Decision **PROPOSED DECISION OF ALJ EDMISTER** (Mailed 8/18/15)

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking Concerning Energy Efficiency Rolling Portfolios, Policies, Programs, Evaluation, and Related Issues.	Rulemaking 13-11-005 (Filed November 14, 2013)

DECISION RE ENERGY EFFICIENCY GOALS FOR 2016 AND BEYOND AND ENERGY EFFICIENCY ROLLING PORTFOLIO MECHANICS

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DECISION RE ENERGY EFFICIENCY GOALS FOR 2016 AND BEYOND AND ENERGY EFFICIENCY ROLLING PORTFOLIO MECHANICS

Summary

In this decision, we:

1) adopt "aggressive yet achievable" energy savings goals for ratepayer-funded energy efficiency program portfolios (portfolios) for 2016 and beyond;
2) establish a "Rolling Portfolio" process for regularly reviewing and revising portfolios;
3) update various energy efficiency program portfolio metrics, including Database of Energy Efficient Resources values, effective January 1, 2016.

This decision does *not* conclude Phase II of this proceeding. There are additional details still to work out on the review process for which additional time and/or record development are needed. A second decision on remaining Phase II issues will follow early next year. It will provide additional guidance on 2016 portfolio changes and on the "Rolling Portfolio" review process.

Looking ahead to Phase III of this proceeding, many important policy issues remain before us. Energy savings goals continue to go up, while we are to some extent a victim of our own success: the low-hanging fruit has largely been harvested. Energy efficiency portfolios as we know them are on the verge of no longer being cost effective. Program Administrator expenditures on costs other than customer rebates appear excessive, as they have come to represent approximately half of portfolio expenditures. The rate of observed savings compared to forecast savings is distressingly low in some market sectors. *Ex ante* review continues to be a source of controversy.

We will take these issues, and more, up in Phase III of this proceeding. Critical issues include: ~~re-evaluations of baseline choice~~implementing new legislation, restatement of baseline treatments and provisions for savings from

behavioral interventions, any associated adjustments to goals, and the role of utilities in energy efficiency. These are interrelated, highly technical issues. Addressing them will be neither quick nor easy, but we are in this for the long haul.

This proceeding remains open.

1. Procedural Background

Pursuant to Cal. Pub. Util. Code § 381 *et seq.*, and § 454.5,[1] we fund and oversee ratepayer-funded energy efficiency programs with a combined budget of roughly $1 billion per year. Program Administrators (PAs) use these ratepayer funds for portfolios of energy efficiency programs subject to our oversight. We have generally funded energy efficiency spending for a three-year cycle.[2] The three-year process paralleled the Commission's statutory responsibility to report to the legislature "triennially . . . on the energy efficiency and conservation programs it oversees."[3]

Rulemaking (R.) 13-11-005 contemplated moving away from triennial review towards a "rolling" review of energy efficiency program portfolios. Consistent with that vision, D.14-10-046 provided ongoing funding for energy efficiency programs from 2015 onward, and concluded Phase I of this proceeding.

[1] All statutory citations are to the California Public Utilities Code, unless otherwise noted.

[2] In addition to the standard triennial funding, the Commission sometimes approved 'bridge' funding between triennial cycles to allow regulatory processes to be completed. *See, e.g.*, Decision (D.) 12-11-015 (approving energy efficiency funding for two years rather than for three).

[3] Cal. Pub. Util. Code § 384.2.

We conducted a Phase II prehearing conference (PHC) on January 28, 2015, for which parties filed PHC statements.[4] On February 24, 2015, the Assigned Commissioner and the assigned Administrative Law Judge (ALJ) issued a joint "Ruling and Scoping Memorandum Regarding Implementation of Energy Efficiency 'Rolling Portfolios' (Phase II of Rulemaking (R.) 13-11-005)" (Phase II scoping memo). The Phase II scoping memo delineated the scope and procedural schedule for Phase II of R.13-11-005. "The scope [was] as broad as we could manage while still deciding critical-path issues by early 2016."[5]

The procedural schedule set out in the Phase II scoping memo contemplated "potentially *two* decisions in connection with Phase II."[6] This is the first of those two decisions.

2. Issues before the Commission

As the Phase II scoping memo anticipated, this first Phase II decision addresses:

1) revised energy savings goals for 2016 and beyond;
2) the "Rolling Portfolio" review process;

[4] The following entities served PHC statements:⊥
The Bay Area Regional Energy Network jointly with the Local Government Sustainable Energy Coalition⊥
Center for Sustainable Energy⊥
California Energy Efficiency Industry Council⊥
Marin Clean Energy (MCE)⊥
National Association of Electric Service Companies⊥
Natural Resources Defense Council (NRDC)⊥
The Office of Ratepayer Advocates (ORA)⊥
Pacific Gas and Electric Company (PG&E)⊥
San Diego Gas and Electric Company (SDG&E) jointly with Southern California Gas Company (SoCal Gas)⊥
Southern California Regional Energy Network⊥
Southern California Edison Company (SCE)⊥
The Utility Reform Network (TURN)⊥
The University of California

[5] Phase II scoping memo at 2.

[6] *Id*. at 3.

3) initial[7] guidance on 2016 portfolio changes; and
4) updates to other program metrics, including the Database of Energy Efficiency Resources (DEER) and Efficiency Savings and Performance Incentive (ESPI) coefficients, to keep portfolios on a steady course forward.

3. Discussion and Analysis

3.1. Revised Savings Goals

3.1.1. Introduction

Public Utilities (Pub. Util.) Code Sections (§) 454.55 and 454.56[8] require the Commission, in consultation with the California Energy Commission (CEC), to identify all potential achievable cost-effective electricity and natural gas efficiency savings and "establish efficiency targets"[9] for electrical or gas corporations to achieve. To this end, Commission Staff manages the development of a potential and goals study that provides the technical analysis for assessing the cost-effective energy savings potentially available in the state's residential and commercial building stocks, residential and commercial equipment and processes, industrial sector, and agricultural sector. We use this study to set energy savings goals, which in turn feed into various actors' planning activities.

[7] As contemplated in the Phase II Scoping Memo, we will provide two rounds of guidance on portfolio changes for 2016. The first round will concern matters that we can address *prior* to adopting new energy savings goals and technical updates. The second round will address changes *in response* to the new energy savings goals and technical updates that we are adopting here.

[8] Cal. Pub. Util. Code § 454.55: "The commission, in consultation with the State Energy Resources Conservation and Development Commission, shall identify all potentially achievable cost-effective electricity efficiency savings and establish efficiency targets for an electrical corporation to achieve pursuant to Section 454.5."⊥
Cal. Pub. Util. Code § 454.56: "(a) The commission, in consultation with the State Energy Resources Conservation and Development Commission, shall identify all potentially achievable cost-effective natural gas efficiency savings and establish efficiency targets for the gas corporation to achieve."

[9] *Id.*

In D.14-10-046, the Commission established energy savings goals for 2015. The Commission needs to adopt goals for 2016 and thereafter. To update Investor Owned Utility (IOU) goals, we conducted a series of activities, many under the auspices of the Demand Analysis Working Group (DAWG).[10] On February 17, 2015, there was a DAWG potential and goals calibration webinar. On March 17, 2015, we conducted the potential and goals model release and draft results workshop (workshop 2). At workshop 2, Navigant Consulting, Inc. (Navigant)[11] presented initial results from its Commission-directed study of energy efficiency potential (Navigant Study). On April 10, 2015, several parties submitted to Commission Staff informal comments on the Navigant Study. On April 21, 2015, Commission Staff conducted a webinar regarding the comments on the Navigant Study. On May 15, 2015, the assigned ALJ put a revised version of the Navigant study (Revised Navigant Study) out for formal comment.[12] Parties filed comments in response to the ruling on June 8, 2015.[13]

3.1.2. Summary of Energy Savings Goals

Today's decision adopts goals for the IOU territories based on the Revised Navigant Study, with some additional changes. The Navigant Study period and

[10] The DAWG is "a collaborative stakeholder forum established in 2009 by the CEC and the Commission to address technical issues associated with aligning CEC demand forecasting and the Commission's energy efficiency goals modeling efforts." D.14-10-046 at 12.

[11] The Commission's Energy Division contracted with Navigant to conduct an energy efficiency potential and goals update study.

[12] http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=151726019.

[13] The following parties submitted comments on the Revised Navigant Study: ⊥
FirstFuel Software, Inc. (FirstFuel)⊥
Opower⊥
NRDC⊥
ORA⊥
PG&E⊥
SCE⊥
SDG&E ⊥
SoCal Gas⊥
TURN

the goals we adopt here cover nine years. However, we expect these goals will be updated with new values by 2018 using the process for updating goals for 2018 and beyond that we establish in section ~~3.2.3.3~~3.2.2.3 below.

Compared to the goals we adopted in D.14-10-046, the goals we adopt here are very similar overall. There are differences in the details, however, with the net result being that for 2016, ~~gigawatts~~gigawatt hours (gWh) goals are 10% higher, megawatt (MW) goals are 20% higher, and gas goals are 12% lower.

On the electric side, most notably, the forecast savings from Codes and Standards (C&S) are roughly 20% higher than the Navigant's 2013 California Energy Efficiency potential and goals Study (2013 Study) forecast. Savings from rebate programs, in contrast, are modestly lower than the 2013 Study forecast. These changes essentially cancel out, leaving overall savings numbers relatively unchanged.[14]

On the gas side, we see a similar phenomenon. Potential savings available from rebate programs dropped, while potential from C&S increased. "The net effect of both changes is an overall minimal change to the total potential over the 2016-2024 period."[15]

Data limitations continue[16] to require us to develop goals by IOU service territories, rather than by PAs. This means that we have not established separate goals for regional energy networks (RENs) or Community Choice Aggregators (CCAs). Their expected savings are embedded within the savings for the service territories of the IOUs.

[14] Revised Navigant Study at xiii and 60-62.

[15] Revised Navigant study at xiii. For a fuller comparison between the 2013 study results and the Revised Navigant study results, see tables ES-6 through ES-8, and 4-6 through 4-8 in the Revised Navigant study.

[16] D.14-10-046 at 10.

Figure 1- IOU Territory Annual Savings Goals

Table 1. Annual GWh

	PG&E			SCE			SDG&E		
Year	**IOU Programs**	**Net C&S[17]**	**Total**	**IOU Programs**	**Net C&S**	**Total**	**IOU Programs**	**Net C&S**	**Total**
2016	625	611	1,236	674	631	1,304	~~183~~181	143	~~327~~324
2017	637	506	1,144	694	522	1,216	~~186~~185	119	~~305~~304
2018	507	408	916	528	421	949	141	96	~~237~~236
2019	511	401	912	542	414	955	144	94	238
2020	519	381	900	553	393	946	147	89	236
2021	524	326	850	542	337	879	147	76	223
2022	541	295	836	559	304	863	151	69	220
2023	558	254	812	573	262	835	154	59	214
2024	581	240	821	593	247	840	158	56	214

Table 2. Annual MW

	PG&E			SCE			SDG&E		
Year	**IOU Programs**	**Net C&S**	**Total**	**IOU Programs**	**Net C&S**	**Total**	**IOU Programs**	**Net C&S**	**Total**
2016	85	141	226	122	145	267	~~25~~24	33	~~58~~57
2017	87	105	193	123	108	231	26	25	~~51~~50
2018	69	103	172	99	106	206	20	24	44
2019	70	103	173	103	107	210	20	24	44
2020	71	101	173	107	104	211	21	24	45
2021	74	94	169	103	97	201	21	22	43
2022	80	90	170	109	92	201	22	21	43
2023	86	84	171	113	87	200	23	20	43
2024	92	82	173	119	84	203	25	19	44

Table 3. Annual MMTherms

	PG&E	SoCal Gas	SDG&E

[17] For explanation of why C&S are separated from other savings, see 3.1.4.8.

Year	IOU Programs	Net C&S	Total	IOU Programs	Net C&S	Total	IOU Programs	Net C&S	Total
2016	12.9	5.5	18.4	17.3	11.7	29.1	2.6	0.6	3.2
2017	12.9	5.7	18.6	18.1	12.2	30.3	2.7	0.6	~~3.4~~3.3
2018	14.8	6.1	20.9	16.6	12.7	29.4	3.2	0.7	3.9
2019	14.9	6.2	21.1	18	12.6	30.6	3.2	0.7	3.9
2020	15.5	6.2	21.7	18.4	12.2	30.6	3.3	0.7	4
2021	15.9	5.9	21.8	17.7	10.9	28.6	3	0.7	3.7
2022	16.7	5.7	22.4	18.2	10.3	28.5	3.1	0.6	3.7
2023	17.5	5.6	23.2	18.6	9.6	28.2	3.2	0.6	3.8
2024	18.6	5.3	23.9	19	9.1	28.1	3.2	0.6	3.8

Tables updated on ~~6~~9-~~26~~23-15.

3.1.3. Overarching Considerations in Setting 2016 (and beyond) Goals

In our energy efficiency proceedings, we allocate roughly $1 billion per year to specific energy efficiency programs. One of our statutory obligations is setting savings "targets,"[18] i.e., goals, for PAs. Goals feed into various planning processes:[19]

1. Portfolio planning;
2. Transmission and procurement planning efforts of the Commission, the CEC, and the California Independent System Operator (CAISO);
3. AB 32 greenhouse gas reduction planning;

[18] Cal. Pub. Util. Code §§ 454.55 and 454.56.

[19] Goals do not, however, have a direct impact on PA earnings, and have not since we changed the shareholder incentive mechanism from the Risk/Reward Incentive Mechanism (RRIM) to the ESPI. We established the RRIM in D.07-09-043. We established the ESPI in D.13-09-023. Under the RRIM, shareholder incentives related directly to goals: "[shareholder] earnings begin to accrue only as the utilities reach to meet and surpass the Commission's kilowatt-hour (kWh), Kilowatt (kW) and therm savings goals." D.07-09-043 at 4. Under the ESPI, in contrast, goals play no role in setting shareholder incentive awards.

4. The Commission's Energy Efficiency Strategic Plan (Strategic Plan) update.[20]

For the Revised Navigant Study, Navigant's modeling methodology remains the same as that used in Navigant's 2013 California Energy Efficiency potential and goals Study (2013 study).[21] We adopted the results of the 2013 study in D.14-10-046. For the latest study, Navigant's work was largely "to review and incorporate the latest available data into the study."[22] Put colloquially, the modeling under here (what Navigant calls "Stage 1" of the potential and goals study) was a "turning of the crank" using updated data, not a ground-up re-examination of modeling assumptions and methodology. A broader re-examination of the modeling approach is set for the next iteration of the potential and goals study ("Stage 2" of the potential and goals study).

3.1.3.1. Economic vs. Market Potential

There are infinite permutations possible within Navigant's model. However, zero effectively bounds choices at the low end (no possible further savings). Technical Potential bounds the high end.[23]

The Navigant study defines "Technical Potential" as "the amount of energy savings that would be possible if the highest level of efficiency for all technically applicable opportunities to improve energy efficiency were taken," exclusive of behavior programs, whole building programs, and codes and

[20] More information on the Strategic Plan can be found at: http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/eesp/.

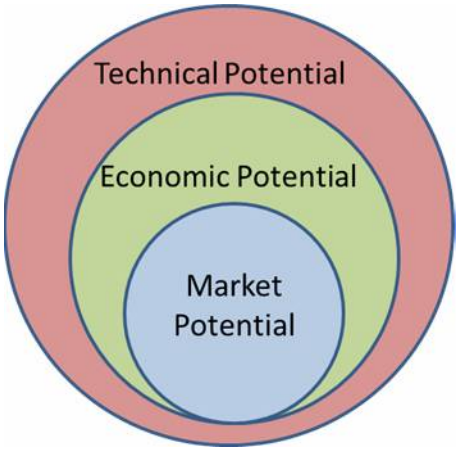
[21] Revised Navigant Study at i (citing the 2013 Study). The 2013 Study is available at http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Energy+Efficiency+Goals+and+Potential+Studies.htm.

[22] Revised Navigant Study at iii.

[23] Some parties dispute that the revised draft Navigant study represent a true upper or lower bound of energy efficiency potential, and contend foundational methodological changes are required. SCE comments at A9-A10. Navigant acknowledges "this study may not capture the upper bound on the total amount of energy efficiency that can be achieved." Revised Navigant Study at v. It nonetheless provides a *practical* upper bound.

standards.[24] "Economic Potential" is a subset of Technical Potential including "energy efficiency potential available when limited to only cost effective measures."[25]

Finally, "Market Potential" is a subset of Economic Potential including "energy efficiency savings that could be expected in response to specific levels of incentives and assumptions about policies, market influences, and barriers."[26] In Venn diagram terms, Navigant's categories look something like this (not to scale):



Some stakeholders have questioned the use of Market Potential to establish energy savings goals for the IOU territories. They favor using something closer to Economic Potential as a reach goal. We further explore this issue below.

[24] Revised Navigant Study at iv-v.

[25] *Id*. Generally speaking, "programs" are made up of "measures," which are often grouped together at a jobsite into a "project." Measures savings and incentive calculations break down into "custom" (i.e., site-specific) and "deemed" (i.e., the savings are consistent in similar implementation scenarios). A "project" may be made up of a combination of types of measures. "Custom measures and projects are energy efficiency efforts where the customer financial incentive and the *ex ante* energy savings are determined using a site-specific analysis of the customer's existing and proposed equipment, and an agreement is made with the customer to pay the financial incentive upon the completion and verification of the installation." ☼
D.14-10-046 at 47, n.40.

[26] Navigant Study at v.

"Economic Potential" considers all, and only, the costs included in the Total Resource Cost (TRC) test[27] in determining whether a measure is "economic." Essentially, this means incremental measure cost, administrative cost, marketing education and outreach cost, and potentially installation cost. Economic potential assumes immediate 100% installation rates of all measures with TRC > 0.85 and a select few below 0.85 that some PAs are already rebating (*e.g.*, the threshold for emerging technologies is a TRC of 0.5).

Thus, as Navigant puts it: "Although economic potential has a financial basis, it does not have a market basis."[28] Many factors in addition to those in the TRC drive real-world decisions about whether to undertake a measure. These do not factor into the Economic Potential calculation.[29]

To see what this means in practice, consider a hypothetical factory with older but still functioning machinery. Assume further that, using the study assumptions, replacing the older machinery with new high-efficiency machinery saves enough energy for the savings value to offset the incremental measure cost.

[27] The TRC test measures costs and benefits from the combined perspective of the program administrator (usually a utility) and the program participant, who are jointly investing in efficiency. As such, it includes both utility and participant costs and benefits. Rebates are not included in the TRC calculation because they are a *cost* to the utility and a *benefit* to the participant, and therefore cancel out. *See* Energy Efficiency Policy Manual, v.7 at 17, n.37. In sum, the TRC "quantifies the costs and creates a ratio of all the costs and the benefits of the energy efficiency portfolio as compared to the supply-side resource. The results provide an estimate of cost-effectiveness recognizing the avoided costs of comparable supply-side investments." D. 09-05-037 at 51. For a lightbulb replacement, for example, the included costs in TRC would generally be the difference in cost between the LED bulb and a baseline (e.g., basic compact fluorescent (CFL)) bulb, a share of marketing and administration costs, and installation cost if the replacement happened before the CFL burned out.

[28] Revised Navigant Study at A-7.

[29] *See* Golove and Ito, Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency, Lawrence Berkeley National Laboratory (1996) at 13-17 (positing various reasons other than market failures for the existence of a gap "between a consumer's actual investments in energy efficiency and those that appear to be in the consumer's own interest").

As far as the study is concerned, replacing that equipment is "economic." However, from the factory owner's perspective the replacement may be nowhere near economic for numerous reasons that Economic Potential does not capture. The factory owner may have to deal with the downtime while machinery is off-line. During that time, the factory owner may have to continue paying labor or layoff costs. The factory owner also faces other business disruption costs, including the potential to lose customers forever, disruption of a longstanding logistics chain, changes to operations and maintenance practices, and software and retraining costs associated with the new machines. Economic Potential does not capture any of these considerations.[30]

In addition to such practical concerns, customers may have different views than PAs (and each other) on what constitutes a "cost-effective" measure or project. Customers seek a certain return on investment (ROI) (*i.e.*, payback period). This is reflected in a customer's implied discount rate. The higher the implied discount rate, the higher the ROI, and the shorter the payback period the customer wants. The research underpinning the potential and goals study shows that customers have implied discount rates approximately ranging from 14% to 70% depending on the customer type.[31] These are significantly higher than the discount rates used in the TRC test.[32]

[30] Many noneconomic factors can enter the decision-making process, particularly in a consumer, as opposed to factory or commercial, setting. Golove and Ito, *supra note 28* at 17-18 (noneconomic variables – psychological considerations such as commitment and motivation, membership in trade groups, status considerations, and expressions of personal values all play key roles in consumer decision making). Technical Potential does not account for these variables either.

[31] Navigant March 17, 2015 2015 California potential and goals Study, Draft Results Presentation to DAWG, slide 6. http://www.cpuc.ca.gov/NR/rdonlyres/1D3525C7-7145-4AD5-80A8-55515B066223/0/2015PGStudyMarch17DAWGPublicWorkshop.pdf

[32] The TRC test evaluates "cost effectiveness" from the regulatory perspective, and uses an implied discount rate equivalent to each IOU's weighted cost of capital (approximately, 8.5% pre-tax; the exact value varies by utility).

Economic Potential also assumes 100% of "cost effective" measures are installed. The reality is that a measure having a TRC of 1[33] does not mean all customers will find the measure cost effective, as some customers will be looking for a much quicker payback than the model assumes for purposes of setting Economic Potential. The market will always have some participants with a higher implied discount rate than modelers used to determine Economic Potential.

Economic Potential, like Technical Potential,[34] also assumes *immediate* adoption of any economic measure by all potential users, regardless of how long it actually takes users to actually adopt a measure. This is what Navigant means by Economic Potential not accounting for the "turnover of stock, or time scale of diffusion for different classes of technologies."[35]

One further complication in bridging from economic to market potential is the shift in investment perspectives from a long-term utility avoided cost of energy (*e.g.* 20-30 year investment time horizon, and using utility or asset-based finance and cost of capital), to the short-term consumer or end-user expectations

[33] Economic Potential assumes 100% installation rates of all measures with TRC > 0.85, and a select few below 0.85 for which the IOUs are already providing incentives (ET threshold is 0.5). We use the example of 1 in the text for simplicity's sake.

[34] "Technical potential refers to a hypothesized, instantaneous or 'overnight' implementation of an energy-efficient technology, device, or appliance." Golove and Ito, supra note 27 at 17-18.

[35] Revised Navigant Study at A-7. For a detailed discussion of adoption rates, see Commission Staff's Industry Standard Practice Guide, v.1.2A at 5-7. http://www.cpuc.ca.gov/NR/rdonlyres/9F18A591-1D11-43D5-977A-343F3A51D754/0/ISPGuideBookv12_A_livingfinal.docx ("In the early stages, a technology has only limited adoption, where only a few early adopters will risk implementing the technology. If the technology does not prove to have any benefit, it will not gain momentum or grow; essentially a flat line - represented by Technology Y in figure 1. If the technology proves to have a valued incremental benefit, it will gain more adoption and start to grow exponentially. Eventually it will reach a take-off point where it becomes imminent that it will achieve near "universal" adoption; represented by Technology X in figure 1. The time when near universal adoption is reached does not indicate when Technology X has become industry standard practice.").

for return on investment. The latter range from as short as 18 months for many commercial businesses (using lines of credit and cash flow savings to pay for efficiency measures), and 2-3 years for industry (tapping capital budgets that primarily are deployed for business expansion), to perhaps as long as ~~5~~five years for residential home owners (relying upon home improvement finance or consumer credit cards). This effectively means that market potential estimates are constrained by the lack of capital frameworks and borrowing terms for energy efficiency investments that can mirror the longer term and lower cost of capital for the benchmark avoided energy supplies.

In sum, then, neither Technical Potential nor Economic Potential provides a realistic basis for setting savings goals for PAs. Accordingly, the Revised Navigant Study endorses using Market Potential (and not Technical or Economic Potential) " to inform [PA] energy efficiency goals."[36]

Navigant's use of the word "inform" signals that Market Potential is just a waypoint on the journey to goals, not the terminus. Within Market Potential are numerous possible "cases" to choose from, depending on the chosen modelling assumptions. "These include assumptions about the manner in which efficient products and services are marketed and delivered, the level of customer awareness of energy efficiency, and customer willingness to install efficient equipment or operate equipment in ways that are more efficient."[37]

Consistent with D.14-10-046, and as recommended by Commission Staff, we are adopting the "mid-case" scenario in setting goals. We will not adopt higher goals that represent a stretch that may not be realistically achievable. As

[36] This example also points up one of the most significant challenges in getting people to adopt energy efficiency measures: energy costs are not necessarily the primary driver behind capital investment decisions.

[37] Revised Navigant Study at v.

Lawrence Berkeley National Laboratory researchers said almost twenty years ago, "there are compelling justifications for energy efficiency policies. Nevertheless, in order to succeed, they must be based on a sound understanding of the market problems they seek to correct and a realistic assessment of their likely efficacy."[38]

3.1.3.2. A Single Set of Realistic Goals

We see no value to setting goals that PAs cannot reasonably be expected to achieve. Unrealistic goals may lead to incentives to inflate results falsely. In addition, unrealistically high goals affect more than just Commission-jurisdictional programs. The CEC and the California Air Resources Board (CARB), among other agencies, oversee significant programs relating to reducing energy use (and carbon emissions more generally). Many municipalities have their own energy efficiency programs as well. All have a role to play in reducing energy use and greenhouse gas emissions; and some or all of these actors rely on our savings estimates in their planning activities (e.g., when the CEC prepares the Integrated Energy Policy Report (IEPR)). Setting unrealistic goals for ratepayer-funded programs gives other governmental entities and market actors bad information for use in their own energy efficiency activities. Misplaced reliance on overoptimistic forecasts can lead to misallocated resources and reduced activity by other actors, to ratepayers' and to the environment's detriment. It can also compound the internal and external pressure to claim success regardless of real-world program impact. Finally, it can lead other actors to discount the validity of the Commission's energy efficiency savings forecasts in their planning activities, thereby rendering the Commission's goal-setting far less useful than if the Commission is realistic in the first instance.

[38] *See generally* Golove and Ito, *supra note 27* at v (emphasis added).

Accordingly, as in D.14-10-046, we will set a single set of goals. That single set of goals will be "aggressive yet achievable,"[39] and will rest on data-based assumptions. This translates into the goals set forth above.

3.1.4. Comments on the Draft Study and Goals

We received comments on the Revised Navigant Study from all the following: FirstFuel, NRDC, ORA, PG&E, TURN, SDG&E, SCE, and SoCal Gas. In today's decision, we adopt limited changes to the revised draft Navigant study in response to party comments. We include a discussion of key issues below as many warrant consideration in future updates to the potential and goals study.

