Verified			
2006	45.8	11.2	0.4
2007	57.9	13.1	0.5
2008	77.0	16.1	0.5
2006-08	180.7	40.5	1.5
Claimed (based on SES)			
2006	42.9	12.1	0.9
2007	42.7	11.8	0.8
2008	54.6	14.2	0.8
2006-08	140.3	38.1	2.4

C & S Program: Net Program Savings, SDG&E

Period	Electricity (GWh)	Demand (MW)	Natural Gas (MTherms)
Verified			
2006	10.7	2.6	0.1
2007	13.6	3.1	0.1
2008	18.0	3.8	0.1
2006-08	42.3	9.5	0.2
Claimed (based on SES)			
2006	10.1	2.8	0.1
2007	10.0	2.8	0.1
2008	12.8	3.3	0.1
2006-08	32.8	8.9	0.3

C & S Program: Net Program Savings, SCE

Period	Electricity (GWh)	Demand (MW)	Natural Gas (MTherms)
Verified			
2006	47.3	11.6	N/A
2007	59.7	13.5	N/A
2008	79.4	16.6	N/A
2006-08	186.4	41.7	N/A
Claimed (based on SES)			
2006	44.3	12.4	N/A
2007	44.1	12.2	N/A
2008	56.3	14.7	N/A
2006-08	144.7	39.3	N/A

C & S Program: Net Program Savings, SCG

Period	Electricity (GWh)	Demand (MW)	Natural Gas (MTherms)
Verified			
2006	N/A	N/A	0.7
2007	N/A	N/A	0.8
2008	N/A	N/A	0.8
2006-08	N/A	N/A	2.3
Claimed (based on SES)			
2006	N/A	N/A	1.4
2007	N/A	N/A	1.3
2008	N/A	N/A	1.2
2006-08	N/A	N/A	3.9



C & S Program Summary Impacts (DRAFT)

	Electricity (GWh)	Demand (MW)	Natural Gas (MTherms)
Statewide Realization Rates for 2006-08	129%	106%	60.6%

Note: Claimed savings are based on SES values.



C & S Program: Summary Recommendations

- Continue to identify and target both appliance and building standards with large potential energy savings.
- Continue coordination of Program among the utilities to leverage resources and expertise.
- Articulate, communicate, and implement a comprehensive strategy linking DSM programs and activities to the C&S Program and long-term goals for standard adoption.

C & S Program: Summary Recommendations (cont..)

- Fully integrate a process of increasing codes and standards compliance and enforcement into the overall C&S Program approach.
- Encourage the California Energy Commission to increase attention to areas such as appliance and building standard compliance to guarantee that anticipated savings are achieved.
- Document and clarify the role of activities less targeted and focused than the preparation of CASE reports to establish the linkage to the adoption of other standards.

Q/A & Discussion



Thank You



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