3.1.4.1. Calibration

Calibration is the systematic adjustment of model parameter estimates so that model outputs more accurately reflect external benchmarks. Generally speaking, calibration means the modeler will:

- find one or more recent periods for which actual results are available (i.e., a prior year or years);
- see if running the model for that period yields results that match the actual observed results;
- if the model results do not match actual results, adjust model parameters until they do.

Navigant explains calibration generally as follows:

> Calibration provides both the forecaster and stakeholders with a degree of confidence that simulated results are reasonable and reliable. Calibration is intended to achieve three main purposes:
>
> - Ground the model in actual market conditions and ensure the model reproduces historic program achievements
> - Ensure a realistic starting point for future projections

[39] *See* D.07-09-043 at 107-108.

- Account for varying levels of market barriers across different types of technologies and end uses.[40]

This generalized description implies that one could rewind the process to an uncalibrated model, and several parties (ORA, NRDC, and TURN) ask that we do just that. These parties have expressed concern that "the use of 'calibration' unduly limits the market potential based on previous program achievements and should not be applied when setting long-term goals.[41]

In fact, calibration is effectively built into the model, and cannot be feasibly disentangled. Navigant performed much of its calibration on an end-use/sector basis. This means that there is no "uncalibrated" model as such. While "[i]t may be tempting to 'relax' the calibrated parameters back toward the average to measure the effect of what could be possible[,] the uncalibrated results can be difficult to interpret and almost certainly would not produce feasible results for certain end uses."[42]

Moreover, we have recognized the value of calibration in modeling in diverse contexts, including gas and telecommunications.[43] Conversely, *not* calibrating a model when the option to do so exists is bad practice.[44]

[40] Revised Navigant Report at A-1.

[41] Comments of NRDC on Energy Efficiency and Goals and DEER Updates, June 8, 2015 at 4 ("Calibration is the process whereby the potential model is altered for the purpose of having final results of efficiency potential be closer in line with the amount of efficiency historically achieved.4 In practice, this artificially suppresses the amount of future potential to be more in line with past achievements, ensuring our future looks more like our past, and makes it difficult if not impossible to use innovative approaches to scale up savings that will be required to reach Governor Brown's goal of doubling projected energy efficiency from existing buildings by 2030.").

[42] Revised Navigant Study at A-3.

[43] *Cf.* D.01-01-037 (for a telecom pricing model "[s]ome 'calibration' with actual data will be helpful in assessing our decision model and its effects on the overall plan, and we will order a calibration period to occur . . . before the trial period begins."); *See also*D.01-12-018 (requiring SoCal Gas to "develop a rule-based model re-calibration process" for its Daily Load Forecasting Model).

[44] Of course, it is not always possible to calibrate or benchmark a model, in which case a modeler has to take another approach to model validation.

The point of calibration is to set the model at a level that is, initially, right for today.[45] One can then make assumptions about tomorrow as one chooses (and as available data will support). As a matter of good modeling practice, modelers should explicitly layer predictions about how the future will depart from the past atop a calibrated model, not bake them into the model *ab initio.*

The upshot of the TURN and NRDC argument is, in effect, that tomorrow will be much different from yesterday, and so adjusting a forward-looking model by fitting it to past performance actually makes the model less rather than more predictive. This misses the point of calibration. Calibration is to ensure that yesterday's inputs yield yesterday's results, regardless of what one expects tomorrow will bring. This is why ORA et al.'s arguments against calibrating the model *at all* are unpersuasive.

As for the particular changes Navigant made during the calibration process, Navigant states that:

> The PG model is calibrated by reviewing portfolio data from 2006 up through 2012 to assess how the market has reacted to program offerings in the past. The Navigant team used ex-post EM&V data from 2006-2012 as the calibration data and also compared results to the 2013-2014 compliance filing data.[46]

The particular parameters that calibration showed needed adjustment were those relating to consumer adoption rates; specifically, consumer awareness of measures, and consumer willingness to adopt measures. Potential per end use or sector decreased or increased depending on the calibration.

What NRDC and TURN characterize as an uncalibrated model's ~~results~~assumptions are equivalent to the Navigant mid-high case.[47] We decline to

[45] As noted above, a reason to calibrate is to "ensure a realistic starting point for future projections."

[46] Revised Navigant Study at A-1.

[47] Use mid case assumptions for housing stock and energy prices, but high case assumptions about policy levers, technology, and customer behavior.

adopt a "mid-high" case over the mid-case for setting savings goals. As discussed at length above as well as in D.14-10-046, we will stay within the realm of the realistic rather than setting goals based on desired changes in customer behavior and (as discussed more below) technology.

SCE has a different issue with calibration. Currently, the Navigant model calibration uses program results from 2006-2012, and omits reported 2013, 2014, and 2015 program savings. SCE notes that its programs have changed significantly since 2006, and contends that using old data to calibrate a model designed to forecast future savings yields results that are *higher* than the EE programs are able to capture. In other words, SCE contends that calibration leads to overestimating future savings rather than underestimating them (as TURN and NRDC contend). SCE recommends that model adjustments based on recent year adoptions be made to the "Applicability," "Awareness," and "Willingness" parameters of the current model to better calibrate the aforementioned measures to more accurately reflect customer program adoption, in particular for "residential refrigerator recycling and pool pump measures.[48]"

We decline to adopt SCE's proposed changes. In addition to the reasons to favor calibration already discussed, we note that Navigant used 2006-2012 program savings to calibrate the model because the savings have been reviewed and vetted through the Evaluation, Measurement, and Verification (EM&V)

[48] SCE's Comments on Ruling Regarding Post-2015 Energy Efficiency Potential and Goals, and Database for Energy Efficient Resources Updates, June 8, 2015 at 4-5.

process. While 2013-2015 program savings data may be available, those data are self-reported by PAs, and have not gone through the EM&V process.[49]

3.1.4.2. Emerging Technology

Closely related to the calibration debate is the debate over how to treat emerging technologies (ETs). ETs are "new energy efficiency technologies, systems or practices that have significant energy savings potential but have not yet achieved sufficient market share to become self-sustaining or commercially viable. Emerging technologies include early prototypes of hardware, software, design tools or energy services."[50]

ORA takes issue with the potential model's use of prior measures and market saturation rates. According to ORA, this approach leads to the model underestimating future market potential of early strategies and measures that may have not reached mass commercialization, and overestimates potential for measures that are no longer producing effective returns. Therefore, ORA argues that this overemphasis on past measures without adequate consideration for new and innovative strategies is problematic when using the results of Revised

[49] SCE has raised a related issue around the data quality in the Revised Navigant Study generally. SCE contends that it is inappropriate for the potential and goals study to use measure-level DEER savings while EE programs use approved workpapers. SCE further asserts that the potential model fails to use best available data on Industry Standard Practice. SCE's Comments on Ruling Regarding Post-2015 Energy Efficiency potential and goals, and Database For Energy Efficient Resources Updates at 3. In fact, Commission Staff-reviewed workpapers, dispositions, and approved workpapers *are* inputs into the Potential Model. Moreover, the Revised Navigant Study includes among its inputs Commission Staff-approved and stakeholder vetted industry standard practices. SCE's issue seems to be with the omission of available but not fully vetted and reviewed workpapers and industry sta ndard practices. Workpapers (as with much in the world of *ex ante* review; see ~~3.2.4.4~~3.2.3.4) have proven controversial. Industry standard practice likewise. We are not prepared to mandate inclusion of unvetted, unreviewed workpapers, or industry standard practices in the potential and goals study.

[50] Energy Efficiency Policy Manual, v. 5 at 6.

Navigant Study for future energy efficiency planning and meeting savings goals.[51]

NRDC requests that we include a more thorough assessment of potential from technologies in the plug-in equipment categories. NRDC characterizes plug-in equipment (plug load) as the fastest growing source of energy consumption in California.[52]

SoCal Gas contends that the Revised Navigant Study fails to fully capture all market achievable energy efficiency potential. SoCal Gas notes that only six of the thirty ETs modeled in the Revised Navigant Study are natural gas efficiency measures, and points to "many natural gas emerging technologies, such as smart valve insulating jacket and shower drain heat recovery that SoCal Gas is actively investigating as viable energy efficiency measures."[53]

These areas, as well as the combined heat and power pilot we authorized in D.14-10-046, are not currently modeled in the Revised Navigant Study.

With respect to emerging energy efficiency technologies generally, we have seen (and the goals incorporate) some discouraging results of late from the emerging technologies that were supposed to produce major savings in the near future. Specifically, LED savings estimates have been revised downwards in response to post-2013 research. Costs for LEDs, meanwhile, have been revised upwards in response to recent market survey data and California lighting quality standards. While presumably performance will improve, and costs will drop,

[51] These arguments blend emerging technology and calibration issues, as already mentioned in the calibration discussion at section 3.1.4.1. We therefore address them in both the calibration discussion and here in the emerging technologies discussion.

[52] Comments of NRDC on Energy Efficiency potential and goals and Deer Updates, June 8, 2015 at 5.

[53] Comments of SoCal Gas on Energy Efficiency potential and goals and Deer Updates,¤ June 8, 2015 at 3.

both may happen less rapidly than we and others had hoped based on earlier information.

In addition to modeling and data adequacy issues (*e.g*. emerging technologies, operation and maintenance impacts, and behavioral approaches), there are more additional uncertainties to ponder. It remains to be seen how new finance mechanisms such as Property Assessed Clean Energy loans and the Commission-approved finance pilots[54] will impact market activity. Relatedly, it remains to be seen how expanded private market offerings such as energy services agreements and performance guarantees might affect energy efficiency adoption rates.

For the time being, we can do little more than speculate about the promise of the technologies called out by commenters. When adequate data become available, the potential and goals study can and should integrate them. We will manage the inherent uncertainty around emerging technology by updating goals regularly with the best available data. Thus, we can capture and reflect technological developments and trends, including the rate of technological improvement generally.

3.1.4.3. **Use of Smartmeter Data**

Both FirstFuel[55]

and ORA[56] note that the potential model does not use smartmeter data. They encourage its use in future iterations of the model.

These proposals are certainly something to explore in future goal-setting exercises. They are, though, (as FirstFuel itself notes) outside the scope of the

[54] *See* D.13-09-044.

[55] Firstfuel Comments on Administrative Law Judge's Ruling Regarding Post-2015 Energy Efficiency potential and goals, and Database For Energy Efficient Resources Updates at 1-6, June 8, 2015.

[56] ORA's Responses to the ALJ's Ruling Regarding Post-2015 Energy Efficiency Goals, June 8, 2015 at 1-10.

present decision. As noted already, what we are doing here is an update to an existing model and methodology, rather than a wholesale redesign of our approach. A harder look at more fundamental aspects of the model should happen between now and 2017.

More generally, ORA's comment implicates several larger issues. First is the question of what data is "best" for purposes of use in the potential and goals study. Smartmeter data may inform unit energy savings values. However, we cannot say that smartmeter data can (or ever will) inform incremental cost, measure life, and appliance saturation. Availability of smartmeter data, and aggregation and disaggregation of the data for purposes of the potential and goals study, remain issues. The upshot of all of this is that it continues to be appropriate to rely on EM&V data, DEER, and other Commission-vetted studies as much as possible. R.13-11-005's placed data issues in the preliminary scope Phase III.

3.1.4.4. Behavioral Programs

FirstFuel encourages us to state "operational savings are real and that the Commission includes them as countable under the Commission's current policy rules."[57] We lack the record to understand, much less make, such an assertion.

Opower contends that there are effectively no technical limitations on the number of households that can be enrolled in its behavioral programs, as utilities have the technical capability to send mail to 100% of their customers. Therefore, Opower posits that the Technical Potential from behavior programs is the total number of residential customers in a given service territory, multiplied by a given kWh or percent-of-use reduction. Opower then argues that, for behavioral programs, Technical Potential is calculated by determining how many customers

[57] Firstfuel Comments on ALJ's Ruling Regarding Post-2015 Energy Efficiency Potential and Goals, and Database For Energy Efficient Resources Updates, June 8, 2015 at 5.

can be enrolled in a behavior program cost-effectively, taking into account the fact that higher usage households generally yield greater savings than lower usage customers. Finally, OPower equates Economic Potential with Market Potential. OPower does not identify what the Market Potential numbers should be, were we to agree with this line of argument. Exploration of OPower's arguments will be something to consider in the next iteration of the goals and potential study.

SCE, for its part, "questions [the] reasonableness of the drastically increased [behavioral program] participation rate (23%), as participation is planned to remain at 5.1% in 2016. SCE pilot studies indicate that a participation rate of 5.1% with savings ranging from 19 GWh to 24.8 GWh is cost-effective reliable and achievable, while maintaining a diverse residential portfolio."[58] SCE further contends that "Although the total population in behavior programs for 2016 is projected to be three times the size of the 2013 Opower Wave 1 population, simply multiplying the validated 2013 savings by three constitutes an upper bound for expected savings for 2016, because the 2013 participants were unusually high users."[59] The upshot of this is that SCE would have us assume lower participation rates in behavioral programs than Navigant did, and, further, assume lower savings rates per participating customer than Navigant did.

SCE's concerns relate to an earlier version of the Navigant report. In the revised Navigant report, Navigant used a participation rate for SCE behavioral programs of approximately 5%, as documented in Table 3-14. Accordingly, the revised Navigant study and the goals we adopt already reflect this lower participation level.

[58] SCE's Comments on Ruling Regarding Post-2015 Energy Efficiency Potential and Goals, and Database for Energy Efficient Resources Updates at A-9.
[59] *Id.*

3.1.4.5. Building Retrofits

A draft Commission staff memo dated April 20, 2015, titled "Commission staff responses to IOU comments on draft updates to Retrofit Add on Guidance Document" (April 20, 2015 memo) details approaches to claimable energy savings for "retrofit add-on" (REA)[60] measures. ~~Examples of REA measures are additions to a building's equipment, retro-commissioning/monitoring-based commissioning of a building, process changes within a building, building maintenance, and pump overhaul measures.~~

According to SCE, the proposed savings goals do not capture the alleged impact of the April 20, 2015 memo. SCE asserts that modifications to what constitutes an REA measure, as defined by the April 20, 2015 memo will likely reduce participation in programs that currently offer REA measures. SCE states that it experienced a reduction in program participation when documentation was required for early retirement measures. SCE anticipates a higher reduction in program participation for REA measures because it applies to both calculated and deemed measures.

PG&E raises similar concerns. Further, PG&E asserts that it has received several custom project *ex-ante* dispositions that limit its ability to pursue comprehensive retro-commissioning opportunities.

It does not appear that the potential and goals model needs to change in response to the April 20, 2015 memo, which follows existing policy by recognizing that existing equipment baselines are permissible in instances of program-induced early retirement. The April 20, 2015 memo treats REA measures in the same manner as other program-induced early retirements when all the requirements for early retirement measures are met.

[60] The acronym here comes for DEER, "Measure Application Types: Codes and Definitions," http://www.deeresources.com/index.php/21-ex-ante-guidance.

The concern here appears to lie with the Commission's baseline policy, not with the potential and goals model's reflection of baseline policy. ~~Baseline issues are out of scope for this phase of R.13-11-005. We will take them up in Phase III. In the meantime, the potential model properly assumes a continuation of the current baseline policy.~~

Recent legislation (SB350, AB802) passed by the Legislature and awaiting the Governor's disposition would require changes to how we measure savings. Until this legislation becomes law and we can respond to its requirements, and since model development and completion predated this legislation, we will go forward with pre-legislation assumptions on baseline.

There is always a lag between the end of a modelling exercise and Commission adoption of a model and/or its results. Real-world events often overtake a model's assumptions in that interregnum. This phenomenon presents an inherent challenge for much of what the Commission does in the energy efficiency space and in many other areas.

The long-term approach to this problem is the "bus stop" approach we adopt below for numerous technical aspects of energy efficiency work (e.g., DEER updates, EM&V, and, of course, goals). At a fixed point, the bus pulls up to the stop, and our analysis will go forward based on the information on hand at that time. Anything that shows up after the bus leaves the station will get picked up the next time the bus comes to the stop (i.e., annually for DEER and EM&V, biannually for goals). To do otherwise risks trapping us in an endless loop: a model is finished and pending adoption, an outside event leads to holding a decision adopting the model, and then a second outside event occurs while the revisions to address the first outside event are pending, taking us back to the

start of the cycle. This is the sort of issue that the "bus stop" approach to many aspects of energy efficiency oversight will, we hope, minimize.

With the set of goals now before us, we have seen two major events since the "final" draft goals were issued for comment in May. The delay in codes and standards is one such event. In addition, on September 11, 2015, the Legislature passed SB350[61] and AB802.[62] These bills are currently awaiting action by the Governor. They have potentially significant ramifications for energy efficiency generally, and for the Commission's goal-setting work in particular. In pertinent part, AB802 states:

> Recognizing the already underway 2015 commission work to adopt efficiency potential and goals, the Energy Commission work on its 2015 energy demand forecast, and the need to determine how to incorporate meter-based performance into determinations of goals, portfolio cost-effectiveness, and authorized budgets, the commission, in a separate or existing proceeding, shall, by September 1, 2016, authorize electrical corporations or gas corporations to provide financial incentives, rebates, technical assistance, and support to their customers to increase the energy efficiency of existing buildings based on all estimated energy savings and energy usage reductions, taking into consideration the overall reduction in normalized metered energy consumption as a measure of energy savings. . . . The commission may adjust the energy efficiency goals or targets of an electrical corporation and gas corporation to reflect this change in savings estimation consistent with this subdivision and subdivision (d).

[61] "Clean Energy and Pollution Reduction Act of 2015" Full text is available at https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350

[62] Full text is available at http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB802

Relatedly, SB350 includes various requirements regarding how the Commission and the CEC set savings goals.[63]

In sum, AB 802 would require that we establish by September 2016 a different baseline for measuring savings, for some or all portions of the portfolio, than we use currently. AB 802 invites, but does not require, the Commission to revise its savings goals before then. SB 350, meanwhile, would require that the CEC, with input from the Commission, establish new savings goals by November 1, 2017.

Given this shifting landscape, is it worthwhile to go forward with the current goal setting process in this decision? On balance, we conclude that it is. We still need to establish goals for 2016. The CEC is going forward with the IEPR update this year, and needs new savings goals from us now. Current goals expire at year's end. Thus it is appropriate to adopt goals now that include assumptions pre-dating SB 350 and AB 802. AB 802 appears to expressly contemplate our doing so in "[r]ecognizing the already underway 2015 Commission work to adopt efficiency potential and goals."

AB 802 also provides, assuming it becomes law, that we may provide a goals update sooner than we ordinarily would under the "Rolling Portfolio" schedule we adopt later in this decision. The object of the update would be to "adjust the energy efficiency goals or targets of an electrical corporation and gas corporation" to reflect legislative changes in time to inform the programs that we are ultimately to approve in alignment with the Legislative changes. It will be up to the assigned Commissioner and ALJ to determine whether to move such an

[63] *See*, e.g., SB350, Section 6 (amending Section 25310 of the Public Resources Code to identify sources of energy efficiency savings and demand reduction that count towards achievement of savings goals) and Section 16 (requiring the Commission to "review and update its policies governing energy efficiency programs funded by utility customers to facilitate achieving the targets established pursuant to subdivision (c) of Section 25310 of the Public Resources Code").

update forward and on what timeframe, balancing the priorities of other work that must be completed in this proceeding.

3.1.4.6. Capturing Temporal and Locational Aspects of Savings

NRDC asks that we improve the temporal and locational aspects of the potential and goals study. According to NRDC, this will allow for a better valuation of energy efficiency's impacts. By extension, incorporating these values may increase the cost effectiveness of some energy efficiency activities. It may reduce the cost-effectiveness of others, of course, but in any event should allow for more targeted activity.

This will be something to consider in the next iteration of the potential and goals study.

3.1.4.7. Assorted Other Measure-Specific Issues

PG&E objects to the continued inclusion of "strip curtains" in potential. PG&E contends that strip curtains are no longer a cost-effective measure, citing to a Commission Staff workpaper disposition for "Strip Curtains for Doorways to Refrigerated Storage" issued February 27, 2013.

Continued inclusion of strip curtains is a consequence of this iteration of goals utilizing the pre-existing modeling approach. Producing revised goals in time for adoption this year meant being strategic about which measures to update. Navigant did not update data for strip curtains because they represented approximately 1/10th of 1% of total portfolio savings. Now that PG&E has brought the issue to our attention we will direct that strip curtain values be updated in the next iteration of the potential and goals study, but we will not require re-running of the model this time for such a small value.

PG&E identifies for further study a number of measures that it contends the Commission should evaluate more closely in the next iteration of the potential and goals study:

- Use of Industrial Assessment Center Data
- Machine Drive End Use
- Commercial Behavioral Savings
- Computers and displays
- Evaporative Cooling
- LED Potential
- Lighting C&S Code Change

All of these issues bear consideration in the next iteration of the potential model. Data availability will be a critical consideration in taking on these issues.

In SCE's Energy Efficiency potential and goals Model Stage 1 Comments, SCE highlighted what it characterized as significant issues with the Potential Study's conclusions regarding the residential refrigerator recycling and pool pump adoptions and savings, street lighting savings, behavioral savings, and whole building savings,[~~61~~64] and the treatment of residential recycling and pool pump measure adoptions in the Revised Navigant Study. Navigant has addressed SCE's concerns about measure savings values[~~62~~65] in the most recent iteration of the study, which show significantly less savings per participant than before, for these measures. The goals above reflect reductions from the proposed goals, to account for these changes.

Navigant changed refrigerator values in the May 2015 model release. The model projects an annual average number of units over the 2016-2024 period to be approximately 32,000 per year with higher values in the early years and lower

[~~61~~64] SCE Response to First Draft of the 2015 Energy Efficiency Potential Study at 4-10.
[~~62~~65] SCE concerns remain around measure uptake rates for refrigerators and pool pumps, as discussed in connection with calibration, above.

values in the later years. Navigant also adjusted pool pump unit energy savings per SCE's comment.

SoCal Gas notes one large, allegedly unexplained change to its goals. SoCal Gas's savings potential dropped by 29% between the draft results released in March to those released in May. SoCal Gas identifies the cause of this drop as a single change to the oil and gas sector. SoCal Gas asserts that it has committed to projects with oil and gas customers in 2016 exceeding 10 million therms; whereas the May 2015 Draft Revised Navigant Study includes potential of just 3.2 million therms for 2016.

The question SoCal Gas raises is what to do about allegedly foreseeable "lumpy" changes in savings. Potential forecasts generally appear "smooth" with drastic changes generally the result of changes to C&S. In reality, certain industries are much more "lumpy" in their annual participation in programs. The oil and gas sector may be one of those.

In sum, then, SoCal Gas can indeed have actual projects proposed that demonstrate that there are greater savings than the potential model predicted, and those savings will allow them to exceed their goals in a given year. That SoCal Gas expects a large departure from the regression line so early in the planning horizon makes it tempting to adjust the forecast upwards, but a single point value that is a *planned* value rather than an observed value is not a good basis on which to modify model results.

3.1.4.8. **Codes and Standards**

"Codes and Standards" (C&S) refers generically to local, state and federal standards that mandate minimum efficiency levels (*e.g.*, Cal. Code. Reg., Title 24, Part 6). "Each of the utility portfolios support[s] statewide program

activities in the areas of . . . support for codes and standards."[~~63~~66] We refer to such support activities as C&S "advocacy programs."[~~64~~67] "Using ratepayer dollars to work towards adoption of higher appliance and building standards may be one of the most cost-effective ways to tap the savings potential for energy efficiency and procure least-cost energy resources on behalf of all ratepayers."[~~65~~68]

As Navigant noted in the Revised Navigant Report, C&S reduces the Unit Energy Savings (UES) for rebated measures, thus decreasing the savings claimable by IOUs. Conversely, IOUs can claim a portion of savings from C&S that come into effect through the IOU C&S advocacy programs, thus increasing the savings claimable by IOUs.[~~66~~69] We have historically been concerned about avoiding double-counting of savings between C&S and programs. That is, we seek to avoid IOUs claiming C&S advocacy savings for measures, and then also claiming savings credit for those measures in connection with a program. In D.14-10-046 we directed Commission Staff to work with CEC staff to investigate this issue. Double-counting will be an issue to consider as we reexamine our policies concerning baseline in ~~Phase III to potentially~~2016, including reflecting legislative direction, to allow ~~additional~~ savings credit for "to and through code" activities.

We have historically set goals for C&S advocacy savings as separate from the balance of a PA's portfolio. This practice originates in part from the fact that under the RRIM, we initially treated C&S advocacy savings differently than other savings for purposes of awarding shareholder incentives. We only "credit[ed] 50% of the energy and peak savings resulting from those programs towards the 2006-2008 savings goals" on the premise that "these savings [are] a hedge against

[~~63~~66] D.05-09-043 at 5.
[~~64~~67] D.05-09-043 at 6.
[~~65~~68] D.05-09-043 at 123.
[~~66~~69] Revised Navigant Report at 35.

inherent risks that other programs may not meet their performance goals."[~~67~~70] This provided the utilities with an incentive to push mature measures into code. We subsequently allowed IOUs to count 100% of verified savings towards savings goals for purposes of awarding shareholder incentives.[~~68~~71]

Even with the elimination of the RRIM, we have continued to set C&S goals separately. As the Commission stated in D.12-05-015:

> We continue to believe it is prudent to develop and hold utilities accountable for separate codes and standards and IOU program goals. The utility role in and programmatic approach towards these two types of efficiency-generating activities are wholly different from one another. It is important that we continue to encourage the utilities to develop the market for new technologies through both emerging technology and mainstream incentive programs. It is equally important that measures are not pushed through to code before they are market ready, and that we do not incent the utilities to do so. For these reasons, we adopt in this decision separate codes and standards advocacy and IOU program goals.

TURN would have PAs keep C&S savings segregated in the savings forecast, caveat them heavily, and not allow PAs to claim them as savings at all. According to TURN, the problem with setting goals that are heavily reliant on C&S savings – 46% of projected portfolio GWh savings, 55% of projected portfolio MW savings, and 36% of projected MMTherms savings in 2016 – is that the reliability of savings from recent code updates is highly uncertain. TURN recommends that, if the Commission adopts the proposed C&S goals, it do so only with the following caveats: (1) an acknowledgement that the C&S goals are

[~~67~~70] D.05-09-043 at 6. For the 2006-2009 portfolio cycle, allowing full credit for C&S savings would have created a mismatch with the goals we had set for the 2006-2008 portfolios, which did not contemplate C&S savings.

[~~68~~71] D.07-10-032 at 119-120; D.10-04-029 at 46.

significantly uncertain, (2) a prohibition on counting the C&S goals as savings accomplishments in the energy efficiency portfolios, at least in the near term pending further data collection and/or EM&V, and a related prohibition on using the C&S goals to buttress portfolio cost-effectiveness, and (3) a warning that the C&S goals may be adjusted based on the Commission's investigation of possible policy changes in Phase III.

TURN further recommends that the Commission explicitly anticipate that it may be appropriate to update the 2016 and 2017 PA Programs goals in Phase III of this proceeding, should the Commission determine that a change in baseline policy is appropriate. As noted above in TURN's discussion of the proposed C&S goals, such a change in baseline policy could trigger a decrease in the C&S goals and an increase in the PA Programs goals.

SoCal Gas, in contrast, recommends that the Commission represent the energy efficiency portfolio goal as a single goal, instead of disaggregating goals into distinct elements for C& S and for other programs. The gist of SoCal Gas' argument is that savings are savings and the Commission ought not be overly prescriptive about how PAs obtain those savings.

We see no reason at present to depart from the policy of establishing separate goals for C&S. The reasons for this policy that we rearticulated in D.12-05-015 remain valid today. Further, the goals are not prescriptive. They reflect expectations, but do not *mandate* any particular actions, as we discuss next.

In comments on the proposed decision, several commenters note that C&S goals include anticipated Title 20-related savings that were expected to be in effect, but will no longer be realized in 2016 due to delayed adoption at the CEC. Commenters recommend modifications to the goals to reflect the most recent

Codes and Standards adoption timeline. This we decline to do, as we will address this change in circumstances at the next goals "bust stop."

3.1.4.9. Aligning Goals and Policies

Though TURN differs from SoCal Gas on segregating codes and standards separately from other program savings, TURN echoes SoCal Gas's request that we not be overly prescriptive as to whether portfolio designs track goals. TURN urges the Commission to clarify that the energy efficiency goals for PA Programs are not intended to serve as a specific template for how the PAs are to capture the energy efficiency savings, despite that they were derived from a bottoms-up potential analysis. We clarify here that we are not requiring adherence to any particular portfolio structure.

Several parties raised baseline issues in their comments. For the time being, it is appropriate for the potential model to extrapolate current baseline policy into the future. As previously discussed, recent Legislation awaiting the Governor's disposition would impose various requirements for the baseline used for savings calculations. We will revisit baselines in Phase III, likely on an accelerated timeframe, and will not incorporate any assumptions about a departure from current policy into the potential model now. Further, baseline is only one among many policy areas that ongoing discussions outside this agency could considerably alter. Other areas include the CEC's contemplation of enhanced codes & standards compliance strategies articulated in the CEC's Existing Building EE Action Plan (Assembly Bill 758) document. Some of these strategies may lead to changes in PA portfolios.

Finally, in assessing the SDG&E 2016 and beyond market potential which will serve as the basis for determining the final 2016 and beyond energy efficiency goals, SDG&E recommends that the Commission ensure that the

increase in the 2015 goal and the allowance for ramping up to achieve the 120% of annual savings claims for commercial whole building retrofit programs is calibrated and accounted for appropriately in the 2015 P&G Study. The Ruling Appendix A Table 1 provides a 2016 GWh goal of 183 GWh (PA Programs) compared to the 2015 GWh goal of 173.6 GWh (PA Programs).[69][72] It is not clear to SDG&E if the increase of approximately 20 GWh includes rolling over from 2015 or this is a pure incremental increase over and above the 2015 GWh goal.

In response to SDG&E, we clarify that the 20 GWh increase is "pure incremental increase." Goals are stated as incremental potential for each year. The 2016 goal does not "roll over" unrealized savings from 2015.

As to whether the goals in the proposed decision included the "ramp up" authorized for SDG&E in D.14-10-046, [73] the goals in the proposed decision did not. They should have. Commission Staff has provided corrected numbers, which we have incorporated into Figure 1 above. This correction results in a slight reduction to SDGE's goals compared to what was reflected in the proposed decision.

3.2. The "Rolling Portfolio" Review Process

3.2.1. Introduction

As we noted earlier, we allocate roughly $1 billion per year in ratepayer funds to energy efficiency programs. In D.14-10-046, we authorized that level of funding for the next ten years. Tempting as it is to jump right into substantive changes to energy efficiency portfolios, it is critical to attend to process now. Even – especially – in the face of potentially major changes to energy efficiency

[69][72] D.14-10-046 at 11.

[73] D.14-10-046, at 16-17 ("we have adjusted SDG&E's 2015 goal to reflect 120% of SDG&E's recent annual savings claims for commercial whole building retrofit programs. This considers (but does not require) a linear, five-year ramp up to the level of savings the draft 2013 Study forecasts for SDG&E.").

policies in Phase III of this proceeding. Those policy changes, whatever they may be, will take some time to implement. We need a revised portfolio review process in place starting in 2016, so that portfolios can remain up-to-date.

In preparation for this decision, the Assigned Commissioner invited parties to work on a Phase II proposal during Phase I. Once Phase II was under way, at a March 9-10, 2015 workshop (~~workshop~~Workshop 1), a collection of parties[~~70~~74] (Joint Parties) made a largely[~~71~~75] unified presentation on how Rolling Portfolios could work (joint proposal). Parties submitted post-workshop 1 comments on March 27, 2015.[~~72~~76] Building from that foundation, Commission staff prepared a white paper on rolling portfolio mechanics, which the assigned ALJ put out for

[~~70~~74] Joint Parties include:
San Francisco Bay Area Regional Energy Network
California Energy Efficiency Industry Council
Local Government Sustainable Energy Coalition
MCE
NRDC
ORA
PG&E
SDG&E
SCE
SoCal Gas
Southern California Regional Energy Network
TURN

[~~71~~75] There were instances where individual joint party members diverged from the joint proposal. We will not catalog those divergences here, but will discuss them in the text as needed.

[~~72~~76] The following parties submitted post-workshop 1 comments:
1.San Francisco Bay Area Regional Energy Network
Local Government Sustainable Energy Coalition
Center for Sustainable Energy
PG&E
NRDC
ORA
SDG&E jointly with SoCal Gas
EnerNoc, Inc.
TURN

public comment on May 19, 2015.[73][77] Parties submitted comments on the white paper on May 26, 2015.[74][78]

The joint proposal contemplates a "business plan"[75][79] filed with the full Commission every five years. Beyond that, Commission Staff would see annual budgets filed as ministerial (i.e., Tier 1) advice letters, effective without further action by Commission Staff. Everything else, like reports and implementation plans, would happen informally either internally with PAs, in stakeholder processes outside the Commission, or in informal Commission Staff processes. Many current processes would continue, but be trimmed down and coordinated through a stakeholder-led "coordinating committee". PAs would set their own program goals and metrics, subject to our review.

Commission Staff, in its white paper following the joint proposal, "generally found the Joint Parties' proposal to provide a solid foundation for a "Rolling Portfolio" cycle framework. . . . The overall structure of the joint party proposal, with its business plans, implementation plans, and "bus stops" is

[73][77] http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=151794292.

[74][78] The following parties submitted comments on the Commission Staff white paper on rolling portfolio mechanics: ⊥
California Technical Forum Staff⊥
SCE⊥
Association of Bay Area Governments⊥
PG&E⊥
MCE⊥
National Association of Energy Service Companies⊥
SoCal Gas jointly with SDG&E⊥
ORA⊥
Southern California Regional Energy Network⊥
NRDC⊥
TURN⊥
Local Government Sustainable Energy Coalition

[75][79] "[Business plans] are major, new documents developed by each PA to describe its overarching strategy to support the State's EE goals & objectives and plans for each customer sector, and to seek EE funding approval." Joint Parties' Proposal: Portfolio Review Process, presented at ~~workshop~~Workshop 1, session 1, slide 8.

reflected [in the white paper]." Staff's white paper recommendations did "depart from the joint party proposal in certain particulars," principally in adding various filing requirements and Commission oversight not present in the joint proposal.

What we will adopt here is a blend of the joint proposal and the Commission Staff white paper proposal (recognizing that the Commission Staff white paper itself adopted much of what the Joint Parties proposed). Our concerns with the joint proposal lie with some of the joint proposal's details.

Thus, we largely adopt the joint proposal's overall structure. The approach we adopt follows a hierarchy, with the strategic plan at the top, guiding business plans, which in turn guide budgets and implementation plans. To summarize:

1. Strategic Plan – Commission developed, provides overarching guidance to PAs.
2. Business Plan – PA and stakeholder developed, PAs file periodically via application for Commission review; explains at a high level of abstraction how PAs will achieve the goals of the Commission's strategic plan; leads to a Commission guidance decision adopting the business plan and setting budget expectations to be more fully developed in annual budget filings.
3. Annual Budget – PA and stakeholder developed, PAs file annually via advice letter; provides a budget for the programs/implementation strategies described in the business plans.
4. Implementation Plan – PA ~~andstakeholder~~and stakeholder developed, not formally filed with the Commission; uploaded onto a Commission-maintained website as (and a PA website also, at each PA's discretion); provides detail on programs/implementation strategies.

Before we delve into the details, a note on our overarching reasons for departing from aspects of the joint proposal is in order.

The joint party view seems to be that the joint proposal is trading a black box (Commission process) for a transparent box (stakeholder process). However, *from the Commission's perspective*, the joint proposal moves much that ~~decisionmakers~~decision makers can currently see behind a curtain, or even off-stage altogether. In a twist on the maxim that "where you stand depends on where you sit," the joint party reliance on PA discretion and stakeholder processes in place of formal regulatory processes actually makes many energy efficiency activities more opaque for Commissioners and possibly for other stakeholders who do not have time or ability to participate in multiple detailed stakeholder processes.[~~76~~80] It also raises due process issues.

This is true even with Commission Staff participation in stakeholder processes. The joint parties seem to conflate Commission Staff activities with Commission review under the rubric of "regulatory events." However, Commission Staff's participation in an informal process is not equivalent to *Commission* participation. Moreover, a stakeholder process, even with Commission Staff participation, is not necessarily an adequate substitute for Commission review of an application or advice letter. Open meeting laws and the Commission's ex parte rules may be in effect as concerns some or all issues covered in stakeholder processes. Commission Staff may not become an improper "conduit" for extra-record information. The Commission may be hard-pressed to perform its statutory responsibilities to protect ratepayers and

[~~76~~80] The joint proposal states that full ~~coordinating committee~~Coordinating Committee meetings would be publicly noticed. However, the joint proposal also provides for topic-specific subgroups to review the PAs' sector and sub-sector activities. The joint proposal is silent on whether subcommittee meetings would be public; the implication is that they would be limited to topic area experts, as with past Project Coordination Groups (PCGs) such as the water-energy nexus PCG prior to that PCG's absorption into R.13-12-011.

authorize all cost-effective energy efficiency if so much depends on a process into which the Commission has such limited visibility.

The Commission has generally weighed in biannually with guidance decisions and/or funding decisions. Baseline changes, cost-effectiveness methodology changes, changes in administrative structure; all of these things require Commissioner, not just Commission Staff, involvement. The Commission needs more opportunities to weigh in via decisions and/or resolutions than the joint proposal contemplated.

There are workarounds for these concerns. However, they tend to look much like current filings, hearings, and workshops. These procedural mechanisms provide the Commission with a record, and allow ~~decisionmakers~~decision makers to interact with stakeholders in ways they otherwise could not, albeit at a cost in terms of responsiveness and time.

Finally, the joint proposal raised timing concerns. The review schedule must allow everyone concerned adequate time to accomplish their work.

Our departures from the joint proposal flow largely from these considerations. We support the joint proposal's goals of moving towards informal processes in order to facilitate innovation and to make portfolios and the PAs that administer them more nimble. However, we must continue meaningful oversight of energy efficiency spending, and insure due process for everyone concerned with the disposition of energy efficiency funds.

With those considerations in mind, the sections below discuss how we will proceed with Rolling Portfolio Cycle mechanics.

3.2.2. Rolling Portfolio Mechanics

3.2.2.1. Commission Policy Guidance

The Commission will provide ongoing high-level strategic guidance via a "policy track" in an energy efficiency proceeding. The policy track will run in parallel with more granular portfolio review activities.

In addition to dealing with discrete policy questions through the policy track, we anticipate adopting a revised strategic plan. We last adopted a strategic plan in 2008.[~~77~~81] We revised it in limited part in 2011.[~~78~~82] Commission Staff is working on a revised strategic plan, which will then undergo a public review and comment process.

Phase III of this proceeding will fulfill the role of the policy track beginning in 2016. We anticipate leading off Phase III with an examination of energy efficiency baseline issues, followed by an examination of the role of the utility in energy efficiency. Remaining items will follow. The emphasis in Phase III will be on strategic guidance.

3.2.2.2. ~~3.2.3.~~ Program Administrator Business Plan Applications

Each PA will file an initial business plan in 2016, as an application. Business plans will explain at a relatively high level of generality how PAs will effectuate the strategic plan.[~~79~~83] PAs will divide business plans into market sectors and subsectors as discussed below.

After the initial filing, PAs *must* file revised business plans only when a "trigger" event happens; PAs *may* also file revised business plans whenever they choose to do so. Business plan filings will generally be untethered to the

[~~77~~81] D.08-09-040.
[~~78~~82] D.10-09-047 (updating the chapter on lighting).
[~~79~~83] As discussed below, we are re-defining sectors versus those in the 2011/2008 Strategic Plan. Hence we are not directing here that the business plans precisely track the strategic plans sectors.

calendar except that PAs will need to apply for an extension of funding – that is, a restarting of the ten-year clock -- no less than one year before funding is set to end.

There will be a stakeholder process associated with business plan preparation. Participants in that stakeholder process may be eligible for intervenor compensation, as we elaborate below. Commission staff may participate in the stakeholder process subject to parameters to be decided.

Business plans shall contain the following.

1. Portfolio summary and description of applicable intervention strategies;
2. A chapter for each of six sectors (residential, commercial, industrial, agriculture, public, cross-cutting) providing;
    - A description of each PA's overarching goals, strategies and approaches; near-, mid- and long-term strategic initiatives;
    - Sector-specific intervention strategies;
    - Description of how each sector approach advances the goals, strategies and objectives of the strategic plan.
    - Description of which and how strategies are coordinated statewide and regionally among PAs and/or with other demand-side options;
    - Description of how cross cutting 'sectors' are addressed.
        - Leveraging cross-cutting activities for success for particular customer groups.
        - Minimizing redundancy.
        - Avoiding working at cross purposes with other PAs.
    - A description of any pilots contemplated or underway for the sector.
3. Portfolio and sector level metrics for regulatory oversight (GWh, MW, therms, cost-effectiveness, and other metrics

where applicable), including performance metrics for non-resource programs;

- Statement of evaluation "preparedness" in terms of:
  - data collection strategies embedded in the design of the program or intervention to ensure ease of reporting and near term feedback, and
  - internal performance analysis during deployment.

4. Portfolio and sector-level budgets[~~80~~84] that meet portfolio savings and cost effectiveness requirements (note that the Commission will address budgets at a general level in response to business plans, but the Commission will give funding authorization in response to a subsequent PA budget advice letter);
5. Separate milestones with associated timelines to track PA programs in a sector, that are not formally reported (proposed only by some parties);

The joint proposal contemplated the business plans providing a "comprehensive vision outlining long-term strategic initiatives, intervention strategies, budgets and funding justification." Business plans would "focus on customer-oriented approaches."[~~81~~85]

As Commission Staff pointed out in the white paper: "The challenge is striking the right balance between being specific enough to be strategic, but general enough not to end up duplicating implementation plans." [~~82~~86]

We adopt many aspects of the joint proposal plus some (but not all) of the Commission Staff's recommendations. We will focus our discussion below on where we depart from one or both of the joint proposal and Commission Staff White Paper.

[~~80~~84] For the portfolio cost effectiveness showing, only cost calculator outputs need to be filed; the full-fledged cost calculator submittals will be in the subsequent budget filing.

[~~81~~85] Joint Parties' Proposal: Portfolio Review Process, presented at ~~workshop~~Workshop 1, session 1, ☼
slide 14.

[~~82~~86] Commission Staff white paper, at 7.

Sector Definitions

The first departure from the joint proposal involves the sector organization. The question before us here is what to do about measures or strategies or interventions that do not cleave neatly along sector boundaries. An example of a cross-cutting intervention is lighting. Lighting plays a role in many sector-specific programs (e.g., residential retrofits). It also cuts across multiple sectors (e.g., lighting rebates for bulbs found in commercial, industrial, and residential buildings). Hence, "cross-cutting." Finance, marketing education and outreach (ME&O), workforce education and training (WE&T), codes and standards, and emerging technologies all can be considered cross-cutting. [87]

Cross-cutting items by definition can be divided into sectors and/or be treated as standalone. The joint parties favor treating cross-cutting as a standalone sector "to reduce redundancy, increase clarity, and provide the 'full picture'" for these activities." [~~83~~88] TURN, in contrast, "recommends that the various 'Cross-Cutting' activities be included as intervention strategies within each of the other sectors proposed by the Joint Parties, as appropriate."[~~84~~89] Commission Staff expressed concern that "the joint parties' specific program structure seems like it will create a new source of confusion, since cross-cutting is not actually a sector, and many of the programs in it are very distinct and not closely related."[~~85~~90]

Sector assignment is a substantive issue, not merely semantic. The sector to which a program is assigned can determine who administers it, who controls

[87] In comments, some parties requested a definitive list of what falls under the definition of "cross-cutting," or at least a more refined definition. We lack the record here to offer more than an exemplary list.

[~~83~~88] Commission Staff Rolling Portfolio White Paper at 7.

[~~84~~89] TURN comments on Commission Staff Rolling Portfolio White Paper at 2.

[~~85~~90] Commission Staff Rolling Portfolio White Paper at 9.

its budget, how effectively it achieves savings, and who is accountable for the program's success or failure. Consider, for example, the Commission's energy efficiency finance decision, D.13-09-044, and the Commission's ME&O decision, D.13-12-038. In both instances, the Commission shifted funds and operational responsibility for cross-cutting interventions from incumbent PAs[86 91] to other entities.[87 92]

We will treat cross-cutting as a separate sector, as (most) joint parties propose. Segregation makes it easier to coordinate interventions, budgets and responsibility for cross-cutting activities across different administrators, or to move those activities to a single administrator if/when appropriate.

We recognize this approach might reduce tailoring of cross-cutting activities to particular service territories/sectors/programs/intervention strategies. Note that ultimately we still expect individual PAs to engage in cross-cutting activities where and when needed. It may, for instance, make sense to have a WE&T activity associated with a particular sector (e.g., residential duct sealing) and also have WE&T activities that cut across sectors (e.g., heating, ventilating, and air conditioning HVAC installation). The same is true for ME&O. We are not precluding PAs from engaging in ostensibly cross-cutting activities as part of that PA's sector approach. For example, a PA's residential retrofit program will include HVAC measures, even though HVAC is cross-cutting, as it does today. When treading into cross-cutting territory, PAs should minimize redundancy, and should avoid altogether working at cross-purposes. This will require coordination with whoever oversees a

[86 91] *See*, *e.g.*, D.13-12-038 at 59 ("We should reduce IOU funding for administrative staffing if it no longer adds value to statewide marketing.").

[87 92] The other entities are the California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA) for finance and Center for Sustainable Energy for ME&O.

cross-cutting activity in a PA's service territory, if it is not the PA, and hence we are requiring documentation of the long-term strategy for the cross cutting activities in the customer sector plans.

Metrics

Joint parties intend the business plans to "provide *portfolio and sector-level* metrics to be used to assess PAs' progress towards goals."[~~88~~93]

The joint parties ask "that the Commission clearly state that the existing program performance metrics (PPMs) and market transformation indicators (MTIs) will no longer be used past 2015, which will provide clarity and free up resources to work on other priorities."[~~89~~94] The Joint Parties propose to have PAs submit PPM/MTI reports annually instead of monthly, and for PAs to no longer report on and/or complying with existing PPMs and MTIs while PAs fashion new metrics.

The Commission Staff White paper calls for more granular metrics in the business plans.

Generically speaking, we use metrics to gauge portfolio and/or program performance. For resource programs, savings and spending are two possible metrics. For non-resource programs like workforce education and training, tracking measure installation quality over time might be a metric.

PPMs and MTIs are special kinds of metrics. They "measure and track whether a specific energy efficiency portfolio program—e.g., incentives for high efficiency air conditioners—is advancing our market transformation goals."[~~90~~95]

[~~88~~93] Joint Parties' Proposal: Portfolio Review Process, presented at ~~workshop~~Workshop 1, session 1, ☼
slide 8 (emphasis added).

[~~89~~94] NRDC comments on Commission Staff White Paper at 8-9. This is more than a little discouraging given the effort we put into establishing a collaborative process for developing PPMs in D.09-09-047 at 89-93. Once again, here is an experience that calls into question how effective collaborative processes can be where energy efficiency is concerned.

[~~90~~ 95] D.09-09-047 at 88.

> In D.09-09-047 we directed IOUs to develop Program Performance Metrics (PPMs) to serve as objective, quantitative indicators of the progress of a program toward the Strategic Plan's short and long-term market transformation goals and objectives. . . . Given the extensive effort that has been invested by IOUs and Commission staff to develop the PPMs, we [were] confident that process will result in metrics that can be efficiently brought to bear to assess our progress toward the market transformation objectives detailed in the Strategic Plan.[~~91~~96]

Resolution E-4385 approved an exhaustive set of PPMs and MTIs. Current practice is to set PPMs at, as their name implies, the *program* level.[~~92~~97] MTIs track combinations of programs rather than a specific program. PAs file monthly reports on PPMs. MTI progress is reported on a cycle basis.

In a more recent exploration of market transformation policy, Commission Staff recommended revisiting the role of MTIs:

> Measuring Progress Toward Market Transformation Goals: Review the role of MTIs. If the other policy changes suggested in this paper are made, then the current broad MTI framework might be best replaced by detailed program theories (and associated market effects indicators) for only those programs that are viewed as true market transformation initiatives.[~~93~~98]

With those definitions and that history in mind, here is how we will proceed.

PAs must establish up-front expectations for their activities. To that end, business plans shall contain sector-level metrics (not necessarily PPMs or MTIs).

[~~91~~96] D.10-10-033 at 36-37 (citing D.09-09-047 at 89).
[~~92~~97] D.09-09-047, Appendix 2.
[~~93~~98] *See* "Building a Policy Framework to Support Energy Efficiency Market Transformation in California" at 37. http://www.energydataweb.com/cpucFiles/pdaDocs/1207/MT_Policy_White_Paper_final_Dec%209%202014.doc.

PAs will still need to set more granular metrics than just sector-level metrics, but they will do so in implementation plans, not business plans. It is in the implementation plans that we want to see *at least* one metric for each program/strategy/sub-sector/intervention strategy; more than one where appropriate. The business plan is not the place for that additional level of detail.

The metrics PAs adopt can be PPMs or MTIs (defined terms, per D.09-09-047), but do not have to be. They will just be metrics –appropriate benchmarks against which to measure program/strategy/intervention performance, and should be designed to be valuable to implementers as well as other stakeholders to improve the chances of longevity of the metric and associated perspective of measuring it over time. In the business plans, we want to know what a PA intends to accomplish in a given sector in the short term and the long term. For example, we want to be able to tell that for investment of Y dollars we can expect to see X achievement(s) towards Strategic Plan objectives from Z programs/strategies/interventions in a sector. On subsequent review, we want to know where those programs/strategies/interventions fall on the continuum of success through failure. The same is true for both the general metrics in the business plans and for the more granular metrics in the implementation plans.

We are not going to require any particular number of metrics, such as Commission Staff's requested three metrics per sector. Requiring any number other than a non-zero one would be arbitrary. PAs will have to tie their metrics back to the Strategic Plan. As with so much that we do here, there is going to be an element of trial and error in determining the right type of, number of, and level of abstraction for metrics. This is an excellent place for stakeholder involvement, via the Coordinating Committee that we discuss more in section

~~3.2.3.2~~3.2.2.2 below. The past experience in developing the PPM and MTIs should not be lost. The principles and frameworks for considering and developing the metrics and discussed in workshops and meetings are still relevant today, even if the metrics themselves may need to be updated. In addition, experts in EM&V should contribute their expertise on process and impact evaluations to development of metrics.

Turning to the PPMs and MTIs now in place, we relieve PAs from their reporting requirements for both PPMs and MTIs under resolution E-4385. The joint parties' request was unopposed by any parties, including those that originally supported adoption of PPMs and MTIs. It appears that time has overtaken the utility of the specific PPMs and MTIs as currently adopted by the Commission. However, we encourage the PAs to utilize experience and possibly some actual metrics from the PPMs and MTIs, where warranted and logical.

A final word about metrics. Metrics complement EM&V but they do not displace it. As we observed as recently as 2013, "the PPM process, however, is not yet mature enough for use as an effective program evaluation tool. . . ."[~~94~~99] EM&V is still required to see whether and how effectively PAs achieve their metrics.

Showing of PA Staff Resources for Sectors

Commission Staff recommended that PAs identify who would work on sectors, and provide a PA organization chart. This seems of a piece with our other efforts to reduce administrative costs. We conclude, however, that tracking staffing levels, or even individual employee activities, is more detail than appropriate for the business plans. Commission Staff can ask for organization charts via data requests as necessary.

[~~94~~99] D.13-09-023 at 80.

Business Plan Budgets

Some commenters on the proposed decision expressed confusion about the interaction of the business plan budgets and the annual advice letter budget filings.

To clarify, the business plans are to provide *general* information on the expected levels of annual spending for the duration of the business plan (i.e., "under the business plan, we expect spending to be $X per year for up to ten years"). The decision on the business plan will provide guidance for PAs on funding levels to use in developing the more detailed annual budgets that PAs will file via advice letter. The decision on the business plan will also provide guidance to Commission Staff in reviewing those annual filings.

The decision on the business plans will not establish a particular amount for cost recovery (for IOUs) or for transfers from IOUs (for CCAs) or for contracting purposes (for RENs). It will establish a "ballpark" figure for spending for the life of the business plan. The annual advice letter filings, not the business plans, will propose detailed budgets for cost recovery, transfer, and contracting purposes.

The goal is to give flexibility to PAs to adjust spending during the life of the business plan. Giving PAs this flexibility necessarily entails some discretion for staff in reviewing the annual advice letters. Hence those advice letters are properly Tier 2 rather than Tier 1, as discussed later in this decision.

Business Plan Schedule

PAs will file *full* business plans, for all sectors, including cross-cutting, during 2016. In the second Phase II decision, we will set a filing date; it will be no later than September 1, 2016, consistent with our discussion of the implementation plans and business plan "triggers." We agree with TURN that

"The State would benefit from having this document sooner rather than later," but it is premature to set a date now when we have not fully addressed portfolio changes to make in 2016.[100]

Once PAs file their initial business plans, PAs will not file business plans again until either (1) a trigger mechanism requires a subsequent application, or (2) a PA elects to file a new business plan. Triggers are:

1. A PA is unable to adjust its portfolio in response to goal, parameter, or other updates to:
   a. meet savings goals,
   b. stay within the budget parameters of the last-approved business plan, or
   c. meet the Commission-established cost effectiveness (excluding Codes and Standards and spillover adjustments)
2. The Commission calls for a new application as a result of a decision in the policy track of the proceeding (or for any other reason);
3. The affected PA must file a business plan not less than one year prior to the end of funding. As noted above, energy efficiency funding is in place for ten years. We expect to extend funding well before those ten years run, in response to business plan filings, and on a rolling basis as business plans come in thereafter. However if we have not otherwise extended funding and a funding cliff is approaching, PAs shall file for extended funding.

Some parties expressed concern over vagueness in the triggers. These triggers are actually as close as we can get to a bright-line set of requirements.

[100] Relatedly, some commenters on the proposed decision recommended setting different filing dates for different classes of PAs (e.g., MCE requests direction for CCAs to file before IOUs, while PG&E recommends that RENs and CCAs file budgets only bi-annually). We decline to require different filing timing for particular classes of PAs. RENs and CCAs should work informally with IOUs where IOUs need information from RENs or CCAs for concurrent filings.

The obvious objective for PAs will be to frame the business plans as strategically as possible to minimize the need for re-filings.

A more detailed list of what a business plan shall contain is set forth in Appendix 4. We delegate to Commission Staff responsibility for developing additional business plan guidance~~, if necessary~~. Commission Staff should balance the need for information from PAs with the need to keep business plans compact and focused, and to reduce PA administrative costs. In comments, parties asked for additional detail on business plan contents (and on the process for determining such contents). Commission Staff is requested to prepare a white paper further detailing what business plans should contain. Commission Staff shall circulate the white paper to the service list in this proceeding, and take informal comments on the white paper. Commission Staff shall then prepare a guidance document detailing what business plans shall contain, with a template for PA use.

3.2.2.3. ~~3.2.3.1.~~ Annual Budget Advice Letter Filings

Our overarching goal with the budget filing requirement is to ensure meaningful budget review without turning the triennial fire drill under the existing review process into a series of annual fire drills. The rolling nature of the portfolio should afford an opportunity to stabilize the flow of information, improve access, and enable review and analysis by stakeholder groups to support compliance. The debate here is over the form, content, and level of review of annual PAs annual budgets. The joint parties have proposed a ~~tier~~Tier 1 advice letter filing. A ~~tier~~Tier 1 advice letter is effective pending disposition; no Commission or even Staff action is required.[~~95~~101]

Commission Staff would have each PA file a budget proposal as a *Tier 2* advice letter whenever it files its business plan, and every calendar year by the

[~~95~~101] General Order 96-B.

first business day in September thereafter, if the PA has not filed a business plan that year. In addition, Commission staff would have each PA list in its budget advice letter changes it made to implementation plans in the prior year. Along with the budget advice letter, each PA would upload to a centralized web page (Energy Efficiency Statistics[96][102])detailed cost and savings information in support of its budget filing in a standardized format across administrators.

The joint party proposal would reduce budget review to a ministerial task. This proposal, however well intentioned, provides the Commission with an inadequate level of oversight. Conversely, the Commission Staff proposal seems much closer to a full-blown application filing than needed.

With those concerns in mind, here is how we will proceed.

On the first business day in September, each PA will file a Tier 2 ~~AL~~advice letter for continued collection of energy efficiency funding from ratepayers, consistent with the last Commission-approved business plan.[97][103]

The advice letter will contain:

1. **Portfolio Cost Effectiveness statement**; only cost calculator outputs will be filed in paper; the detailed cost-effectiveness calculator data will be submitted electronically in an online tool and be referenced in the advice letter;

[96][102] Historically Commission Staff has maintained a webpage for submission of energy efficiency data from the Program Administrators. This ensures public access and tracking by all stakeholders with the exception of private information. The site has been updated on an ongoing basis to meet the needs of parties. It is funded through the EM&V budget and is external to the Commission web page. Energy Efficiency Statistics is the current web page maintained by Commission Staff: http://eestats.cpuc.ca.gov/.

[97][103] If a PA has a new business plan awaiting approval before the Commission when the budget filing is due, the PA should file a budget consistent with the last approved business plan. If the Commission approves a business plan close to September, (e.g., the Commission issues a decision approving a PA's business plan in August) , then the Commission may also need to set a new filing date for that PA's business plan as part of the decision approving the business plan.

2. **Application summary tables** with forecast budgets and savings by sector and program/intervention; filed in paper, with an electronic query output available in an online tool; and,[98][104]

The joint parties proposed to report on portfolio changes, update sector level forecasted budgets and savings, report on fund shifting and disclose annual spending in PAs' Annual Reports instead of in an advice letter. We want this information for use at the same time we receive budgets, and we want it submitted formally via the same advice letter that contains the PA's budget. That way, Commission Staff can use it when reviewing budgets and, if needed, drafting a corresponding resolution. Since the joint proposal already contemplated providing this information, this requirement should not impose much, if any, burden beyond what joint parties already contemplated.

The annual review we contemplate here *should* be relatively ministerial. However, if a PA departs in significant ways from that PA's most recent ~~business plan~~budget, the PA can expect a higher degree of scrutiny from Commission Staff, and possibly a suspension of the advice letter.[99][105] In comments on the proposed decision, some commenters asked what happens if the calendar year ends before disposition of the advice letter with the budget for the next calendar year. In that case, the prior year's budget shall remain in place until disposition of the pending advice letter. IOUs shall continue to recover costs, and make transfers to CCAs and RENs, based on the prior year's authorized budget. The idea is that a budget remains in place until superseded by Commission or Commission Staff action.

[98][104] PAs will provide the specific details on implementation changes in the online tool we describe in the implementation plan section of this decision. PAs will provide more general descriptions of implementation plan changes in their annual advice letters.

[99][105] *See* General Order 96-B, 7.5.2 (Initial Review Period; Suspension; Status Report).

Cost and savings information comprises the bulk of budget filings as they form the core justification for the proposed expenditures. The claims submissions and evaluation outputs have already been standardized to be submitted through the online tool. ~~The~~As commenters on the proposed decision noted, the application data are fundamentally prospective, while claims are retrospective. Nonetheless, the portfolio application data ~~is~~should be structurally similar to the claims data, ~~and can be incorporated into the online tool in time for the 2016~~as both will draw from the same underlying sets of measure savings data (e.g., DEER). This will be something for Commission Staff to address when setting up the business plan ~~filings~~template. .

SDG&E and SoCal Gas, in comments on the proposed decision, ask that PAs only provide cost-effectiveness and savings forecast data with business plans, and not with budgets. We *do* want cost-effectiveness and forecast data filed with budgets. These data are essential for evaluating whether the budgets will achieve the business plan metrics. These data assist Commission Staff to determine whether a "trigger" for a new business plan is warranted.

Commission staff shall provide the filing tool in time for an annual budget submission in 2016. Failing that, we will have to defer budget filings to 2017 (which may happen in any event, depending on how long it takes the Commission to review and approve business plans).

We delegate to Commission Staff responsibility for developing additional annual filing guidance and the tools to track compliance, simplify submission, and ensure transparency. Commission Staff should balance the need for information from PAs with the need to keep business plans compact and focused, as well as the principles noted at the beginning of the section. Commission Staff shall use the following guidance in defining the specifics of the submission:

1) Consistency and stability of the information over time;
2) Access to common information by all stakeholders;
3) Level of detail that allows aggregation (rather than multiple submissions customized for a particular piece of information) ;
4) Incremental changes are clear, transparent, and tracked; and,
5) Notification to stakeholders when changes to the online tool are made.

Several commenters on the proposed decision expressed concern about seeming redundancy between the business plan budgets and the annual budget filings. The discussion in the business plan section of this decision should allay that concern. To reiterate:

- The business plan contains high-level budget estimates, and will result in a decision providing Commission guidance for PAs in preparing and Commission Staff in reviewing annual budget filings.
- The annual budget filing is more detailed, and will result in spending authorization (for all types of PAs) and revenue requirement for rate recovery purposes (for the IOU subset of PAs).

Some commenters also expressed concern about the level of work required for the annual budget filing creating the annual end-of-year time crunch that we seek here to avoid. To clarify, the annual budget filings and their associated review should be relatively ministerial. The question for Commission Staff in reviewing a budget advice letter should be "does this conform to the approved business plan?" The annual budget filings are *not* designed to create a forum for debating the merits of particular programs; that is for the business plan proceeding. Neither are the annual budget filings supposed to create a forum for debating the merits of how PAs implement particular programs; we address the

process for implementation plans below. We acknowledge that the first filing and review under a business plan will likely take more time and effort to prepare and review than subsequent filings/reviews, which we expect will in large part be able to re-use a prior year's budget. We are looking to information technology solutions to keep that filing tractable.

3.2.2.1. ~~3.2.3.1.~~ Implementation Plans

As just discussed, PAs will submit implementation plans and all associated cost and savings data to a Commission-maintained online system. The output of the online system will provide that each program can be displayed as its own webpage, complete with ex ante data, and links to files and other non-data documents such as logic models, program manuals and other relevant narrative. The system will control versioning, making it clear when PAs change implementation plans. As tracking data comes in, it will be shown in summary format on the program's page to enable comparison with the application.

Each PA will maintain current implementation plans on the publicly available web page as described in the preceding section. PAs can change the implementation plans as needed without further review, and the version on the publicly available web page will always be current. PAs will catalog any changes, or it will be automated, and file a list of the changes annually as noted above. The current system of maintaining PDF copies of implementation plans with tracked changes is not sustainable in a rolling portfolio environment.

We will not require replacement of all existing program implementation plans (PIPs)[~~100~~106] with new implementation plans. That is, we see no value in

[~~100~~106] PIPs are what we historically required PAs to file with their applications to describe individual programs. Joint parties have asked that we drop the word "program," since much of what they propose to undertake will not be "programs" as commonly understood , but instead will be "intervention strategies," We will adopt "implementation plan" here to distinguish what we are going to require of PAs going forward from what we have required previously to describe the specifics of PA activities.

requiring PAs to immediately reformat all of their current PIPs into the implementation plan format. We will "grandfather" existing PIPs. EEStats will allow for upload of both current PIPs and future implementation plans. The difference will be in the upload format. PIPs will only be uploadable as documents. Implementation plans will be submitted in electronic form in an online tool. The implementation plans will have greater functionality than PIPs, so we encourage PAs to migrate from PIPs to implementation plans over time for evergreen programs, even though we do not require the migration on any particular timeline.

There will be a stakeholder process associated with implementation plan preparation, as discussed in detail in section ~~3.2.3.2.~~3.2.2.2. This should be the first forum for addressing any aspect of the implementation plans. Such issues could range from the detail needed to track changes as discussed in section ~~3.2.3.1~~3.2.2.3 above, through appropriate metrics and information collected, to much more macro issues such as the adequacy of a proposed implementation strategy, coordination and standardization of program design across PAs.

Implementation plans will contain metrics, as already discussed. PAs are free to start with a clean slate in developing metrics and associated reporting requirements, but for *all* programs will continue to provide monthly cost reports, and for *resource* programs will provide monthly savings data as well.

The submission tool will allow for tracking incremental changes to the PA proposals, and notifying parties when a change has happened. The details of addressing this functionality are delegated to Commission staff.

As part of the implementation plans, PAs are to provide (and keep current) PA-designed manuals and rules that provide guidance to customers and implementers with respect to program delivery, including measure and

participant eligibility requirements. The manuals and rules must follow Commission policy and guidance as provided in past decisions and rulings, as well as guidance provided by CPUC Staff as a result of *ex ante* and ex post activities.

If (alleged) non-compliance with Commission/Commission Staff direction is identified in the implementation plans, manuals, and/or rules, the dispute resolution process we previously approved for ex post evaluation disputes in D.13-09-023[101][107] may be invoked. A party may file a "Motion for Implementation Plan Dispute Resolution" in this docket (R.13-11-005) or in the relevant PA's most recent business plan application docket. This formal procedure should only be invoked after informal attempts to resolve disputes have been exhausted.

3.2.2.2. 3.2.3.2. Stakeholder Processes for Business Plans and Ongoing Programmatic Evolution

We have promoted many energy efficiency stakeholder processes over the years. Currently, we are aware of the following stakeholder processes:

Stakeholder Group Title	Outcomes/ objectives
Demand Analysis Working Group (DAWG)	Pertinent to Commission energy efficiency activities, the DAWG vets energy savings goals before formal issuance/adoption
EM&V Stakeholder Quarterly Meetings and Project Coordination Groups (~17 Total)	Prioritizing research, commenting on methods, reviewing results, follow-up on 60 day reports, satisfying webinar requirements. (See Version 5 of Joint EM&V Plan for List of Coordination Groups and structure[102][108])
Western HVAC Performance Alliance (WHPA)	Inform the development and implementation of efficiency policy and programs focused on topics such as HVAC workforce education and training, HVAC system specifications, code compliance,

[101][107] D.13-09-013 at attachment 4.

[102][108] Joint EM&V Plan V5: http://www.cpuc.ca.gov/NR/rdonlyres/2B9A7A84-E787-4023-89C3-F376B0CF018B/0/EMVEvaluationPlan20132015.pdf.

	proper installation, system commissioning, operation, service, and maintenance, and emerging HVAC technologies.
Emerging Technology Coordinating Council	Share research, coordinate research, vehicle for submitting new research ideas
IDEA365 Peer Review Group (PRG)	Review proposals for new programs
CalTF (and CalTF advisory group)	Peer review of energy savings impact workpapers
ME&O stakeholder group	Discuss communication plans, collaborate
Home Upgrade Program working group	Program compliance and implementation, best practice sharing
Compliance Improvement Advisory Group	Inform the IOU C&S Compliance Improvement subprogram activities and produce white papers shared publically via their website
SoCal Gas Program Advisory Group	Stakeholder and local government partner updates of IOU or CPUC energy efficiency developments
Local Government Advisory Groups/ Project Coordination Groups (PCGs)	Various, including two advisory groups for EM&V activities.

Not listed above are the energy efficiency Peer Review and Program Advisory Groups (PRGs and PAGs) that Decision D.05-01-055 established. The PAGs and PRGs were (apart from SoCal Gas's) short-lived endeavors. In D.07-10-032, we eliminated energy efficiency PAGs in favor of other processes for considering strategic deployment of energy efficiency programs and measures. In D.09-09-047, we eliminated mandatory PRGs. PAGs have continued since then on a voluntary basis for SoCal Gas, but are otherwise a thing of the past.

Also not listed is the evaluation PCG we established in D.12-05-015 to "review, deliberate, and provide feedback on IOU proposals for changing the Market Transformation Indicators adopted in the upcoming Ruling."[~~103~~109] This PCG appears to be inactive.

[~~103~~109] D.12-05-015 at 357.

Faced with this plethora of participation opportunities, the Joint Parties complain simultaneously of too many stakeholder processes, and not enough opportunities for meaningful stakeholder input.[~~104~~110] In many respects, these complaints echo those that led us away from PAGs and PRGs.[~~105~~111] The Joint Parties' proposed solution for what they characterize as dysfunctional stakeholder processes is the "Coordinating Committee."

The joint parties propose stakeholder processes to obviate the need for most Commission-directed processes in managing ratepayer-funded energy efficiency programs:

> Furthermore, the [joint parties] fully support the Commission initiating Rulemaking proceedings when necessary, but emphasize that it is in the best interest of Staff and parties to first rely on collaborative efforts to address matters that do not necessarily require such formal endeavors. For example, while the Commission may need to provide high level Portfolio Guidance from time to time, the [joint parties] recommend that such guidance not come in extensive decisions issued as part of the Policy Track. Any relevant specifics should instead be left to informal collaborative forums to avoid challenges experienced in the past where formal decisions provided specific directions regarding how to design programs for forthcoming Applications.[~~106~~112]

The Joint Parties assert that the Coordinating Committee will:

[~~104~~110] *See, e.g.*, TURN ~~workshop~~Workshop 1 comments at 3 ("[W]e do not have a meaningful opportunity to engage with the IOU PAs and discuss the real portfolio challenges and opportunities, and most importantly, to have this dialogue in a substantive way and in time to potentially influence what the IOU PAs bring to the Commission.").

[~~105~~111] D.07-10-032 at 105 ("We take seriously the concerns of many parties regarding the PRGs and PAGs, especially the comments that these are more often forums for the utilities to pre sent decisions already made rather than to seek input in a collaborative manner. We also share the utilities' concerns that advisory groups are not effective ways to provide useful information on the details of utility program management or administration.").

[~~106~~112] NRDC comments on Commission staff's rolling portfolio white paper at 30 (emphasis added).

1. ~~provide~~Provide an ongoing forum for stakeholders to bring ideas for consideration (e.g., new ideas) that could be referred to the appropriate topic specific subgroup;[~~107~~113]
2. ~~leverage~~Leverage what is working;[~~108~~114]
3. ~~identify~~Identify and aim for resolution and/or propose recommendations for CPUC consideration on timely and critical issues;[~~109~~115]
4. ~~seek~~Seek to find efficiencies in the process (e.g., review opportunities for combining meetings, prioritize key issues for stakeholders to discuss, etc.);
5. ~~coordinate~~Coordinate activities important to implementing a "rolling portfolio.[~~110~~116]

There is a striking similarity between the Coordinating Committee proposal and the (unrealized) vision we had for the PAGs and PRGs (as well as for a broader scope for PAGs and PRGs that we rejected in D.05-01-055). The obvious question, already addressed to some extent in the introduction at 3.2.1 above, is why will a new stakeholder process be any more successful than its

[~~107~~113] *Compare* D.05-01-055 at 98 ("[Advisory groups] create the forum for an open and informative exchange of information among Program Administrators, industry experts and stakeholders").

[~~108~~114] *Compare* D.05-01-055 at 100 ("we expect the IOUs and PAGs to ensure that statewide residential and nonresidential program offerings take advantage of 'best available practices'").

[~~109~~115] *Compare* D.05-01-055 at 101 ("PAGs will provide a joint report to the Energy Division with recommendations on how the IOUs can improve their effectiveness as administrators in managing the portfolio of programs, including how the program selection process could be improved to better meet the Commission's procurement goals. If consensus on these issues cannot be reached, the report should present consensus and nonconsensus positions.").

[~~110~~116] Joint Parties' Proposal: Portfolio Review Process, presented at ~~workshop~~Workshop 1, session 1, ☼
slide 10.

predecessors?[111][117]

TURN provides an interesting answer: "Against the backdrop of the untenable status quo, TURN submits that [the coordinating committee] is a gamble worth taking. And if we end up back in the same place in a decade, it won't be for a lack of trying something different."[112][118] If the result is, as TURN hopes, "a meaningful opportunity to engage with the IOU PAs and discuss the real portfolio challenges and opportunities, and most importantly, to have this dialogue in a substantive way and in time to potentially influence what the IOU PAs bring to the Commission,"[113][119] then we will have achieved what we set out to do in creating PAGs and PRGs in D.05-01-055. On its face, there seems to be little portfolio quality risk associated with putting this to the test, although the intervenor compensation levels will need to be managed to avoid significant ratepayer costs for an as-yet undetermined benefit.

The Joint Parties propose the following refinements on previous stakeholder efforts:

- A clear charter or mission,
- Defined and measurable outcomes (e.g., deliverables or decision points),
- Process to keep track of discussions,
- An independent facilitator and administrative support,
- Committed and representative membership,

[111][117] In asking for comments on the joint proposal, the Assigned Commissioner and ALJ asked: "How can we be confident that the various stakeholder groups will not end up as dissatisfied with the joint proposal process as they appear to be with the current stakeholder processes ⌘
(e.g., the Program Advisory Groups)? Relatedly, how can we be confident that stakeholders will participate in those processes?" Administrative Law Judge's Ruling Regarding Comments on Phase II Workshop 1, March 18, 2015 at 4.

[112][118] TURN comments on ~~workshop~~Workshop 1 at 3.

[113][119] TURN comments on ~~workshop~~Workshop 1 at 2.

- Presentation of ideas at an appropriate time to allow for input early in development,
- Resources to "follow through" with action items and decisions, and
- A feedback loop for PAs to update stakeholders on actions taken after a discussion.

These recommendations largely overlap those of a 2007 report we commissioned on PAGs and PRGs, as referenced in D.07-10-032 (the TecMarket report).[~~114~~120] Our response to the report in 2007 was to disband the PAGs. Today, given that our alternative approach did not work as well as hoped, we can use the TecMarket report to help the next generation of stakeholder groups work better than their predecessors.

In recognition of the foregoing, we will adopt the following recommendations for the coordinating committee, blending the recommendations of the TecMarket Report, the joint proposal, and our experience with various past and present stakeholder activities.

1. Intervenor Compensation: PAG and PRG participation was eligible for intervenor compensation prior to termination.[~~115~~121]

   We will extend intervenor compensation eligibility to stakeholder participation in stakeholder processes around developing and revising business plans. The guidelines we established in D.07-11-024 will apply to claims for stakeholder participation in stakeholder processes around developing and revising business plans. We remind

[~~114~~120] D.07-10-032 at 105, n. 103. The report, conducted pursuant to a contract with the Commission, is titled "Program Advisory Group and Peer Review Group Process Evaluation" and was published February 14, 2007 by TecMarket Works (TecMarket Report).

[~~115~~121] D.07-11-024 at 3. For examples of our granting intervenor compensation for participation in energy efficiency PAGs and PRGs, *see* D.06-01-034 (awarding compensation to UCAN), D. 07-04-008 (awarding compensation to NRDC), and D.08-04-022 (awarding compensation to TURN).

parties that any claims for intervenor compensation will, of course, be subject to the usual requirements applicable to intervenor compensation claims. Claims must include enough information for the Commission to make the findings required by §§ 1801-1812. In particular, an intervenor seeking compensation for work on the joint proposal must clearly describe its unique contribution(s) to developing a proposal that helps to achieve the overarching process goals articulated in R.13-11-005. A claimant must also demonstrate reasonable collaboration with others to avoid duplication of effort. Claimed amounts must be reasonable. As with other extra-proceeding intervenor compensation claims, we will have to work through the inherent difficulty of knowing whether/to what extent an individual claimant influenced a group outcome where we did not participate in the group's deliberations. We will address such issues on a case-by-case basis. This entails some uncertainty for stakeholders, but that is presumably preferable to the certainty of no recovery.

2. One statewide coordinating committee, with a single individual as chairperson, or not more than two co-chairs. There is no need for PA-specific PAGs, as the PAs all deal with a similar set of issues. The focus then can be on how the PAs incorporate the ideas and concepts developed by the coordinating committee into their specific portfolios. Longer meetings may be a consequence of this approach, but meetings should be fewer in number. A single coordinating committee should facilitate greater statewide coordination and harmonization of statewide programs across PAs. As we said in D.05-01-055, "we expect the [PAs] to ensure that statewide residential and nonresidential program offerings take advantage of best practices and avoid customer confusion by being as uniform and consistent as possible. It should also reduce participant travel costs. Subcommittees should be along sector lines, not separated by PA. The coordinating committee should select ~~a single person as chair~~the chairperson(s) for the coordinating committee, and also

should select ~~individual chairs~~the chairperson(s) for each subcommittee.

3. Charter of Mission for the Coordinating Committee and its members. A complaint about many prior stakeholder activities (PAGs and PRGs in particular) is that many PAG members did not understand the roles of the CPUC, PAs, or themselves, and noted that various participants played different roles depending on the individuals attending. Some thought that the CPUC was to be in charge, others said the IOU was in charge, others said that the membership should be in charge. To avoid confusion and conflicting opinions, these roles should be made clear to all members. The practical reality is that stakeholders other than PAs (and more particularly the IOU subset of PAs) will be unable to cover more than a discrete and focused subset of issues under the auspices of the proposed stakeholder group. What we said in response to a similar proposal to have stakeholders shoulder more of the policymaking burden in D.05-01-055 remains instructive today: "We believe that the resolution of significant policy and program management issues can be better achieved through other procedural venues, including workshops." There will continue to be an ongoing need for Commission involvement in energy efficiency at multiple levels; we neither can nor should defer matters to stakeholders to the degree joint parties propose. With those considerations in mind, here are the roles we envision for the coordinating committee and its members.

   a. Scope of Work:

      i. ~~Participate in~~Provide input into development of business plans *prior to and throughout the drafting process* (see notes below re scope of input and timing);

      ii. ~~Participate in~~Provide input into development of implementation plans, again, *prior to and throughout the drafting process*;

iii. ~~Participate in~~Provide input into development of annual budget advice letters, again, *prior to and throughout the drafting process*; and,

iv. ~~Develop~~Provide input into development and ~~revise~~revision of metrics for inclusion in business plans and implementation plans as part of i and ii.

v. Provide a clearinghouse for discussion of the scope and schedule of other stakeholder processes.

b. The coordinating committee may take on other issues, but we will not authorize intervenor compensation for parties participating in *coordinating* committee work outside the above scope (e.g., we will not provide intervenor compensation for coordinating committee work on EM&V).

c. We authorize Commission Staff to participate in the coordinating committee. Commission Staff shall develop a proposed scope of participation. They are to work with Legal Division to ensure our compliance with relevant open meeting and *ex parte* laws, rules, and regulations. We will put a proposal out for comment. In the meantime, Commission Staff should limit input into the coordinating committee to high-level guidance. We note that staff perspectives may not reflect the final position of the Commission, and cannot bind the Commission.

d. For the coordinating committee to work, PAs must be collaborative. PAs should work with the coordinating committee "consistent with today's decision in the spirit of the collaborative approach they discuss in their filings."[~~116~~122] PAs shall give stakeholders early and meaningful opportunities for input, as discussed more below.

e. Non-PA stakeholders should focus on program/strategy/intervention design consistent with the Strategic Plan, statewide coordination, market characteristics, and particularly on cost effectiveness as

[~~116~~122] D.05-01-055 at 98.

defined by our adopted cost-effectiveness methodologies. The TecMarket Report noted allegations by some PRG members that "not all PRG members fully understand the concept of cost-effectiveness even though the PRG is specifically charged with improving the cost-effectiveness of the portfolio in the ALJ's order establishing the PRGs. Members also noted that improving the cost-effectiveness of the portfolio requires expert skills that may not be embedded in the membership of the PRG."[~~117~~123] We do not want to see those shortcomings repeated here. Stakeholders should staff the coordinating committee accordingly and/or arrange for appropriate preparation of those who will participate in stakeholder processes.

6. Group-developed agenda: Stakeholders will collectively set the coordinating committee agenda. A PA to be selected by the stakeholders will file an annual Tier 1 advice letter in January setting out the coordinating committee meeting plans and agendas for the year. A PA to be selected by the stakeholders will post to the online tool any modifications to the meeting plans during the year.

7. Run by a facilitator, and with an operational budget: Stakeholders are to arrange for professional meeting facilitators. PAs will fund the coordinating committee budget pro-rata based on their share of the overall authorized annual energy efficiency spending. The budget will be filed with us for review as part of the Tier 1 advice letter containing the meeting plans. Budget should be the minimum needed to hire a facilitator and conduct meetings to cover the scope of work outlined above. This is not a blank check. Also, we will review how well the facilitator is functioning. The Commission delegates to Commission Staff to decide whether to continue with a particular facilitator. If it is brought to our attention that the facilitator *concept* (as opposed to a particular facilitator) is

[~~117~~123] TecMarket Report, at 29.

not working, we will revisit whether to continue with a facilitator at all.

8. Coordinating committee meeting process

   a. The coordinating committee chairperson is responsible for convening coordinating committee meetings.

   b. More meaningful/earlier input. A consistent theme from stakeholders is that non-IOU stakeholders want more influence over portfolios and the programs within the portfolios, rather than only reacting to the programs placed in front of them to review. PAs are to involve stakeholders early and often in business plan and implementation plan development.

   c. Equal input opportunities: stakeholders should have equal input opportunities within the discussion process and individual IOU and non-IOU members should not be allowed to dominate the discussions.

   d. Sufficient review time of materials: Another common complaint about stakeholder processes is that they are too rushed, that stakeholders did not have enough time to review the materials provided to them, and that there are many instances in which materials were provided too late to be reviewed prior to the meetings, or not at all. The coordination committee will need to develop rules for timely submittal of materials for review, and hold all participants accountable to these rules, to see that these problems do not re-emerge.

   e. Records of meeting outcomes: there is to be a decision-advice documentation trail, so that the advice of the coordinating committee, as a group, moves into program design changes or results in a documentation of why specific advice is not used. ~~Stakeholders are to select a scribe from within their ranks~~The facilitator shall also ensure an objective and clear decision-advice documentation trail.

   f. More reliable conference room equipment: many stakeholder events are hampered by poor conference calling equipment not designed to capture all attendee

> conversations. Reliable, multi-distributed microphones that allow all attendees to be heard need to be provided for coordinating committee events.

Many commenters on the proposed decision requested additional guidance on the Coordinating Committee's role, its membership, and its governance. While we want to avoid micromanaging the Coordinating Committee, we agree that some additional guidance is in order.

First, PAs, not the Coordinating Committee, are responsible for the content of what PAs file with the Commission (i.e., applications and advice letters).[124] PAs also bear responsibility for what PAs post to Commission-maintained web sites pursuant to this decision (e.g., implementation plans). This means that PAs, not the Coordinating Committee, will have the final say in what PAs file with the Commission.

The Coordinating Committee's role is to advise the PAs. The Coordinating Committee therefore needs both stakeholder and PA participants, but *PAs must not dominate Coordinating Committee proceedings*. PAs must provide the Coordinating Committee with information in a form and on a timeline that allows for meaningful stakeholder input. Beyond that, PAs must be willing to take Coordinating Committee advice. If the Coordinating Committee becomes a "forum[] for the utilities to present decisions already made rather than to seek input in a collaborative manner,"[125] rather than a source of useful input, then we will be back to the drawing board.

What this translates to in terms of Coordinating Committee and subcommittee membership is that anyone should be able to participate. We understand the Joint Parties' desire to require a certain level of commitment and subject-matter competence. However, the more of a time commitment and the

[124] *See* Rules of Practice and Procedure, Rule 1.
[125] D.07-10-032 at 105.

more selective the experience and training required to participate, the more the participant pool could be winnowed down to utility employees. In other words, imposing formal requirements for membership increases the likelihood of IOU domination of the Coordinating Committee. Hence our unwillingness to impose such requirements. In practice, we would expect that participants will self-select their level of participation appropriately.

We will require that subcommittees be on a sector basis, notwithstanding some commenter's objections. Sector organization should promote uniformity across PAs by having all PAs discuss all statewide programs for a sector in a single statewide forum.[126] Sector-specific subcommittees should also simplify translation of subcommittee work to business plans, which will also be organized by sector. This direction does not preclude formation of other ad-hoc subcommittees, if needed. Again, though, ad-hoc committees should be the exception, not the rule.

We expect that the Coordinating Committee will obviate the need for some current stakeholder processes. From a practical perspective, some current processes will have to give way, as stakeholders and Commission Staff have time for only so many processes. If the Coordinating Committee simply becomes another addition to the long list of ongoing stakeholder activities in energy efficiency, it seems unlikely to succeed.

That said, we do not prescribe here which current processes should change (or cease altogether). As joint parties noted in comments on the proposed decision, this is something that the Coordinating Committee itself should take up with PAs in initial meetings. We have modified the scope of the Coordinating Committee's role above accordingly.

[126] As contrasted with, say, PA-specific subcommittees, with a correspondingly fragmented discussion of each PA's sector-specific approaches.

Whether a more stakeholder oriented approach to energy efficiency programs will work ultimately comes down to trust. No matter how many rules we promulgate, no matter how prescriptive ~~we and~~ Commission Staff and we are, ultimately this edifice will stand only if all concerned act in good faith towards a common goal of reduced energy use for a given level of activity. In closing our remarks on the stakeholder process, we repeat here the admonition we gave in D.05-01-055: "we provide general guidance and expectations for the [stakeholder] group structure, but purposefully do not specify every implementation detail.

3.2.2.3. ~~3.2.3.3.~~ Technical Updates to DEER

DEER updates (available via on line datasets and documentation on DEEResource.com) flow into the portfolio development process by providing new savings estimates from which to design programs. New savings estimates, including baseline assumptions, inform where a current program may need to shift to continue to capture savings cost effectively. DEER updates may also reflect new market conditions (reflected in baseline and predicted attribution rates). PAs need to factor in all of these new values and assumptions by a) knowing there is an update, b) understanding the fundamental assumptions for the update, and c) identifying necessary shifts to their programs to still capture cost effective savings. Updates to DEER methods similarly may re-define the adopted approach to estimating savings, and hence would need to be applied in the work paper development and program deployment decisions.

In D.09-09-047, the decision approving 2010 to 2012 EE Portfolios and Budgets, we addressed the issue of "freezing" *ex ante* values, including DEER values and workpaper values, in order to provide stability to the values that the

PAs use for planning, program implementation, and goals achievement.[118][127] D.09-09-047 directed Commission staff to update DEER and non-DEER *ex ante* values using best available information and to freeze "both DEER and non-DEER *ex ante* measure values as the 2010-2012 portfolio implementation begins."[119][128] This decision allowed for staff, in consultation with the utilities, to develop a process by which new measures values can be added to the frozen measure datasets and mutually agreed errors in the frozen values can be corrected. D.11-07-030 also allowed for mid-cycle updates to ex ante values for custom projects if errors were found. "Any overstated ex ante values or unrealistic savings estimates must be corrected as soon as possible and cannot wait for the next cycle."[120][129]

D.12-05-015 allowed additional mid-cycle changes if there are new state and federal codes and standards that affect DEER values. Specifically, the decision stated in Conclusion of Law 84: "We generally agree with parties' request that ex ante values should be adopted and held constant throughout the portfolio cycle. However, mid-cycle updates of *ex ante* values are warranted if newly adopted codes or standards take effect during the cycle."[121][130] Conclusion of Law 80 states: "Our Staff should have significant latitude in performing DEER and other policy oversight functions and, absent specific directives to the contrary, should not be required to consult with or otherwise utilize any other groups to perform this work."[122][131]

From this history, there are two major takeaways for incorporation into the new review process. First, DEER values should generally remain frozen for a

[118][127] *See* D.09-09-047 at 42-44.
[119][128] *See* D.09-09-047 at 44.
[120][129] *See* D.11-07-030 at 39.
[121][130] *See* D.12-05-015 at 396.
[122][131] *See* D.12-05-015 at 396.

locked in period. With the "bust stop" approach we adopt here, DEER values will generally change only once per year, and there will be a delay between when changes are announced and when changes are effective so that market participants have time to incorporate changes into their activities. Second, there must and will be limited exceptions to the general rule of no mid-year changes.

Commission Staff shall propose changes to DEER once annually via resolution, with the associated comment/protest period provided by General Order 96-B. However, Commission staff may make changes at any time without a resolution~~:~~ to fix errors or to change documentation.

~~1. to fix errors or change documentation~~

~~2. to add additional tiers to measures already in DEER.~~Several commenters on the proposed decision have requested that we provide more boundaries around these exceptions to the general rule of changes only at the "bus stop." Our objective with these exceptions is to continue the policy from prior decisions allowing for correction of errors (i.e., "correction of typographical and clerical errors, and other obvious, inadvertent errors and omissions"[132]). Those policies have been in place for years and do not require additional gloss here. In response to comments, we strike the exception for additional tiers under existing measures. Those can be picked up at the next bus stop, and addressed via workpapers in the interim.

3.2.3. ~~3.2.4.~~ Rolling Portfolio Cycle Schedule

Central to the rolling portfolio cycle framework is the schedule. The joint parties prepared a proposed proceeding schedule that was defined by firm "bus stops," or deadlines for the critical steps in the portfolio updates. The value in the bus stop concept is that it sets a reliable, regular schedule for future updates,

[132] Resolution A-4661 (re: orders correcting errors in commission decisions).

so that any new information that "misses a bus" can get on board when the bus rolls around to the stop again the following year.

In the joint parties' proposal, the last business day of November each year would be the cut-off date for EM&V studies to be included in the following year's *ex ante* update. Draft *ex ante* values would be released for comment by January 31, two months later. Stakeholders would review and comment by March 31, and savings values and parameter would be finalized by May 31 for inclusion in the portfolio the following year.

The concept of bus stops is a useful one, and we will adopt it as already discussed. However, the joint parties' specific deadlines do not provide enough time to complete each process, and do not align with the ESPI schedule, which is tied into the EM&V and ex ante updates.

In the rolling portfolio cycle schedule, a new set of studies is initiated each year for parameters identified to have the greatest uncertainty. The *ex ante* uncertain measure list will be updated at the end of every year during the EM&V planning period. EM&V studies for specific measures or parameters will typically have a two-year implementation horizon since most EM&V studies need a full calendar year past the original study year in order to collect pre and post-installation data. Results will be released on a regular basis each year reflecting best available information at that time. This is a major departure from the three year cycles, in which we studied all high-priority areas of the portfolio for the entire three year period.

The annual EM&V plan is expected to be completed at the end of each calendar year. The studies to be implemented in the following year will inform, and be informed by the EM&V plan. March 1st will be a consistent target to ensure information will be available for program planning, *ex ante* savings

updates, and potential and goals, but interim results and actionable findings may be available throughout the year. This date aligns with the schedule for delivering ESPI draft ex post savings results, which will also be informed by all available EM&V studies.

With this shift in the EM&V bus stop, the DEER update bus stop needs to shift to the fall. The *ex ante* update period would run through Q2 and Q3, with draft results released on June 1, and the final DEER released on September 1.

Commission Staff's proposed Gantt chart provided the PAs and CalTF with an open-ended period for work paper development and review. However, if the *ex ante* review team is to be able to meet the schedule set for them to develop DEER updates, there will need to be a reasonable schedule for when workpapers are submitted for review. If the workpapers are all submitted in March or later, the *ex ante* review team will not be available to timely complete the DEER update. ~~Thus, workpaper updates to conform to DEER should be submitted by January 1. New measures may be submitted at~~The concern here is one of Commission Staff resources. If a large tranche of workpapers arrive concurrent with the DEER update process, Commission Staff will be unable to handle all of this simultaneously. In the proposed decision, we imposed a January 1 deadline for workpapers that just reflected recent DEER updates, in order to allow Commission Staff to work through those workpapers and then be free to focus on the next set of updates to DEER itself. As some commenters observed, this deadline for workpaper submission was in tension with provisions elsewhere in the decision for filing updated workpapers on the first and third Monday of each month (and new measures any time).

We clarify that the distinction we are drawing is between workpaper updates to reflect changes in DEER, and workpaper updates for other reasons

and/or for new measures. Historically Commission Staff received a large volume of workpaper updates all at once that PAs were only changing because of DEER changes. The goal with the January 1 deadline is to ensure a window between the arrival of that mass of updated workpapers and the start of the DEER update process. Commission Staff will then have adequate time for workpaper review. The schedule we adopt here provides for DEER updates to be completed by Commission Staff by September 1. A January 1 deadline allows PAs four months (September through December) to make corresponding changes to their workpapers. In comments on the proposed decision, SDG&E and SoCal proposes that after DEER updates are completed, PAs should update workpapers over a two-month span, and then submit them for review over the next two months.[133] We encourage PAs to use this timing, but do not require it.

Accordingly we will maintain the January 1 deadline for *updates to workpapers to reflect changes in DEER values*. Workpapers for new measures, and workpapers that do more than just update values to conform with revised DEER values, may come in at any time or on the first and third Monday, respectively.

The Gantt chart in Appendix 6 provides for an annual workpaper plan in October. Some commenters requested that we impose requirements on the workpaper plan.[134] We are requiring a workpaper plan. We will leave development of the particulars of the workpaper plan to Commission Staff, with stakeholder input, as we do with EM&V workplans.

Relatedly, goals will be updated every other year, in sync with the CEC's IEPR demand forecast. Since the IOUs need the potential and goals Report to

[133] Sempra's proposal contemplated DEER updates being due from Commission Staff in March, and have the two months run June-July. To be clear, we are encouraging compliance with the two-month timeframe, but are expressly not adopting the June-July proposal.

[134] E.g., Joint Parties (requesting that we reiterate the need to include a workpaper /workplan each year based on areas of uncertainty or programmatic focus).

prepare their annual compliance filing, a draft potential and goals study should be released the first business day every other May, with a comment period following. The final potential and goals study, with associated goals, should then issue as part of a proposed decision adopting goals in time for an August meeting.

Each PA's annual budget advice letter is to be filed on the first business day in September.

3.2.3.1. ~~3.2.4.1.~~ Evaluation Measurement & Verification (EM&V)

EM&V updates from impact, process and market studies flow into the portfolio development process by providing actionable information. This includes updates to savings estimates, information about the effectiveness of deployment of programs, and information about market conditions. Commission Staff have facilitated a collaborative EM&V processes since the adoption of D.10-04-029. Commission Staff and PA staff discuss key findings and the PAs report back to Commission Staff on the changes made to the programs based on feedback from EM&V. This can come in formal 60 day reports of how PAs will address key recommendations (as done after 2006-2008), and as presented in amendments to the program implementation plans (as was done in 2013-2014) portfolio applications. Most of the information, however, is exchanged in the on-going communications between staff and PAs.

Commission Staff will remain responsible for EM&V. Commission Staff and PAs will issue EM&V reports also using a "bus stop" approach. It is important to note that the research available for the "bus stop" in any given year is not expected to reflect the last year of program activity. Results will be based on information gathered and built over a longer period of time. This is consistent

with the expectations for updating "uncertain measures" in the Energy Savings Performance Incentive structure, and the general process currently required for field EM&V.

The public process for EM&V now in place will continue but will be updated to reflect new PAs. We delegate to Commission Staff authority to make changes to that process so that it does not ossify. We note that Commission Staff are undertaking various reforms to EM&V activities. A broader reexamination of EM&V is in order, but will have to await Phase III of this proceeding, and would be best aligned with updates to goals, program design and implementation.

Under the rolling portfolio cycle model the information available from current evaluations will be available to infuse at key points in the process. Impact evaluation results will inform DEER and *ex ante* updates, process and market studies will be available to inform program applications and updates to implementation plans. However, actionable information to improve programs can be leveraged at any time. For example, if an evaluation reveals a particularly ineffective implementation mode (e.g., one resulting in high free-ridership) there is nothing to preclude the implementer making an adaptive change (e.g., improving customer outreach) and updating savings claims. Likewise, if a market opportunity is revealed mid-stream of implementation, it is not the Commission's intent to stifle action. In fact that is exactly what EM&V results and the rolling portfolio process should enable.

Historically, we have grossed IOU budgets up by 4% and used the resultant funds for EM&V. "In D.05-01-055, the Commission split evaluation activities along two tracks: (1) impact evaluation that assesses program performance (conducted by the Commission); and (2) process and market characterization studies' that support program improvement (conducted by the

IOUs)."[135] We have historically divided EM&V funds between Commission Staff for impact evaluations and IOUs for process and market characterization studies at a 3:1 ratio.

We authorized CCAs to conduct their own process evaluations in D.14-01-033.[136] In comments on the proposed decision, MCE observed that it has not been allocated any EM&V funds for its own use. MCE may request EM&V funds in its business plan and associated budget proposals, consonant with D.14-01-033. We note that all PAs using EM&V funds must comply with the public review, vetting, and stakeholder processes adopted in D.10-04-029, and cooperate with Commission Staff.

3.2.3.2. ~~3.2.4.2.~~ ESPI

D.13-09-023 established the ESPI to award energy efficiency shareholder incentives. The decision established a detailed timeline for Commission staff activity that needs to be modified to flow with the rolling portfolio cycle. Specifically, Attachment 6 of D.13-09-023 established the annual process for submission, review, and resolution of management fees and incentive awards claims and Attachment 5 established a process for the *Ex-Ante* Review performance incentive award. These two processes preceded the concept of a rolling portfolio cycle, so we modify those two annual ESPI processes with the schedule in Appendix ~~6.~~5. This schedule in Appendix ~~6~~5 of this decision will replace the timelines in Attachment 5 and 6 of D.13-09-023.

3.2.3.3. ~~3.2.4.3.~~ Accounting and Fund Shifting Requirements

3.2.3.3.1. ~~3.2.4.3.1.~~ Accounting Issues

[135] D.14-01-033 at 6.

[136] "CCAs may also undertake their own process evaluations and market studies in conjunction with Commission oversight in the same manner as authorized for IOU energy efficiency projects pursuant to D.12-11-015 and D.10-04-029." D.14-01-033 at 6.

In order to develop a more effective and transparent accounting system, Commission Staff has contracted with the State Controller's Office (SCO) to review the current PA accounting systems and make recommendations for improvements. While we are not yet in a position to speak to details, we can provide a few high level recommendations on accounting issues.

In any "Rolling Portfolio" process, there will no longer be vintaging of funds and associated tracking for accounting purposes, as there was prior to D.14-10-046. In addition, budgets will be annualized rather than for a multi-year (portfolio cycle) period, creating new budgeting issues associated with under/over-spending compared to the pre-D.14-10-046 world. These changes will require a re-think of budgeting practices, some mechanism for dealing with carry-forward of unspent/uncommitted/unencumbered funds rather than just letting those funds pile up in balancing accounts, and new reporting requirements not tied to the "vintage"[~~123~~137] of funds. As long as we are making these changes, a hard look at all accounting practices is in order.

On the point about "standard utility accounting practices," we note that a recurring problem we encounter is that such "standard" practices are not standardized *across utilities*. This is something we would like to address.

We will of course invite and expect formal public input on SCO's forthcoming proposal before adopting any changes.

Here are the principles guiding the SCO's work.

1. **Clean-sheet approach:** The Commission has imposed a variety of non-standard accounting requirements on PAs over the years, in pursuit of various policy objectives (e.g., an administrative cost cap and accounting categories adopted in D.09-09-047). All of these requirements should be up for reconsideration. Questions the State Controller's

[~~123~~137] *I.e.*, what portfolio cycle the money was collected for (e.g., 2010-2012).

Office will consider are: is the policy underlying the accounting requirement still valid? If so, is there a way to achieve the Commission's policy objective that does not require use of non-standard accounting rules?

2. **Use standard accounting conventions:** PAs should use generally applicable accounting principles (GAAP) wherever possible. If we can achieve a policy goal (e.g., reduced administrative costs) within a commercial off-the-shelf accounting framework, then that is preferable to our creating unique accounting rules.
3. **Clarify 'committed', 'spent/unspent' and 'encumbered':** We need to simplify or eliminate use of committed/encumbered/unspent funds as the basis for determining carryover amounts. Relatedly, we will want insight into project pipelines, so that we can evaluate the validity of claimed commitments/encumbrances. That said, we recognize that smaller PAs like CCAs and RENs may have particular concerns here. Because of their relatively small size, it is difficult for them to smooth revenues and costs over time. For the time being we will defer to later in Phase II of this proceeding consideration of proposals to allow a carry-forward of unspent portions of annual budgets (or borrowing from future years when annual spend exceeds the budget).

Deferring accounting issues means that the status quo will continue on the accounting front. We will continue to protect ratepayers by using balancing accounts for IOUs (and, by extension, RENs), and adjusting annual IOU payment amounts to CCAs to reflect actual spending.[~~124~~138] Current accounting reporting requirements will remain in effect.

3.2.3.3.2. ~~3.2.4.3.2.~~ Fund-shifting Requirements

Fund shifting guidelines or rules establish the level of flexibility that utility PAs have (without prior authorization) to modify funding levels for specific

[~~124~~138] *See* D.14-10-046 at 43-44 (discussing mechanics for protecting ratepayers while we resolve accounting issues).

energy efficiency activities as the portfolio plans are implemented. In particular, the guidelines establish the extent to which the utilities may shift funds among programs within the same program category, across program categories, carry over or carry forward funds from one program year to the next, as well as discontinue programs that are not performing or add new programs during the program cycle.[~~125~~139] The idea here is to prevent a "bait and switch" approach to budgeting where a PA represents in its budget filing that it will do X, but the PA then takes money for X and instead does Y. The Policy Manual[~~126~~140] summarizes the Commission's current fund shifting rules. [~~127~~141]

The Joint Parties did not propose changes to fund-shifting rules. Rather, they responded that fund-shifting requirements should be developed based on portfolio structure decisions and further dialogue with staff. MCE requested changes to account for the fact that its budget is comparatively small. The application of percentage thresholds to MCE means that even very small shifts in MCE's budgets give rise to an advice letter filing obligation.[~~128~~142]

Commission Staff proposed to eliminate advice letter requirements for fund-shifting and instead require PAs to track fund shifting on the online tool and report updated budgets in their annual compliance filings.[~~129~~143] The Joint Parties subsequently supported the Commission Staff proposal.

[~~125~~139] D.05-09-043 at 83.

[~~126~~140] "The Policy Manual is a Commission Staff-prepared compendium of our decisions and resolutions relating to energy efficiency, and it also includes some additional staff-prepared gloss on those decisions. Commission Staff has revised the Policy Manual periodically, updating it to incorporate regulatory changes that have come along since the most recent edition. It is a convenient reference for Program Administrators." D.14-01-033 at 12.

[~~127~~141] Energy Efficiency Policy Manual, v. 5 at Appendix C (citing D.12-11-015, 12/22/2011 ACR (R.09-11-014), D.09-09-047, D.09-05-037, D.07-10-032, D.06-12-013, and D.05-09-043).

[~~128~~142] MCE Comments on Workshop 1 at 5, 16.

[~~129~~143] NRDC Comments on Commission Staff White Paper at 15-16.

We adopt the Commission Staff recommendation that we eliminate advice letter requirements for authorization for fund-shifting. Many advice letters filed regarding fund shifts receive minimal review, have no significant impact on the portfolios, and contribute to regulatory churn. There are also a variety of "work-arounds" that PAs employ to avoid triggering fund shifting reporting requirements, further reducing the potential for oversight that was originally envisioned in creating the filing requirements. Most importantly, the problem we are trying to solve with fund-shifting triggers (a "bait and switch" situation in which utilities submit for multi-year portfolios that are dramatically changed after the Commission authorizes them) is rendered largely moot in a rolling portfolio environment in which budgets are revised annually. Consequently, fund shifting alone will no longer trigger an advice letter filing.

Instead, we will require PAs to track fund shifting on the online tool and report updated budgets in their annual budget filings, as discussed at ~~3.2.3.1~~3.2.2.3 above. If Commission Staff or stakeholders identify fund-shifting activities that substantially depart from Commission policy direction or, in the opinion of Commission Staff or stakeholders, are not in the best interest of ratepayers and/or the efficiency portfolios (e.g., the sort of "bait and switch" behavior described in the opening paragraph of this subsection), they should raise their concerns in response to the next budget advice letter.

3.2.3.4. ~~3.2.4.4.~~ *Ex Ante* Review

Ex ante values are savings values established before (hence, *ex ante*) a program or project is completed; often before a project even begins.[~~130~~144] In our policy construct, all PA-submitted savings claims are termed ex ante values even if they have been developed using post-installation information. The PA *ex ante* values come in several flavors. There are DEER values, workpaper values, and custom values. As far as DEER goes, we know of only two significant recent *ex ante* updates. There are: (1) the changes that we directed for codes and standards updates last year, and (2) the changes that we are making to DEER values here.

> For custom projects the adopted *ex ante* review process provides Commission Staff with the ability to review and update ex ante values including NTG for those projects. The IOUs are expected to respond to Commission staff reviews by taking steps to improve NTG results. Utility programs should strive to push customers to augment projects to include action that would not occur without incentive support or redesign the incentive structure to encourage deeper and more comprehensive activities as well as aligning the incentive amounts to be commensurate with the level of savings that can be attributed to the program.[~~131~~145]

We are aware of stakeholder dissatisfaction with *ex ante* processes, particularly in connection with custom projects. Exemplary comments are these:

[~~130~~144] PA *ex ante* values contrast with Commission evaluation ex post values. PA deemed *ex ante* values rarely depend on current participant field measurements and surveys but rather are developed from estimates using historical data or best estimates using judgement and models. PA ex ante custom project values are often subject to post installation true-up using field measurements and as-installed parameters. Commission ex post values are savings values established after a project is completed. Ex post values often rely on field measurements and surveys targeted at truing up site and measure specific ex ante parameters and assumptions to provide an accurate estimate of savings for all the projects and measures completed during a particular annual or other period.

[~~131~~145] Commission Staff Energy Efficiency Policy Manual at 21.

> Current technical update processes are unpredictable, can result in significant modifications within a short time frame, and are not in sync with program planning.
>
> In the existing process, changes to ex ante savings are made on an ongoing basis, without commensurate changes in the potential and goals to which the IOUs are held. This introduces uncertainty of energy savings for PAs, implementers, and most-importantly customers.[132][146]

And these:

> … the whole custom review process still embodies unclear expectations, long turn-around times, poor communication, and unexpected policy changes. All parties in the system share joint responsibility in solving these issues, but the issues still remain, and will take further time to resolve. This uncertainty creates large enough business risks that no one is willing to step forward, which means customers are left hanging. The overall [e]ffect is resulting in decreased program participation and decreased installation of large custom energy efficiency projects. The short-term impact is an immediate "chilling" of large energy efficiency projects in the state and further market uncertainty. [¶] An immediate solution to reduce the problem this creates for customers is to apply custom dispositions prospectively after a period of "market transition" so the customer whose project is the subject of the disposition can move along the implementation process without delay, as proposed in the Joint Party comments.[133][147]

And these:

> "EnerNOC has attempted to obtain clarifications and modifications regarding the custom project review process since 2011. [citation to comment filed on Proposed Decision Providing Guidance on 2013-2014 Energy Efficiency Portfolios] Most recently, EnerNOC has worked with CEEIC, the IOUs, the Commission's Energy Division, and other stakeholders to develop specific processes to improve the timing, develop a communication plan, and propose a dispute resolution. [¶] However, none of these efforts have resulted in significant improvements to the custom project review process.

[132][146] NRDC's comments on white paper at 4 (emphasis added).

[133][147] California Energy Efficiency Industry Council Comments on Phase II Workshop 1 received on April 6, 2015 at 7-8.

> Meanwhile, it is EnerNOC's experience that customers will not accept the uncertainty caused by the inability to reach a final conclusion about a potential custom project. EnerNOC's customers have experienced delays in excess of two months. In fact, many of the customers, frustrated by the uncertainty and delays, will choose not to implement custom measures, taking with them a substantial portion of the deep retrofit savings that the Commission expects to achieve from custom measures"[~~134~~148]

From our high-level vantage points, there seem to have been significant strides towards addressing these sorts of complaints. The four investor-owned utilities and Commission staff are engaged in a collaborative process to develop guidance documents for custom project ex ante review. Final "*Ex Ante* Review Custom Process Guidance Documents" addressing early retirement and industry standard practice studies are available on the CPUC website. Additional guidance documents are in process and will be available when finalized. These guidance documents provide details on the Commission's policies and procedures for custom projects/measures. Commission Staff developed these guidance documents to address concerns expressed by the PAs and implementers that Commission staff review criteria and requirements should be set forth in documents available to those engaged in program implementation activities. The CPUC webpage also contains downloadable industry standard practice studies, which are used when setting baselines for custom projects.

Ex ante review expectations and processes have been communicated to the PAs, implementers, and stakeholders in various ways since the review process was first implemented. For example, in 2014 staff and contractors had several meetings with CEEIC and CEEIC members (twice alluded to in part in the comments quoted above) to discuss ex ante requirements and procedures. Staff have met with PAs and their implementers (many are members of CEEIC) on

[~~134~~148] *Enernoc Comments on Workshop 1, Phase II, April 6, 2015 at 6-7.*

dozens of occasions from 2011-2015 and discussed details of specific projects and issues such as ineligible measures, incorrect baseline assumption, incorrect calculations methods, incorrect use of site-specific M&V methods or use of M&V data. Theses meeting must involve the PAs~~ as the~~. The customer's contractual relationship is not with ~~CPUC and all~~ the Commission. Customer information is confidential to the PA and cannot be discussed with ~~their~~a customer's contractor implementer without ~~their~~customer permission. Communication of the CPUC staff's custom projects review findings and dispositions thus is the responsibility of the PAs to their account representatives, field staff, third party implementers and project sponsors.

Additional changes to ex ante processes are under way. In particular, custom project *ex ante* review guidance documents in various developmental stages are:

- Energy Efficiency Savings Eligibility at Sites with non-IOU Supplied Energy Sources
- Custom Project Cost Development
- Net-to-gross/Free-ridership guidance
- Industrial Retrocommissioning
- Use of DEER assumptions, methods and values in custom measure/project ex ante value development.
- To make sure that ex ante findings and dispositions are widely available, SDG&E is developing a searchable online document storage system that will hold redacted versions of Commission Staff's project review findings, final dispositions, guidance documents and standard practice studies for all PAs. Once completed SDG&E will turn over this online document storage system to Commission Staff. Commission staff will host this as a publicly accessible and searchable online document system that will hold these redacted dispositions as well as all the other guidance documents and standard practice studies for all PAs.

> SDG&E has indicated to Commission Staff that they plan to start uploading redacted dispositions this year. A link to the new database site will be provided on the CPUC's website.

From the Commission Staff perspective, the implementer and joint party complaints about delays and lost opportunities are a red herring. Customer and implementer payments are based on gross first year ex ante savings estimates. The real issue is the ability to set the *ex ante* values that determine the customer and implementer payments. In Commission Staff's view, prospective application of review findings will actually prevent fixing the underlying problems of overpromising savings and hence overpayment of incentives. Ex post evaluation is of little concern to customers or to implementers compared to the *ex ante* values that set their incentive or compensation payments.

For our part, we are frustrated and perplexed by the ~~continuing complaints in this area. We direct the PAs~~radically competing narratives regarding issues with ex ante custom review. CEEIC and the implementer community have their complaints, as represented in the quotes above. PAs largely echo these complaints. Commission Staff have their markedly contrasting concerns, as articulated in the preceding paragraph. With as much experience as all concerned have in the energy efficiency arena, Commission Staff, PAs, and implementers should be converging on agreed-upon approaches to custom project savings estimates. This does not appear to be happening. If anything, parties and Commission Staff seem to be hardening in their respective positions.

It is clear from party comments on the *ex ante* custom review section of the proposed decision that there is work to be done in this area. We note as well that there is legislation currently pending before the governor that will impact *ex ante*

review.[149] We direct the PAs to work with stakeholders to jointly investigate and propose potential solutions to Commission Staff to improve the usability and transparency of all *ex ante* values. The solutions may include new software tools that offer a common platform for all PAs to compose savings estimates transparently and consistent with Commission direction. Proposals should be focused on opportunities to facilitate transparency and collaboration. Proposals should specify the expected outcomes from the proposals and how they will improve the process to develop ~~and~~ review, and implement *ex ante* values. Any proposal must recognize that Commission staff is still responsible for review and approval of *ex ante* values and methods and that past and current ex ante guidance still pertains.

Once Commission Staff receive the proposal, they will prepare a white paper in response, which will be put out for public review and comment. Then we can decide on next steps.

We are deliberately not specifying timing here for an ex ante reform process. Timing will be for PAs and stakeholders (for their proposal), Commission Staff (for their white paper, and possibly a round of informal comments), and then for the assigned office and ALJ (for formal public comment and any formal next steps) to address.

In the meantime, PAs shall accelerate the ongoing effort to publish redacted copies of Commission Staff dispositions of custom projects. PAs shall also publish for each disposition redacted versions of the project material the PA submitted to Commission Staff that led to the disposition.

[149] SB350, Section 16, amending section 399.4 to add subsection (d)(4): "In updating its policies, the commission shall, at a minimum, do all of the following: . . . (4) Ensure that customers have certainty in the values and methodology used to determine energy efficiency incentives by basing the amount of any incentives provided by gas and electrical corporations on the values and methodology contained in the executed customer agreement. Incentive payments shall be based on measured results."

We note numerous factual questions around ex ante custom review. We hear anecdotes from implementers about Commission Staff acting capriciously when disposing of custom project submittals. Conversely, we see Commission Staff dispositions identifying myriad defects in custom project submittals. We are also aware of EM&V reports showing much lower levels of actual savings than PAs and implementers forecast in their submittals (i.e., low "realization rates"),[150] which call into question the quality of PA and/or implementer ex ante savings estimates.[151] What are the problems here, and with whom does the ability to rectify them lie?

Without facts, reform efforts will likely just devolve into a finger-pointing exercise. Parties and Commission Staff should look into the following questions in performing the work we direct above.

1. How many custom projects does Commission Staff review actually delay, and for how long?
2. Relatedly, what percentage of the custom projects by MW and/or MWh are delayed by Commission Staff review, and for how long?
3. What is the PA process for custom review? What delays does it introduce either in conjunction with or independent of Commission Staff review?

[150] See, e.g., *2010-12 WO033 Custom Impact Evaluation Final Report*, Itron, Inc., July 14, 2014. ("With all sample points included, the mean realization rates by IOU, fueland energy metric are less than 0.70 for all but two energy metrics.") See generally section 5.1. ¤
See also *2013 Custom Impact Evaluation Industrial, Agricultural, and Large Commercial*, Itron, Inc., July 17, 2015. See generally sections 1.2 and 3.2.

[151] 2010-12 WO033 Custom Impact Evaluation Final Report, Itron, Inc., July 14, 2014. See generally section 5.2 ("Discrepancy Analysis"). ¤
See also *2013 Custom Impact Evaluation Industrial, Agricultural, and Large Commercial*, Itron, Inc., July 17, 2015. See generally section 3.4 (Discrepancy Analysis).

4. What volume of projects (by number, and by savings amount) are impacted by the "retroactivity" of Commission Staff disposition, of which implementers and PAs complain (discussed more below)?

5. What are the specific issues that Commission Staff tends to raise with the submittals they review? Are there recurring issues that can be dealt with generically?

6. What models are PAs and implementers using to forecast savings, and why are realization rates for custom projects not higher?

Parties should consider these questions and the answers to them in preparing their proposal for ex ante custom review reform, as should Commission Staff in their white paper.

Market Transition and Retroactivity

As already discussed, many commenters are displeased with the *ex ante* review process. One area where parties express concern is with Commission Staff's allegedly "retroactive" application of Commission Staff determinations of savings values for custom projects. The thrust of the concern is that Commission Staff will identify a value in connection with one project, then apply that value to similar projects that were already in, but not yet through, the Commission Staff review process. CIEEC's comments,[135][152] as well as NRDC's and Joint Parties' comments on Phase II Workshop I; [136][153] and NRDC's response to the staff White Paper propose that custom review disposition be made applicable on a prospective basis by applying a "market transition period."

[135] California Energy Efficiency Industry Council[152] CEEIC Comments on Phase II Workshop 1 received on April 6, 2015 at 8. See also CEEIC opening and reply comments on the proposed decision, *passim.*

[136][153] NRDC Comments on Phase II Workshop 1 received on April 6, 2015 at 19-21.

NRDC suggests in the Response to the Staff White Paper that "the project under review [should] be approved, completed, and paid out without the additional time associated with the Custom Measure Project Archive (CMPA) review allowing customers currently in the pipeline to rely on information provided by implementers in good faith."[137][154]

NRDC Comments on Workshop I[138][155]

propose that: "Projects in the pipeline" or projects previously submitted as a lead, application, or signed agreement on the Custom Measure Program Archive (CMPA) list would be grandfathered under the original, existing policy. "NRDC defines project pipeline as a combination of: (1) project leads and (2) project applications.

NRDC proposes further that "dispositions be applicable on a prospective basis to future projects of similar nature." They further propose that "the project under review [should] be approved, completed, and paid out without the additional time associated with the Custom Measure Project Archive (CMPA) review allowing customers currently in the pipeline to rely on information provided by implementers in good faith." [139][156]

We decline to adopt these proposals. ~~A lead is simply a customer-expressed interest at an energy efficiency opportunity.~~ Were we to adopt the "grandfathering" proposal, PAs could avoid the impact of dispositions simply by submitting project leads as a placeholder. It is inappropriate to classify a project in the 'project lead' stage the same as with a project in the 'project application' stage where the customer has submitted its plans and a signed application to the PA.

[137][154] NRDC comments on Commission Staff White Paper at 32.
[138][155] NRDC and Joint Parties Comments on Phase II Workshop 1 received on April 6, 2015 at 19-21.
[139][156] NRDC comments on Commission Staff White Paper at 32.

Further, the proposals at hand fail to give effect to prior dispositions and do not allow application of quality control determinations to the actual project under review. As TURN notes in its comments, "The current custom review process was developed to address important quality assurance concerns."[~~140~~157] These concerns persist today. To apply the Parties' proposed "market transition" approach would fail to remedy the concerns the review process was designed to address; the Commission rejected a similar argument regarding the custom review process was in Decision 11-07-030, and the reasons are applicable to the proposal before us now: "The utilities propose that they not be required to adjust ex ante values in response to Energy Division reviews and that non-reviewed ex ante values not be subject to a gross realization rate adjustment. We will not adopt this suggestion, which would delay or even preclude *ex ante* values being reflective of actual savings."[~~141~~158]

We are sensitive to concerns about market certainty. The optimal way to ensure certainty is to have quality submittals and universally understood rules for their review. We look to the reform process laid out in the prior subsection to bring us towards that endpoint.**Workpaper Reviews**

Joint Parties did not directly propose any changes to the current workpaper review process first adopted by ALJ Ruling[~~142~~159] and modified in D.12-05-015. We note that that the current process and the joint proposal for the schedule of workpaper updates do not provide for an organized and predictable workflow for workpaper reviews. We will adopt a "bus stop" approach to submissions and reviews of both new and updated workpapers. Presently,

[~~140~~157] TURN, Comments on Phase II Workshop 1, at 12-13.
[~~141~~158] Decision 11-07-030, at 39-40.
[~~142~~159] The phase 1 and phase 2 workpaper review process was first adopted by "Administrative Law Judge's Ruling Regarding Non-DEER Measure Ex ante Values", dated 18 November 2009 in A.08-07-021, *et.al*. The process steps and timeline are provided in detail in the attachment to the ruling.

workpapers can be submitted at any time and the "clock" for Commission staff's 15 day preliminary and 25 day technical review begins with the date of the submission. Requiring Commission Staff and PAs to track many dozens or even hundreds of annual workpaper submissions on separate clocks to be unreasonable.

For custom projects, we aggregate submissions into semi-monthly windows. For workpapers, we will adopt a similar approach. All workpaper submissions, independent of the exact time submitted, will be considered to have been submitted on the 1st or 3rd Monday of the month; workpapers actually submitted after the close of business of the first Monday will be considered submitted on the 3rd Monday and workpapers submitted after the close of business of the 3rd Monday will be considered submitted on the 1st Monday of the following month.

Commenters on the proposed decision asked how this timeline intersects with the requirement elsewhere in the decision that PAs submit by January 1 all workpaper updates to conform to changes in DEER. We address this issue at 3.2.3 above.

3.3. Guidance on 2016 Program Changes

The Phase II scoping memo placed in scope a "limited universe of changes we will discuss for 2016 portfolios." In pertinent part[~~143~~160] we stated we would consider the following changes for 2016:

- Changes to standardize statewide programs across PAs

[~~143~~160] The Phase II scoping memo identified several additional 2016 changes we could consider in Phase II, but that depended in part on the outcome of this decision, or other outside events. Those changes include: changes in response to new savings goals, changes to maintain portfolio cost-effectiveness, and changes to water-energy measures or programs. We expect to take these up in the second Phase II decision.

- Changes to third-party programs[144][161]

We defer consideration of these issues to the next decision in Phase II of this proceeding, with the exception of clarifying how PAs should handle renewal of their third party programs in the interim.

Until our next Phase II decision in this proceeding, PAs may move forward under the existing Third Party Programs framework. They PAs may execute new contracts that will extend up to three years from the date of this decision. This PAs may also extend existing contracts. PAs may also redefine program design parameters for the three year period. The additional time will give the Commission sufficient time to properly address additional revisions to Third-Party Programs.

3.4. Updates to Other Program Metrics

3.4.1. DEER Updates

We base *ex ante* savings estimates on predictions of typical operating conditions and baseline usage. One repository for these predictions is DEER. DEER requires periodic updating, and Commission Staff on March 5, 2015 conducted a DEER2016 scoping webinar. Commission Staff has since proposed to update DEER various additional and revised savings values:

a) The ESPI Uncertain Measures Update

   i) screw-in CFLs of all types with wattages of 30 watts and less, and

   ii) T5 fluorescent lamps and fixtures replacing metal halide.

b) The DEER 2015 Update

   i) updates to reflect code changes that went into effect in 2014 and in 2015.

[144][161] "i. includes proposed changes to administration practices; proposed expansion of percentage of portfolio devoted to third party programs; auction design and targeted market segments." Phase II scoping memo at 7.

c) The DEER 2016 Update

i) consists of updates to non-residential lighting profiles, lighting technologies, HVAC technologies, residential appliance technologies, effective useful life values, net to gross ratio values, and gross savings installation adjustment values, and

ii) Recycled Refrigerator/Freezer measures impacted by Federal Refrigerator/Freezer standard updates as well as the results of the Appliance Recycling Program Evaluation. [~~145~~162]

On May 15, 2015, the assigned ALJ put the DEER2016 Update draft results out for public comment.[~~146~~163] On May 21, 2015, the Commission conducted workshop 4, concerning the DEER2016 Update draft results. Parties filed June 8, 2015 comments on the DEER2016 Update draft release.[~~147~~164] The following day, we issued a ruling requesting comment on updates to certain cost information in DEER. On June 29, 2015, we received comments on the cost information proposal. [~~148~~165]

[~~145~~162] CPUC Rulings and Scoping Rulings: http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=151726019. The ruling categorized updates to refrigerator and freezer measures updates under the Uncertain Measures Update as an error; the measures should be and are part of the DEER 2016 Update.

[~~146~~163] CPUC Rulings and Scoping Rulings: http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=151726019.

[~~147~~164] The following parties submitted post-workshop 4 comments:
NEST
NRDC
PG&E
SCE
SDG&E
SoCal Gas
TURN

[~~148~~165] We received comments from:
ORA
PG&E
SCE
SDG&E
SoCal Gas

3.4.1.1. Revisions to DEER Values for Appliance Recycling Measures

In comments on the proposed decision, AHAM and ARCA take issue with the reduction in savings values for appliance recycling measures. Specifically, they take issue with changes in DEER to Remaining Useful Life (EUL) values and, by extension, to changes to the expected savings from recycling of refrigerators that are older than 10 years. They ask that the Commission decline to make Commission Staff's proposed updates to these values.

Commission Staff's analysis of the Appliance Recycling Program (ARP) ex ante values focused on:

(a) whether; and,

(b) for how long;

a refrigerator the ARP picked up would have stayed in service if not recycled by the program. Commission Staff was, in other words, establishing the counterfactual for appliance recycling.[1]

AHAM argues, citing its own research,[2] that new units, as opposed to used units, stay in service with their initial owner for 14 years. AHAM also cites a national landfill study from 2005, which determined that units found in landfills were 20 years old or older. AHAM also cites a recent DOE standards update that determined the average age at a refrigerator's "end of life" was 17.1 years. AHAM also cites a JACO study (with no specific citation), which apparently found that the average age of 65,000 refrigerators is 25 years. AHAM summarizes its objections to the revised DEER EUL and RUL for refrigerators by as follows: "All these data sources are consistent in that a first owner may use a

[1] ARCA is correct that Commission Staff "seek[s] to quantify that which would have happened in the absence of the ARP's, to the extent that some of these appliances would likely have been placed back into the secondary market." ARCA Comments on PD, at 3.

[2] Although AHAM does not provide or cite specific reports, examination of the information included in a report posted on AHAM's website reveals this value is for units owned in May 2001.

refrigerator for 14 years and the second owner uses it on average for another 6 or more years."[3]

To this point in the discussion, Commission Staff and commenters on this issue are generally in agreement. DEER, as revised, will use 14 years as the EUL for a new refrigerator and 5 years as the RUL of a unit collected by the ARP. AHAM, ARCA and JACO's concerns appear to lie not with EUL or RUL per se. Rather, they take issue with the *discounting of the value of 10-14 year old refrigerators* in the revisions to DEER.

Recent surveys of California IOU customers[4] shows that the desirability of used refrigerators drops rapidly for refrigerators more than 10 years old. Consequently there is not much of a secondary market for these old refrigerators, and they would go out of service at a higher rate than new refrigerators even in the absence of a ratepayer-funded recycling program. If we adopt Commission Staff's proposal, PAs will still receive savings credit for these older units, but at a value discounted to reflect the lack of resale opportunities.

Nothing AHAM et al. present bears on the re-saleability of old refrigerators. Commenters' point is that even unsold old refrigerators remain in service (e.g., as a second refrigerator).[5] "[T]ransfer paths of these appliances begin and continue on with much older, less energy efficient appliances and the increasing consumer use of a second refrigerator in the home compounds higher energy consumption consequences." [6]

[3] AHAM Comments on PD, at 4.

[4] The California Lighting and Appliance Saturation Survey (CLASS, 2012) and the Appliance Recycling Program impact evaluation (2014). Commission Staff discussed the data from these reports at a workshop on May 21, 2015.

[5] "AHAM's Early Replacement Initiative states that 41% of all consumers that buy new refrigerators keep the old one operating." ACRA Comments on PD, at 4.

[6] "AHAM's Early Replacement Initiative states that 41% of all consumers that buy new refrigerators keep the old one operating." ACRA Comments on PD, at 4.

We find that Commission Staff's discounting of the savings value of old refrigerators by 50% (rather than to zero) is reasonable in light of the data presented. Accordingly, we decline to make the changes to EUL/RUL values that commenters request.

On a separate point, ARCA states that "By inserting the two additional disposition paths Destroyed by Discarders-non-viable units and Destroyed by Discarders-working units into the gross savings, and then developing yet another independent Net-to-Gross (NTG) value," [7] it "appears the DEER2015 Update essentially produced a double NTG adjustment, which negatively impacts the net energy savings twice." [8] Both of these new categories reflect independent paths outside of ARPs by which units go out of service, and so both are correctly incorporated into the NTG ratio for ARPs. This is not a "double counting," as any given refrigerators gets counted only once, but in one of two categories instead of in in a single category.

To amplify: ostensible savings from non-viable units discarded or destroyed – that is, refrigerators that certainly would have gone to the scrapyard even without a program – get counted as standard practice. Eliminating such ostensible savings, which are not really savings at all, requires removing them from the calculation of the gross baseline. The result of this change is a significant decrease in *gross* savings, but also a significant increase in *net* savings and so in the NTG ratio. There is no question that recyclers are successfully removing viable, inefficient appliances from the market. However, recyclers are not limiting what they collect to only viable units. Recyclers cast a wide net to get the most valuable catch, and consequently sweep up many appliances that would have been discarded or left unused anyway. The DEER

[7] AHAM Comments on PD, at 4.
[8] AHAM Comments on PD, at 4.

Please note that the NTG has increased more than 50% over previous DEER values.

3.4.1.2. ~~3.4.1.1.~~ Effective Date of DEER 2015 Updates

We will depart from the Commission Staff recommendation on the effective date of changes, and make all changes to DEER approved here effective on January 1, 2016. PAs have already made and implemented 2015 portfolios, customers have undertaken investment decisions; implementers have prepared voluminous paperwork, all in reliance on older DEER numbers. We will not reopen nine months' work by the numerous actors involved in ratepayer-funded energy efficiency programs, as would be necessary were we to make changes effective this year.

3.4.1.3. ~~3.4.1.2.~~ Cost information Updates

SCE and PG&E recommend the Commission to complete the cost updates by Q3 of 2015 in order to apply it to the 2016 energy efficiency portfolio. SCE notes a need for cost models and cost calculators for measures out of scope and would also like Commission Staff to provide further guidance on applying the update to the portfolio. SDG&E recommends that Commission Staff work with PAs to prioritize measures to be addressed by the costs update. SDG&E and SCG note that some of the data in the 2013 Measure Cost Study may already be outdated and should be updated.

The Commission generally agrees with the parties' concerns regarding the timeline for finalizing the update, the technical constraints for the current update, and the need for collaboration in the future on applying the updated costs to the portfolio. Commission Staff are already prioritizing measures for the costs update. Commission Staff are to work with parties to provide further guidance on how to apply the updates.

PG&E identified a number of errors and inaccuracies with the Commission Staff Proposal[1491] for measure cost updates. Commission Staff will correct these errors before finalizing the update. PG&E also recommends the Commission include custom measure cost study results as part of the update. Custom measure costs are out of the scope for the most recent update but may be addressed with future guidance on costs.

SDG&E is concerned with the models being miss-specified and with over-estimation of base equipment costs. Commission Staff is to work with SDG&E on any specific issues unique to the utility, and make adjustments as data warrant.

3.4.1.4. 3.4.1.3. Data Adequacy

SCE takes issue with the choice of data for the estimated useful lives for CFLs. SCE contends that the DEER revisions should have taken account of recent laboratory test work as well as saturation studies.

The updated DEER values should and do reflect the laboratory work (some of which our own the Commission's consultants performed) as well as saturation studies. Best available data is the key here. Neither source should be used exclusively.

PG&E takes issue with the proposal to use a value of 10% for outdoor lights being left on in the daytime. The data problem here results from the technology used to measure when lights are on or off – "light loggers." Light loggers overstate incidences of outdoor lights being left on because light loggers measure light, not current. There is abundant light during the day, even when

[1491] Measure cost Integration Methodology memo: http://www.cpuc.ca.gov/NR/rdonlyres/96B4CC68-5F41-4FA9-9602-412A04E3D118/0/Measure_Cost_Integration_Methodology_Memo.pdf

the lights are off. Light Loggers erroneously interpret daylight as lights being left on.

We know that light loggers on outdoor lights yield material numbers of false positives. Some correction to the light logger data is in order, and we will adopt Commission Staff's proposed correction to the light logger data. We direct Commission Staff to investigate and refine this number in time for a 2017 DEER update.

3.4.1.5. ~~3.4.1.4.~~ Link to Adopted DEER Updates

- The Uncertain Measures Update: http://www.deeresources.com/index.php/deer-versions/2015-uncertain-measures-update
- The DEER 2015 Update: http://www.deeresources.com/index.php/deer-versions/deer2015-code-update
- The DEER 2016 Update: http://www.deeresources.com/index.php/deer-versions/deer-2016

4. Comments on Proposed Decision

The proposed decision of the Administrative Law Judge (ALJ) in this matter was mailed to the parties in accordance with Section 311 of the Public Utilities Code and comments were allowed under Rule 14.3 of the Commission's Rules of Practice and Procedure. Comments were filed on ~~_____, and reply comments were filed on _____ by _____.~~ September 8,

2015.[2] Reply comments were filed on September 1, 2015.[3] Comments were generally supportive of the Proposed Decision. Some commenters, did however request changes, clarifications, and/or further guidance in certain areas of the proposed decision. Changes in response to some comments are interspersed throughout the decision.

5. Assignment of Proceeding

Carla J. Peterman is the assigned Commissioner and Todd O. Edmister is the assigned ALJ in this proceeding.

Findings of Fact

1. The energy savings goals in section 3.1.2 above are aggressive yet achievable.

2. Data limitations require us to develop goals by IOU service territories, rather than by PAs.

[2] The following parties filed opening comments:
Association of Home Appliance Manufacturers (AHAM)
Appliance Recycling Centers of America, Inc. (ARCA)
JACO Environmental, Inc. (JACO)
Nest Labs, Inc. (Nest)BayREN
Cal-UCONS
CEEIC
CSE
EnerNOC
LGSEC
MCE
NRDC
ORA
PG&E
SCE
SDG&E and SoCal Gas jointly.

[3] The following parties filed reply comments:
CEEIC
MCE
NAESCO
NRDC
ORA
PG&E
SCE

3. Many factors in addition to those in the TRC drive real-world decisions about whether to undertake a measure. These do not factor into the Economic Potential calculation

4. In addition to such practical concerns, customers may have different views than PAs (and each other) on what constitutes a "cost-effective" measure or project.

5. Neither Technical Potential nor Economic Potential provides a realistic basis for setting savings goals for PAs.

6. Within Market Potential are numerous possible "cases" to choose from, depending on the chosen modelling assumptions.

7. There are compelling justifications for energy efficiency policies. Nevertheless, in order to succeed, they must be based on a sound understanding of the market problems they seek to correct and a realistic assessment of their likely efficacy.

8. Calibration is the systematic adjustment of model parameter estimates so that model outputs more accurately reflect external benchmarks.

9. Calibration provides both the forecaster and stakeholders with a degree of confidence that simulated results are reasonable and reliable.

10. Calibration is effectively built into the model underlying the potential and goals study, and cannot be feasibly disentangled.

11. As a matter of good modeling practice, modelers should explicitly layer predictions about how the future will depart from the past atop a calibrated model, not bake them into the model *ab initio.*

12. Smartmeter data cannot, and may never, inform incremental cost, measure life, and appliance saturation.

13. Joint party reliance on PA discretion and stakeholder processes in place of formal regulatory processes actually makes many energy efficiency activities opaque for Commissioners and possibly for other stakeholders who do not have time or ability to participate in multiple detailed stakeholder processes.

14. The Commission needs more opportunities to weigh in via decisions and/or resolutions than the joint proposal contemplated.

15. The sector to which a program is assigned can determine who administers it, who controls its budget, how effectively it achieves savings, and who is accountable for the program's success or failure. Segregation of cross-cutting activities into a sector of their own makes it easier to coordinate interventions, budgets and responsibility for cross-cutting activities across different administrators, or to move those activities to a single administrator if/when appropriate.

16. Generically speaking, we use metrics to gauge portfolio and/or program performance.

17. There is no need to require PAs to immediately reformat all of their current PIPs into the new implementation plan format.

18. Stakeholders other than PAs (and more particularly the IOU subset of PAs) will be unable to cover more than a discrete and focused subset of issues under the auspices of the proposed stakeholder group.

19. DEER values should generally remain frozen for a locked in period. With the "bust stop" approach we adopt here, DEER values will generally change only once per year, and there will be a delay between when changes are announced and when changes are effective so that market participants have time to incorporate changes into their activities. Second, there must and will be limited exceptions to the general rule of no mid-year changes.

20. Central to the rolling portfolio cycle framework is the schedule. The joint parties prepared a proposed proceeding schedule that was defined by firm "bus stops," or deadlines for the critical steps in the portfolio updates. The value in the bus stop concept is that it sets a reliable, regular schedule for future updates, so that any new information that "misses a bus" can get on board when the bus rolls around to the stop again the following year.

21. The joint parties' specific deadlines do not provide enough time to complete each process, and do not align with the ESPI schedule, which is tied into the EM&V and *ex ante* updates.

22. The annual EM&V plan is expected to be completed at the end of each calendar year. The studies to be implemented in the following year will inform, and be informed by the EM&V plan. March 1st will be a consistent target to ensure information will be available for program planning, ex ante savings updates, and potential and goals, but interim results and actionable findings may be available throughout the year. This date aligns with the schedule for delivering ESPI draft ex post savings results, which will also be informed by all available EM&V studies.

23. PAs have already made and implemented 2015 portfolios, customers have undertaken investment decisions; implementers have prepared voluminous paperwork, all in reliance on older DEER numbers.

24. PG&E identified a number of errors and inaccuracies with the Commission Staff Proposal for measure cost updates.

Conclusions of Law

1. Public Utilities Code Sections 454.55 and 454.56[~~150~~4] require the Commission, in consultation with the California Energy Commission (CEC), to identify all potential achievable cost-effective electricity and natural gas efficiency savings and "establish efficiency targets"[~~151~~5] for electrical or gas corporations to achieve.

2. One of our statutory obligations is setting savings "targets,"[~~152~~6] *i.e.*, goals, for PAs.

3. It is reasonable to establish single set of goals that is "aggressive yet achievable,"[~~153~~7] and rests on data-based assumptions.

4. Navigant's calibration of the potential and goals model is reasonable.

5. It is reasonable to manage the inherent uncertainty around emerging technology by updating goals regularly with the best available data.

6. It is reasonable to rely on EM&V data, DEER, and other Commission-vetted studies as much as possible in setting goals.

7. In setting goals, the Commission is not requiring PAs to adopt to any particular portfolio structure.

8. Due process requires a greater degree of Commission oversight of energy efficiency spending than the joint proposal contemplates.

9. Commission Staff's participation in an informal process is not equivalent to Commission participation. Moreover, a stakeholder process, even with

[~~150~~4] Cal. Pub. Util. Code § 454.55: "The commission, in consultation with the State Energy Resources Conservation and Development Commission, shall identify all potentially achievable cost-effective electricity efficiency savings and establish efficiency targets for an electrical corporation to achieve pursuant to Section 454.5."
Cal. Pub. Util. Code § 454.56: "(a) The commission, in consultation with the State Energy Resources Conservation and Development Commission, shall identify all potentially achievable cost-effective natural gas efficiency savings and establish efficiency targets for the gas corporation to achieve."

[~~151~~5] *Id.*

[~~152~~6] Cal. Pub. Util. Code §§ 454.55 and 454.56.

[~~153~~7] *See* D.07-09-043 at 107-108.

Commission Staff participation, is not necessarily an adequate substitute for Commission review of an application or advice letter.

10. Open meeting laws and the Commission's *ex parte* rules may be in effect as concerns some or all issues covered in stakeholder processes.

11. It is reasonable to treat cross-cutting programs as their own portfolio sector.

12. It is reasonable to fund a stakeholder-let coordinating committee to work collaboratively on energy efficiency programs.

13. It is reasonable to allow for possible recovery of intervenor compensation under §§ 1801-1812 for participating in the coordinating committee, subject to the usual requirements applicable to intervenor compensation claims.

14. We should modify the ESPI timeline to reflect revisions to other key dates in this decision.

15. It is reasonable to adopt a timeline for energy efficiency portfolio review and related activities as set forth in the Gantt chart in Appendix ~~10.~~6.

16. Requiring Commission Staff and PAs to track many dozens or even hundreds of annual workpaper submissions on separate clocks to be unreasonable. It is reasonable to aggregate energy efficiency program administrators' workpaper submissions to Commission Staff into semi-monthly windows.

O R D E R

IT IS ORDERED that:

1. Each energy efficiency program administrator must file an initial business plan in 2016, as an application. Business plans must contain the information described in Appendix 4 to this decision.

2. Each energy efficiency program administrator must file an application with a revised business plan when a "trigger" event happens. Triggers are:

1. A Program Administrator (PA) is unable to adjust its portfolio in response to goal, parameter, or other updates to:
   a. meet savings goals,
   b. stay within the budget parameters of the last-approved business plan, or
   c. meet the Commission-established cost effectiveness (excluding Codes and Standards and spillover adjustments)
2. The Commission calls for a new application as a result of a decision in the policy track of the proceeding (or for any other reason);

The affected PA must file a business plan not less than one year prior to the end of funding.

3. An energy efficiency program administrator *may* file an application with a revised business plan whenever they choose.

4. Each energy efficiency program administrator must file a Tier 2 advice letter containing a budget for the next calendar year's energy efficiency portfolio by the first business day in September. The Tier 2 advice letter shall contain a portfolio cost effectiveness statement and application summary tables with forecast budgets and savings by sector and program/intervention filed in paper, with an electronic query output available in an online tool. Additionally, the Tier 2 advice letter shall provide a report on portfolio changes, annual spending, and fund shifting.

5. If a calendar year ends before Commission disposition of a Program Administrator's advice letter with the budget for the next calendar year, then the prior year's budget shall remain in place until disposition of the pending advice

letter. Electric corporations and gas corporations shall continue to recover costs, and to make transfers community choice aggregators and regional energy networks, based on the prior year's authorized budget.

6. ~~5.~~ Beginning with the date this decision mails, Energy efficiency portfolio administrators (PAs) shall upload all new implementation plans and all associated cost and savings data to a Commission-maintained online system. Implementation plans shall contain the information described in Appendix 5 to this decision. Each PA will maintain current implementation plans on the online system. PAs will catalog any changes to implementation plans when made.

7. ~~6.~~ We delegate to Commission Staff responsibility for developing additional annual filing guidance and the tools to track compliance, simplify submission, and ensure transparency. Commission Staff is to prepare a white paper further detailing what business plans should contain. Commission Staff shall circulate the white paper to the service list in this proceeding, and take informal comments on the white paper. Commission Staff shall then prepare a guidance document detailing what business plans shall contain, with a template for PA use. Commission staff shall provide ~~the~~an online filing tool in time for an annual budget submission in ~~2016.~~2017.

8. ~~7.~~ There shall be a stakeholder process associated with business plan, Tier 2 advice letter budget ~~filings~~filing, and implementation plan preparation. Participants in that stakeholder process may be eligible for intervenor compensation, subject to generally applicable requirements applicable for intervenor compensation claims. There shall be one statewide coordinating committee, with a ~~single individual as~~ chairperson or two co-chairpersons. The coordinating committee shall select ~~a single person as chair~~the chairperson(s) for

the coordinating committee, and also shall select ~~individual chairs~~the chairperson(s) for each subcommittee.

9. ~~8.~~ The coordinating scope of work for which intervenor compensation may be awarded shall be as follows:

i. ~~Participate in development of~~Provide input into business plans prior to and throughout the drafting process (see notes below re scope of input and timing);

ii. Participate ~~in development of~~input into implementation plans, again, prior to and throughout the drafting process;

iii. ~~Participate in development of~~Provide input into annual budget advice letters, again, prior to and throughout the drafting process; and,

iv. ~~Develop~~Provide input into development and ~~revise~~revision of metrics for inclusion in business plans and implementation plans as part of i and ii.

v. Provide a clearinghouse for discussion of the scope and schedule of other stakeholder processes.

10. ~~9.~~ The coordinating committee shall select an energy efficiency program administrator (PA) to file an annual Tier 1 advice letter in January setting out the coordinating committee meeting plans and agendas for the year. Stakeholders shall also select a PA to post to a Commission-maintained online tool any modifications to the meeting plans during the year.

11. ~~10.~~ Energy efficiency program administrators (PAs) shall fund the coordinating committee budget pro-rata based on their share of the overall

authorized annual energy efficiency spending. The budget will be filed with us for review as part of the Tier 1 advice letter containing the meeting plans. Budget should be the minimum needed to hire a facilitator and conduct meetings to cover the scope of work outlined above.

12. ~~11.~~ The coordinating committee shall arrange for professional meeting facilitators. We will review how well the facilitator is functioning. The Commission delegates to Commission Staff to decide whether to continue with a particular facilitator. If it is brought to our attention that the facilitator concept (as opposed to a particular facilitator) is not working, we will revisit whether to continue with a facilitator at all.

13. ~~12.~~ We relieve program administrators from their reporting requirements for both program performance metrics and market transformation indicators under Resolution E-4385.

14. ~~13.~~ Parties and Commission staff shall comply with the timeline for energy efficiency portfolio review and related activities as set forth in the Gantt chart in Appendix 10.

15. ~~14.~~ Energy efficiency program administrators (PAs) shall continue to provide monthly cost reports for all programs. For resource programs, PAs shall continue to provide monthly savings data as well.

16. ~~15.~~ If (alleged) non-compliance with Commission/Commission Staff direction is identified in the implementation plans, manuals, and/or rules, the dispute resolution process we previously approved for ex post evaluation disputes in Decision 13-09-023 may be invoked.[~~154~~8] A party may file a "Motion for Implementation Plan Dispute Resolution" in this docket (Rulemaking 13-11-005) or in the relevant Program Administrator's most recent business plan

[~~154~~8] D.13-09-013 at attachment 4.

application docket. This formal procedure should only be invoked after informal attempts to resolve disputes have been exhausted.

17. ~~16.~~ Commission Staff shall propose changes to the Database of Energy Efficient Resources (DEER) once annually via resolution, with the associated comment/protest period provided by General Order 96-B. However, Commission staff may make changes at any time without a resolution to fix errors or change documentation ~~and/or to add additional tiers to measures already in DEER~~.

18. ~~17.~~ We eliminate requirements that energy efficiency program administrators (PAs) file advice letters for authorization to shift funds among authorized programs. If Commission Staff or stakeholders identify fund-shifting activities that substantially depart from Commission policy direction or, in the opinion of Commission Staff or stakeholders, are not in the best interest of ratepayers and/or the efficiency portfolios they may raise their concerns in a protest to the PA concerns next budget advice letter.

19. ~~18. Energy efficiency program administrators shall~~PAs shall accelerate the ongoing effort to publish redacted copies of Commission Staff dispositions of custom projects. PAs shall also publish for each disposition redacted versions of the project material the PA submitted to Commission Staff that led to the disposition. PAs shall work with stakeholders to jointly investigate and propose potential solutions to Commission Staff to improve the usability and transparency of all ex ante values. The solutions may include new software tools that offer a common platform for all ~~Program Administrator's~~PAs to compose savings estimates transparently and consistent with Commission direction. Proposals should be focused on opportunities to facilitate transparency and collaboration. Proposals should specify the expected outcomes from the

proposals and how they will improve the process to develop ~~and~~, review, and implement ex ante values. Any proposal must recognize that Commission staff is still responsible for review and approval of ex ante values and methods and that past and current ex ante guidance still pertains.

20. ~~19.~~ All workpaper submissions, independent of the exact time submitted, will be considered to have been submitted on the 1st or 3rd Monday of the month; workpapers actually submitted after the close of business of the first Monday will be considered submitted on the 3rd Monday and workpapers submitted after the close of business of the 3rd Monday will be considered submitted on the 1st Monday of the following month.

21. ~~20.~~ Until the Commission's next Phase II decision in this proceeding, energy efficiency program administrators (PAs) may move forward under the existing Third Party Programs framework. PAs may execute new contracts, and/or modify existing contracts, that ~~will~~may extend up to three years ~~from~~beyond the date of this decision.

22. ~~21.~~ The Database of Energy Efficient Resources shall be updated as set forth in section ~~3.4.1.4~~3.4.1.5 above.

23. ~~22.~~ The changes we approve here to the Database of Energy Efficient Resources shall be effective on January 1, 2016.

24. ~~23.~~ This order is effective today.

Dated _____, at San Francisco, California.

Appendix 2

Navigant Study

Energy Efficiency Potential and Goals Study for 2015 and Beyond

Energy Efficiency Potential and Goals Study for 2015 and Beyond

Stage 1 Final Report

Prepared for:
California Public Utilities Commission

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Reference No.: 174655
September 25, 2015

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Executive Summary

Introduction

Navigant Consulting, Inc. along with its partners Tierra Resources Consultants LLC, DNV GL, ASWB Engineering, RedHorse Corp, and Opinion Dynamics (collectively known as "the Navigant team") developed this study ("2015 and Beyond Potential and Goals Study") to analyze energy and demand savings potential in the service territories of four of California's investor-owned utilities (IOUs) during the post 2015 energy efficiency (EE) portfolio planning cycle. This report includes results for Pacific Gas and Electric (PG&E), Southern California Edison (SCE), San Diego Gas and Electric (SDG&E), and Southern California Gas (SCG). A key component of the 2015 Potential and Goals Study (2015 Study) is the Potential and Goals Model (PG Model), which provides a single platform in which to conduct robust quantitative scenario analysis that reflects the complex interactions among various inputs and Policy Drivers.

The 2015 Study is the third consecutive potential study conducted by the Navigant team on behalf of the California Public Utilities Commission (CPUC). Navigant conducted the 2011[1] study which informed the 2013-14 IOU program goals and the 2013 Study[2] which was used to inform the 2015 goals for California IOUs. The model developed in the 2013 Study serves as the methodological basis for this study. As such, the 2015 study is considered an "update study" relative to the 2013 Study.

The 2015 Potential and Goals Study supports four related efforts:

1. Inform the CPUC as it proceeds to adopt goals and targets, providing guidance for the next IOU energy efficiency portfolios. The potential model is a framework that facilitates the stakeholder process. The model helps build consensus for goals by soliciting agreement on inputs, methods, and model results.
2. Guide the IOUs in portfolio planning and the state' principal energy agencies in forecasting for procurement, including the planning efforts of the CPUC, California Energy Commission (CEC), and California Independent System Operator (CAISO). Although the model cannot be the sole source of data for IOU program planning activities, it can provide critical guidance for the IOUs as they develop their plans for the 2016 and beyond portfolio planning period. The study is also providing California's principal energy agencies with the tools and resources necessary to develop outputs in a manner that is most appropriate for their planning and procurement needs.
3. Inform strategic contributions to greenhouse gas reduction targets. As the rules and impacts of Assembly Bill (AB) 32 are gaining traction, the model must account for Greenhouse Gas (GHG) savings estimates. This will provide an opportunity to understand how extensively IOU programs and energy efficiency can help meet AB32 goals. Navigant will work with the CPUC and stakeholders to develop stretch GHG reduction scenarios.

[1] Navigant. *Analysis to Update Energy Efficiency Potential, Goals, and Targets for 2013 and Beyond - Track 1.* May 2012.
[2] Navigant. *2013 California Energy Efficiency Potential and Goals Study*. February 2014.

4. Develop metrics for the CPUC's Energy Efficiency Strategic Plan update.[3] The Plan identifies a number of strategies that move beyond current approaches for energy efficiency resource deployment and lays the groundwork for their implementation. The 2015 Study is expected to inform, as well as be informed by the Plan, by helping to provide metrics, including projections of additional energy savings estimates, for the 2015 Strategic Plan Update Goals. This may include aligning the potential model with strategic plan initiatives, identifying appropriate metrics, characterizing the baseline, developing scenarios, and creating a tracking mechanism.

CPUC policy making informed and directed this study, as outlined in Rulemaking (R.) 09-11-014 and most recently by Decision (D.) 12-05-015, which provided guidance on the 2013-2014 energy efficiency portfolios. D.14-10-046 (Phase I of R.13-11-005) adopted energy efficiency savings goals for 2015 and Phase II of the proceeding will adopt goals for a three year period starting in 2016.[4] The study period spans from 2016-2024 based on the direction provided by CPUC and focuses on current and potential drivers of energy savings in IOU service areas. Analysis of energy efficiency savings in publicly owned utility service territories is not part of the scope of this effort.

The Navigant team and the CPUC have conducted outreach to stakeholders in the development of this model. The comments and questions raised during these meetings have informed the development of the PG Model and the study.

Scope of this Study

The four primary uses of the 2015 and Beyond Potential Study correspond to the four distinct tasks that will be used throughout the project:

- **Task 1 Potential and Goals Study Update.** This task will **i**nform the CPUC as it proceeds to adopt goals for future IOU energy efficiency portfolios.
- **Task 2: Additional Achievable Energy Efficiency (AAEE) Savings Forecast.** This task will develop savings forecasts for use by CPUC, CEC, and CAISO in long term planning exercises.
- **Task 3: Energy Efficiency Targets for Greenhouse Gas Reductions.** This task will quantify how extensively IOU programs and energy efficiency can help meet AB32 goals.
- **Task 4: Metrics to Support the Strategic Plan Update.** This task will help provide metrics, including projections of additional energy savings estimates, for the 2015 Strategic Plan Update Goals.

This report represents the first of multiple updates to the potential study that will occur through 2018. This report focuses on Task 1: Potential and Goals Study Update. Specifically, this report represents the first stage of Task 1 updates (Stage 1). The CPUC and Navigant worked together to determine the appropriate scope of Stage 1 updates given the regulatory timeline for setting 2016 and beyond goals. Stage 1 of Task 1 is primarily a data update to the PG model to inform 2016 and beyond goals; it is the sole topic of this report. The scope of Stage 1 was to:

[3] More information on the Plan can be found at: http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/eesp/
[4] Note that the 2016-2018 period is tentative and will ultimately be determined in Phase II of R.13-11-005.

- Maintain the 2013 PG Model methodology, infrastructure, architecture, and types of output (the 2013 PG model methodology is documented in detail in the 2013 Study report[5]);
- Correct minor issues where the 2013 PG model methodology is not aligned with current CPUC policy; and
- Rely on new secondary data sources to update the PG model with the latest available information to better inform the 2016 and beyond goal setting process.

The majority of the effort undertaken by the team on Stage 1 was to review and incorporate the latest available data into the study. The CPUC provided the following high level direction to Navigant throughout the data update process:

- Database for Energy Efficient Resources (DEER) data must be incorporated for high impact measures including DEER2014 Update and DEER2015 Update.[6]
- 2010-12 Evaluation, Measurement, and Verification (EM&V) impact studies should further update DEER data for residential and commercial measures.
- 2010-12 EM&V evaluations should be used to inform updates to Codes and Standards (C&S) analysis, behavior program analysis, and financing analysis.
- The latest California appliance saturation survey studies should be relied upon for key market data.
- In regards to IOU workpapers, the Navigant team should only rely upon those reports that went through a rigorous CPUC review process (however, un-reviewed workpapers could be used to characterize emerging technologies).
- In regards to Industry Standard Practice (ISP) studies, the Navigant team should only rely upon those that are CPUC vetted and approved.

Given the short timeline of Stage 1, the various data update tasks were prioritized by the team along with CPUC input. Table ES-1 lists the Stage 1 key data update activities along with their assigned priority. The priority indicates the relative level of effort allocated to each update activity; high priority items obtained more attention and resources than low priority items.

[5] Navigant. *2013 California Energy Efficiency Potential and Goals Study*. February 2014. The report is available at http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Energy+Efficiency+Goals+and+Potential+Studies.htm.
[6] The full DEER2016 cannot be incorporated into Stage 1 due to the timeline of the DEER2016 release relative to the timeline of Stage 1. However, the Navigant team did coordinate with the DEER team to best align the study to any new DEER changes and made some high priority adjustments to the potential study in responses based on a draft of DEER2016.

Table ES-1: Stage 1 Data Update Priorities

Key Data Update Activity.	Stage 1 Priority
Update Residential and Commercial measures with the following data sources: DEER, 10-12 EM&V studies, the Measure Cost Study, and saturation studies.	High
Update C&S savings analysis using the 2010-12 impact evaluation study, update methodology to match CPUC policy.	High
Update Agricultural, Industrial, Mining, and Street-Lighting to incorporate the latest Industry Standard Practice studies.	High
Incorporate the latest non-measure inputs regarding retail rates, building stocks, avoided costs, and utility program costs.	High
Update Whole Building Energy Efficiency data using 2010-12 EM&V data, DEER data, CEC building code data, and other available studies.	Medium
Update Emerging Technologies data assumptions, specifically review LED assumptions with regards to the California Lighting Quality Standards.	Medium
Provide the ability to view measure level results from the model.	Medium
Update Behavior and Conservation analysis with latest EM&V and utility data and coordinate with the ongoing CPUC behavior studies.	Low
Update Financing analysis with latest EM&V data and coordinate with the ongoing CPUC financing studies.	Low

Source: Navigant team discussions with CPUC Staff

Sources of Potential

Consistent with the 2013 Study, the 2015 Study examines the potential from the following:

- Residential and Commercial rebated measures
- Agriculture, Industrial, and Mining rebated measures
- Street Lighting measures
- Residential and Commercial behavior programs (home energy reports and building operator certification/training)
- Codes and Standards
- "Emerging Technologies" for the Residential, Commercial, and Street Lighting sectors
- Whole building initiatives (existing building renovation and new construction for the Residential and Commercial sector)
- Low Income programs
- Incremental savings due to energy efficiency financing

Consistent with the 2013 Study, the 2015 Study forecasts energy efficiency potential at three levels for rebate programs:

1. **Technical Potential**: Technical potential is defined as the amount of energy savings that would be possible if the highest level of efficiency for all technically applicable opportunities to improve energy efficiency were taken, including retrofit measures, replace-on-burnout measures, and new construction measures. Technical potential represents the immediate replacement of applicable equipment-based technologies regardless of the remaining useful life of the existing measure. Consistent with industry best practices, technical potential does not and is not meant to account for equipment stock turnover.
2. **Economic Potential**: Using the results of the technical potential analysis, the economic potential is calculated as the total energy efficiency potential available when limited to only cost effective measures.[7] All components of economic potential are a subset of technical potential. Similar to technical potential, economic potential does not account for equipment stock turnover.
3. **Market Potential**: The final output of the potential study is a market potential analysis, which calculates the energy efficiency savings that could be expected in response to specific levels of incentives and assumptions about policies, market influences, and barriers. All components of market potential are a subset of economic potential. Some studies also refer to this as "achievable potential." Market potential is used to inform the utilities' energy efficiency goals, as determined by the CPUC.

The market potential reported in this study is the incremental market potential. The incremental potential represents the annual energy and demand savings achieved by the set of programs and measures in the first year that the measure is implemented. It does not consider the additional savings that the measure will produce over the life of the equipment. A view of incremental savings is necessary in order to understand what additional savings an individual year of energy efficiency programs will produce. This has historically been the basis for IOU program goals.

A large number of variables drive the calculation of market potential. These include assumptions about the manner in which efficient products and services are marketed and delivered, the level of customer awareness of energy efficiency, and customer willingness to install efficient equipment or operate equipment in ways that are more efficient. The Navigant team used the best available current market knowledge and followed these guidelines in developing the recommended market potential:

1. Provide a view of market potential where data sources and calculation methods are transparent and clearly documented.
2. Avoid assumptions and model design decision that would establish goals and targets that are aspirational, but for which the technologies or market mechanisms to attain these goals may not yet be clearly defined.

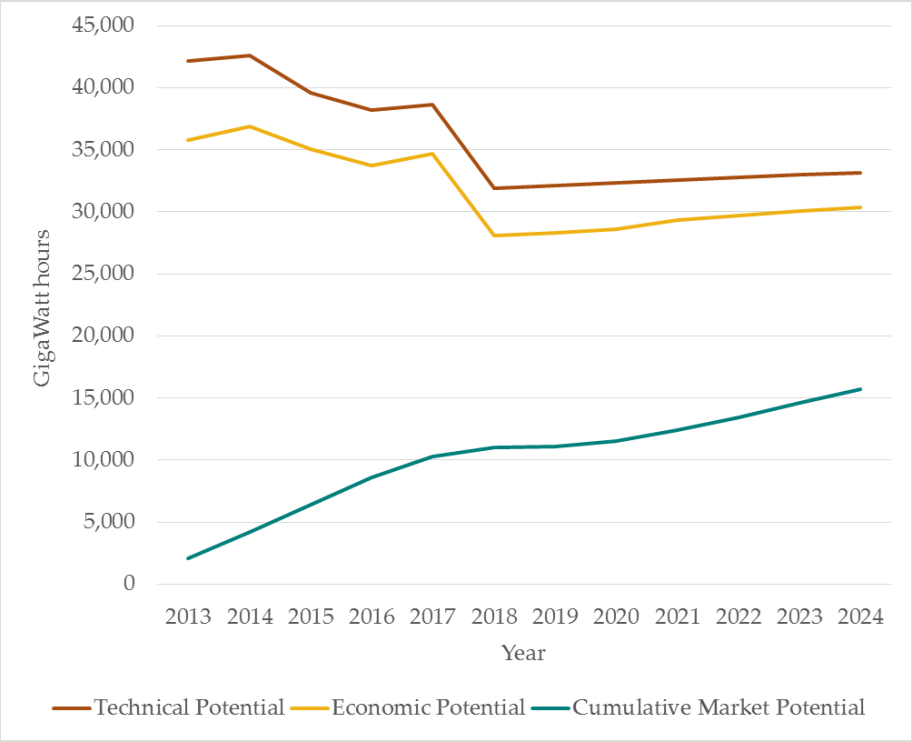
[7] The default assumption for this study includes all non-emerging technologies with a total resource cost (TRC) test of 0.85 or greater; emerging technologies are included if they meet a TRC of 0.5 in a given year and also achieve the TRC for non-emerging technologies (0.85) within ten years of market introduction. The model includes savings from measure bundles commonly adopted for low income programs; low income programs generally have a TRC less than 0.85 and are not required to be cost effective. These measure bundles are thus included for the purposes of calculating economic potential.

With these precepts in mind, the Navigant team considers that the market potential presented in this study is a viable basis for energy efficiency forecasting to which load forecasters, system planners, and resource procurement specialists could agree. However, this study may not capture the upper bound on the total amount of energy efficiency that can be achieved. There may be additional energy savings to capture, particularly from systems efficiency and behavior change, which could not be reliably quantified based on past EM&V results available at the time of this study.

Results

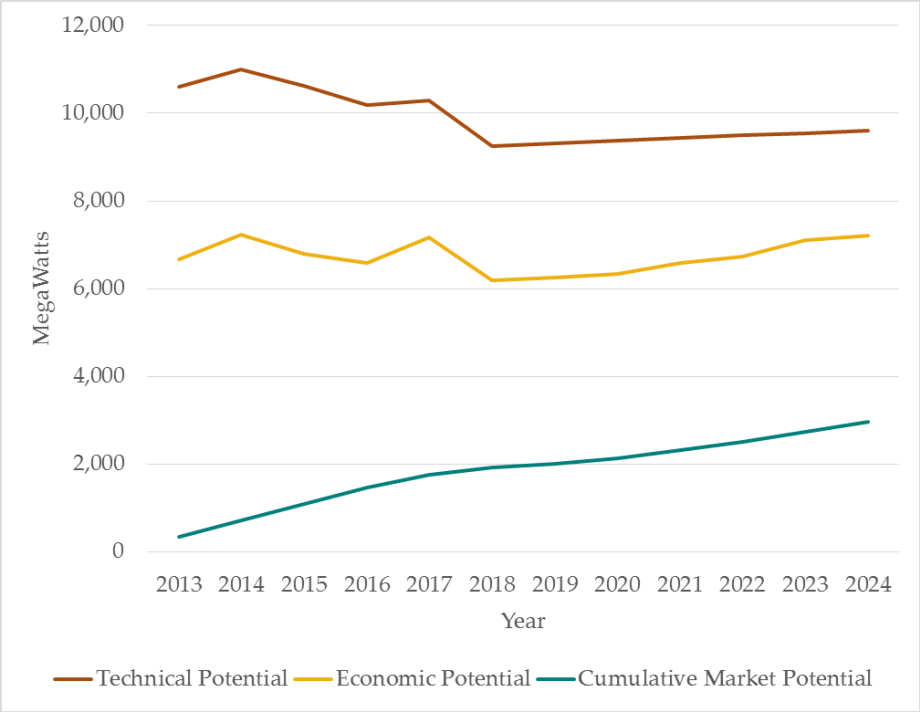
Figure ES-1 and Figure ES-2 illustrate the statewide technical, economic and cumulative market potential for electricity and natural gas respectively. Figure ES-1 shows a technical potential of approximately 38,000 GWh in 2016 and an economic potential of approximately 33,700 GWh. Cumulative market potential grows at a relatively constant rate from 2013 to 2017 when its trajectory slows. This change in trajectory is due to the effects of new lighting C&S that come into effect in 2018 and decrease the IOU claimable savings. Technical and economic potential also decrease in 2018 due to changes in lighting C&S. Figure ES-2 shows a technical potential of approximately 2,000 MMTherms in 2016 and an economic potential of approximately 1,800 MMTherms. Cumulative market potential grows at a relatively constant rate throughout the study period. Section 4.1 of this report contain additional discussion of the technical, economic, and cumulative market potential and also illustrates savings as a percent of energy sales.

Figure ES-1: Statewide Technical, Economic and Cumulative Electric Potential



Source: June 2015 PG Model

Figure ES-2: Statewide Technical, Economic and Cumulative Natural Gas Potential



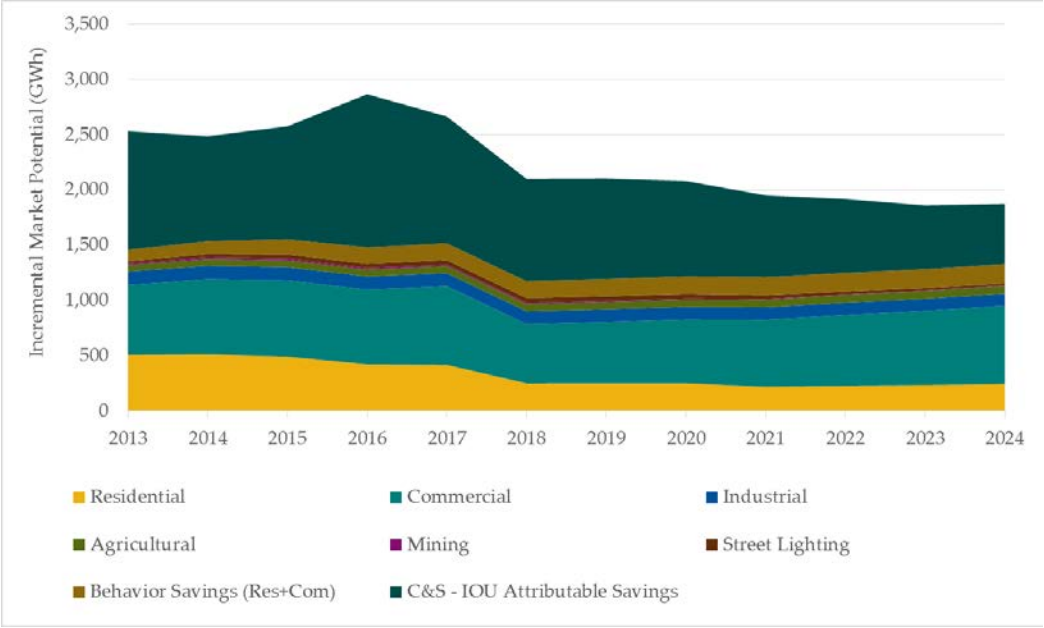
Source: June 2015 PG Model

Figure ES-3 through Figure ES-5 illustrate the statewide incremental market potential from IOU programs for electric (GWh), peak demand (MW) and gas (MMTherms) respectively. These graphs include IOU claimable savings from C&S advocacy programs and behavior programs but they do not include the effects of energy efficiency financing.

Figure ES-3 shows a large portion of IOU potential comes from IOU attributable C&S savings. Residential and Commercial rebated equipment has historically contributed a significant amount of savings to IOU programs and will continue to do so through 2017. In 2018, changes in lighting C&S act to reduce IOU claimable savings. The AIMS sectors remain a small portion of future potential. IOU behavior programs provide more electric savings than the agriculture, mining and streetlighting sectors combined.

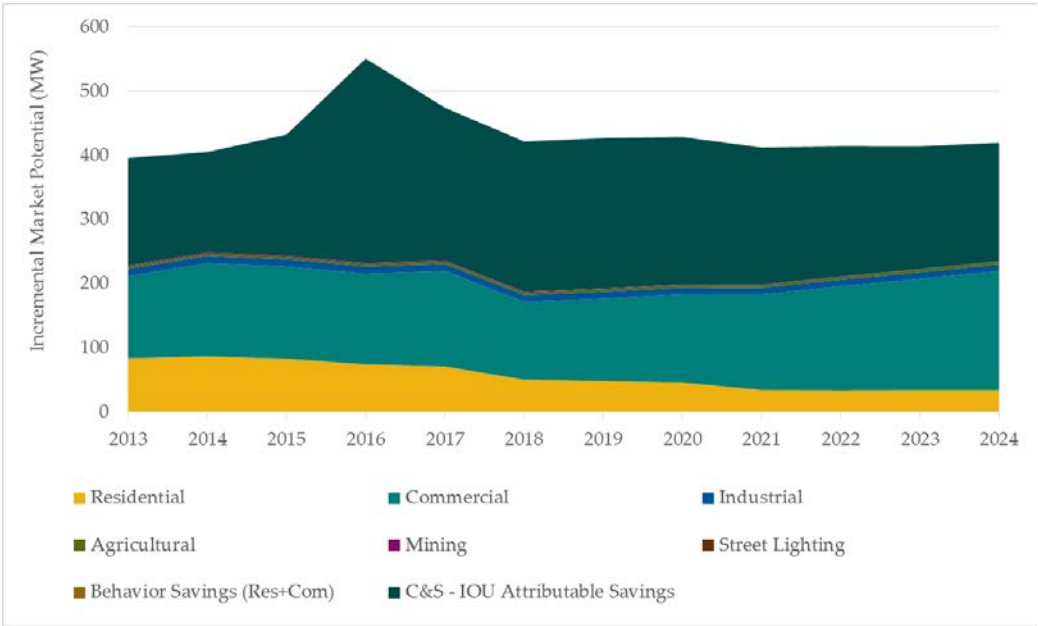
Figure ES-4 shows similar trends for peak demand savings with a few noted differences: behavior programs and street lighting measures do not have any quantified IOU claimable savings potential. Figure ES-4 also shows a spike in expected demand savings in 2016 from C&S. This spike is due to expected 2016 Title 20 HVAC standards regarding air filter labeling.

Figure ES-3: Statewide Incremental Electric Potential



Source: June 2015 PG Model

Figure ES-4: Statewide Incremental Demand Potential

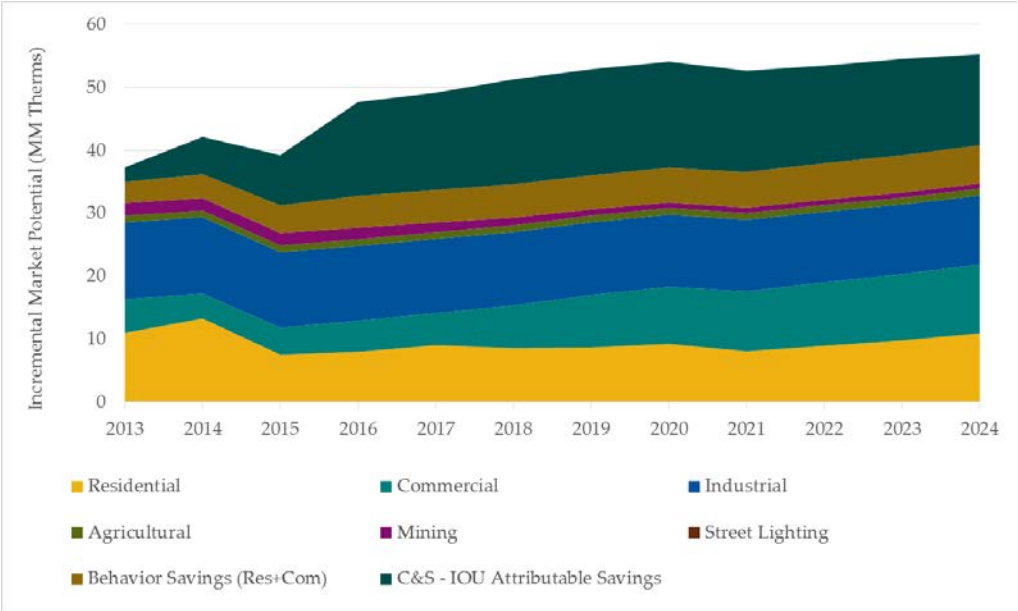


Source: June 2015 PG Model

Figure ES-5 shows larger contributions by the Industrial and Mining sectors towards total gas savings potential. Residential and Commercial savings are expected to grow in 2016 and beyond. C&S savings will continue to play a role in IOU program potential but is not as significant of a contributor when

compared to electric savings. Like electric potential, IOU behavior programs provide more gas savings than the agriculture, mining and streetlighting sectors combined.

Figure ES-5: Statewide Incremental Natural Gas Potential



Source: June 2015 PG Model

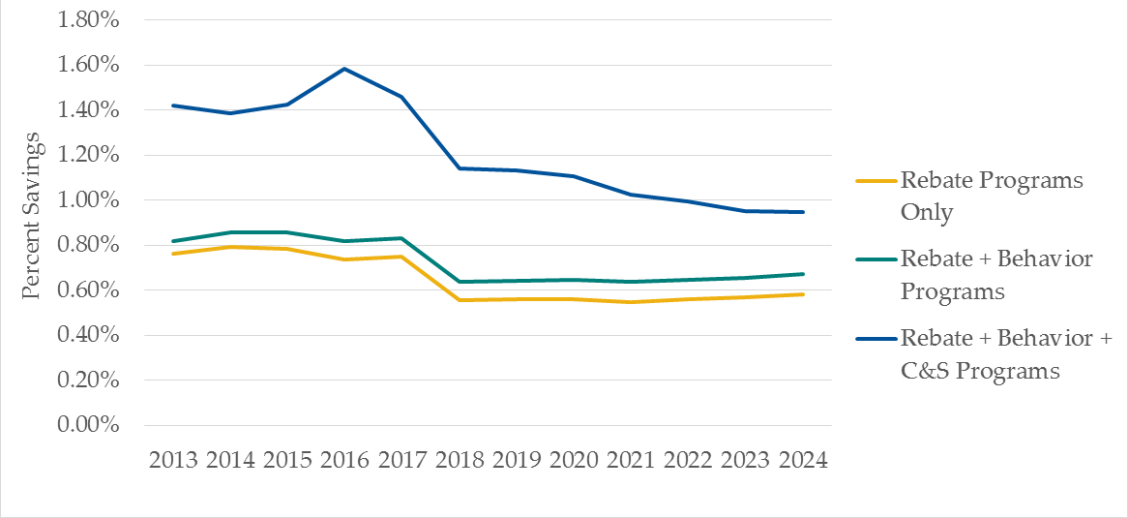
The proposed Assembly Bill 1330 would create an Energy Efficiency Resource Standard (EERS) in California; a statewide target for electric and natural gas efficiency savings. AB 1330, as currently written, would set the following targets:

» Incremental electric savings achieved of no less than 1.5% in 2020 and 2% in 2025

» Incremental natural gas savings achieved of no less than 0.75% in 2020 and 1% in 2025

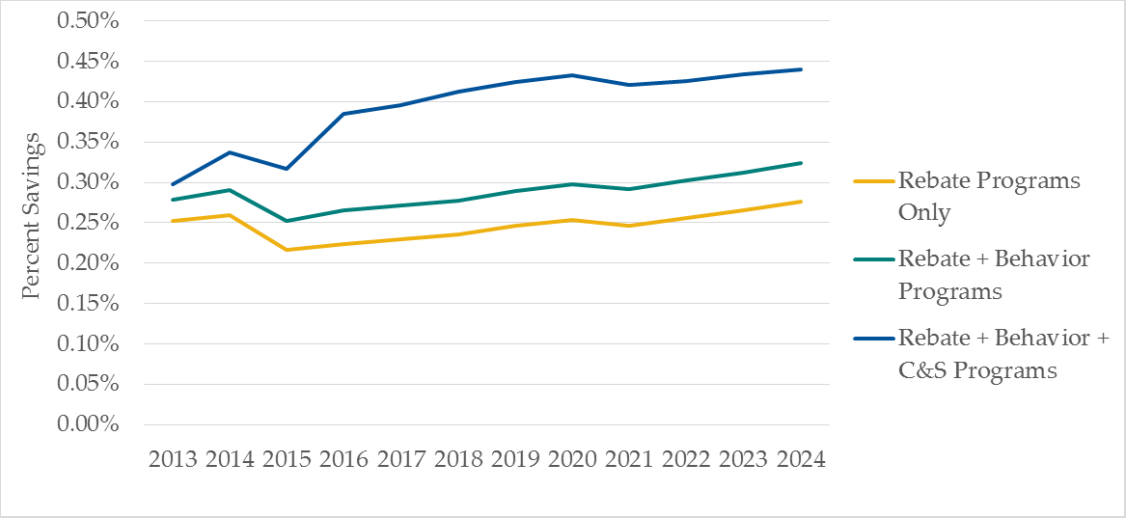
Figure ES-6 illustrates the percent savings in each year considering three sources of savings (rebate programs, behavior programs and IOU C&S programs). It is unclear at this time which sources of savings can and should be counted towards AB 1330 targets. When considering only IOU rebate programs, savings in 2016 amounts to 0.74% of sales. Adding the savings from behavior programs increases the value to 0.82%. The total savings from rebate programs, behavior programs and C&S in 2016 results in 1.58% savings. Savings as a percent of retail sales declines over time. A similar graph for gas savings can be found in Figure ES-7. In all analyzed situations, gas savings is less than 0.5% of CEC forecasted gas sales.

Figure ES-6: Statewide IOU Electric Savings as a Percent of Annual Sales



Source: June 2015 PG Results Viewer

Figure ES-7: Statewide IOU Natural Gas Savings as a Percent of Annual Sales



Source: June 2015 PG Results Viewer

The following tables detail the annual incremental market potential for each IOU from 2016 through 2024. The potential is disaggregated by rebate programs (including behavior programs) as well as net C&S (IOU claimable) savings. Savings values for PG&E and SDG&E include interactive effects (the impact of electric energy efficiency on gas savings) while savings for SCE and SCG exclude these interactive effects. IOU rebate program potential shown in the tables below are gross incremental annual savings while the IOU claimable C&S savings are net IOU attributable annual savings. Savings values for SDG&E further reflect an adjustment to whole building savings to be consistent with CPUC Decision 14-10-046 (further discussion can be found in section 1.4)

Table ES-2: PG&E Market Potential

	GWh			MW			MMTherms		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total
2016	624.5	611.3	1,235.9	85.0	140.6	225.6	12.9	5.5	18.4
2017	637.4	506.5	1,143.9	87.4	105.2	192.6	12.9	5.7	18.6
2018	507.4	408.3	915.7	68.9	103.2	172.1	14.8	6.1	20.9
2019	510.9	401.0	911.9	69.6	103.3	173.0	14.9	6.2	21.1
2020	519.1	380.9	900.0	71.4	101.3	172.7	15.5	6.2	21.7
2021	523.9	326.2	850.1	74.4	94.3	168.8	15.9	5.9	21.8
2022	541.2	294.7	835.9	80.3	89.7	170.0	16.7	5.7	22.4
2023	558.2	254.1	812.3	86.3	84.4	170.7	17.5	5.6	23.2
2024	581.3	239.8	821.1	91.7	81.5	173.3	18.6	5.3	23.9

**Includes behavior programs, excludes effects of financing.*
Source: June 2015 PG Model

Table ES-3: SCE Market Potential

	GWh			MW			MMTherms		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total
2016	673.8	630.5	1,304.4	122.3	145.0	267.3	0.0	0.0	0.0
2017	693.5	522.4	1,215.9	123.0	108.5	231.4	0.0	0.0	0.0
2018	527.7	421.1	948.8	99.4	106.4	205.8	0.0	0.0	0.0
2019	541.8	413.6	955.3	103.1	106.6	209.7	0.0	0.0	0.0
2020	553.0	392.9	945.9	106.9	104.5	211.4	0.0	0.0	0.0
2021	542.4	336.5	878.9	103.3	97.3	200.6	0.0	0.0	0.0
2022	558.8	304.0	862.7	108.6	92.5	201.1	0.0	0.0	0.0
2023	573.2	262.1	835.4	113.2	87.1	200.3	0.0	0.0	0.0
2024	592.8	247.3	840.2	118.8	84.1	202.9	0.0	0.0	0.0

**Includes behavior programs, excludes effects of financing.*
Source: June 2015 PG Model

Table ES-4: SCG Market Potential

	GWh			MW			MMTherms		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S**	Total
2016	0.0	0.0	0.0	0.0	0.0	0.0	17.3	11.7	29.1
2017	0.0	0.0	0.0	0.0	0.0	0.0	18.1	12.2	30.3
2018	0.0	0.0	0.0	0.0	0.0	0.0	16.6	12.7	29.4
2019	0.0	0.0	0.0	0.0	0.0	0.0	18.0	12.6	30.6
2020	0.0	0.0	0.0	0.0	0.0	0.0	18.4	12.2	30.6
2021	0.0	0.0	0.0	0.0	0.0	0.0	17.7	10.9	28.6
2022	0.0	0.0	0.0	0.0	0.0	0.0	18.2	10.3	28.5
2023	0.0	0.0	0.0	0.0	0.0	0.0	18.6	9.6	28.2
2024	0.0	0.0	0.0	0.0	0.0	0.0	19.0	9.1	28.1

**Includes behavior programs, excludes effects of financing.*
***Excludes interactive effects*
Source: June 2015 PG Model

Table ES-5: SDG&E Market Potential

	GWh			MW			MMTherms		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total
2016	181.0	143.1	324.1	24.5	32.9	57.4	2.6	0.6	3.2
2017	185.0	118.6	303.5	25.7	24.6	50.3	2.7	0.6	3.3
2018	140.8	95.6	236.4	19.6	24.1	43.7	3.2	0.7	3.9
2019	143.7	93.8	237.6	20.1	24.2	44.2	3.2	0.7	3.9
2020	147.3	89.2	236.4	20.9	23.7	44.6	3.3	0.7	4.0
2021	146.6	76.4	223.0	21.1	22.1	43.2	3.0	0.7	3.7
2022	151.3	69.0	220.3	22.5	21.0	43.4	3.1	0.6	3.7
2023	154.4	59.5	213.9	23.4	19.8	43.2	3.2	0.6	3.8
2024	158.1	56.1	214.2	24.5	19.1	43.6	3.2	0.6	3.8

**Includes behavior programs, excludes effects of financing. Includes adjustment for whole building savings to be consistent with CPUC Decision 14-10-046*
Source: June 2015 PG Model

Significant data updates have been made in Stage 1 that cause results to depart from those previously stated in the 2013 Study. A comparison of statewide (all IOUs combined) savings found in Table ES-6 through Table ES-8.

Relative to the 2013 study, overall potential from electric rebate programs decreased slightly between 2016 and 2018 while potential from C&S increased during the same period. Thus total electric potential from 2016 to 2018 increased. Rebate program electric potential after 2018 (after major changes in lighting standards take effect) decrease relative to the 2013 study.

Relative to the 2013 study, overall potential from gas rebate programs decreased on the order of 20% from 2016 through 2024. However, during this same period potential from C&S increased significantly relative to the 2013 study. The net effect of both changes is an overall minimal change to the total potential over the 2016-2024 period though a 9% increase is observed in 2016 and 2017.

The key drivers behind the differences in the results of the two studies are listed below.

- The 2015 study uses more up-to date historic market data for the purposes of model calibration. The 2015 study uses evaluated program results from 2010-12 that was not available in the 2013 study as well as better data about the saturation of equipment from saturation surveys (CLASS and CSS).
- Residential and commercial measures assumptions about unit energy savings were sourced from the DEER2015 Update and 10-12 EM&V studies. Some additional adjustments to CFLs, refrigerator recycling, and commercial lighting were made based on DEER2016 and the Ex Ante Uncertain Measures update.
- The 2015 study used updated measure cost data to characterize residential and commercial measures. The 2013 study in some case relied upon cost data from as early as 2008. HVAC and appliance measures saw the largest changes in cost given this data refresh.
- The CEC proved updated building stock and energy consumption forecasts.
- The updated CPUC evaluation of IOU C&S programs (2010-12 EM&V study) shows more savings than previous evaluation results (2006-08 EM&V study)
- Additional data about IOU behavior programs has generally increased behavior program savings
- Better data on LEDs was obtained. LED assumptions are more conservative in both price and efficacy in the 2015 study relative to the 2013 study. This results in a lower LED potential in the 2015 compared to the 2013 study. In the 2013, much of the increase in potential after 2018 came from LEDs. The post-2018 LED potential is more conservative given data updates.

Table ES-6: 2015 Stage 1 vs. 2013 Study Results: Electric Potential (GWh)

	2013 Study			2015 Stage 1			Difference		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total
2016	1,637	937	2,574	1,482	1,385	2,867	-9%	48%	11%
2017	1,600	734	2,334	1,517	1,147	2,665	-5%	56%	14%
2018	1,227	664	1,891	1,177	925	2,102	-4%	39%	11%
2019	1,335	644	1,979	1,196	908	2,105	-10%	41%	6%
2020	1,463	613	2,076	1,219	863	2,082	-17%	41%	0%
2021	1,589	517	2,106	1,213	739	1,952	-24%	43%	-7%
2022	1,720	458	2,178	1,251	668	1,919	-27%	46%	-12%
2023	1,829	366	2,195	1,286	576	1,862	-30%	57%	-15%
2024	1,932	337	2,269	1,332	543	1,875	-31%	61%	-17%

**Includes behavior programs, excludes effects of financing.*
Source: June 2015 PG Model, and 2013 Study

Table ES-7: 2015 Stage 1 vs. 2013 Study Results: Demand Potential (MW)

	2013 Study			2015 Stage 1			Difference		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total
2016	266	192	458	232	319	551	-13%	66%	20%
2017	268	127	395	236	238	475	-12%	88%	20%
2018	218	123	341	188	234	422	-14%	90%	24%
2019	238	122	360	193	234	427	-19%	92%	19%
2020	262	119	381	199	230	429	-24%	93%	13%
2021	285	109	394	199	214	413	-30%	96%	5%
2022	311	103	414	211	203	415	-32%	97%	0%
2023	335	94	429	223	191	414	-33%	103%	-3%
2024	358	90	448	235	185	420	-34%	105%	-6%

**Includes behavior programs, excludes effects of financing.*
Source: June 2015 PG Model, and 2013 Study

Table ES-8: 2015 Stage 1 vs. 2013 Study Results: Natural Gas Potential (MMTherms)

	2013 Study			2015 Stage 1			Difference		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total
2016	39.2	7.3	46.5	32.8	17.9	50.6	-16%	145%	9%
2017	39.0	9.1	48.1	33.7	18.5	52.2	-13%	103%	9%
2018	43.5	10.5	54.0	34.6	19.6	54.2	-20%	87%	0%
2019	45.1	11.2	56.3	36.1	19.5	55.6	-20%	74%	-1%
2020	47.1	11.3	58.4	37.3	19.1	56.3	-21%	69%	-4%
2021	48.9	10.2	59.1	36.6	17.5	54.1	-25%	71%	-9%
2022	50.8	10.0	60.8	38.0	16.6	54.6	-25%	66%	-10%
2023	52.4	9.9	62.3	39.3	15.9	55.2	-25%	61%	-11%
2024	54.1	9.7	63.8	40.8	15.0	55.9	-25%	55%	-12%

**Includes behavior programs, excludes effects of financing.*
Source: June 2015 PG Model, and 2013 Study

1. Introduction

1.1 Context of the Goals and Potential Study

Navigant Consulting, Inc. along with its partners Tierra Resources Consultants LLC, DNV GL, ASWB Engineering, RedHorse Corp, and Opinion Dynamics (collectively known as "the Navigant team") developed this study ("2015 and Beyond Potential and Goals Study") to analyze energy and demand savings potential in the service territories of four of California's investor-owned utilities (IOUs) during the post 2015 energy efficiency (EE) portfolio planning cycle. This report includes results for Pacific Gas and Electric (PG&E), Southern California Edison (SCE), San Diego Gas and Electric (SDG&E), and Southern California Gas (SCG). A key component of the 2015 Potential and Goals Study (2015 Study) is the Potential and Goals Model (PG Model), which provides a single platform in which to conduct robust quantitative scenario analysis that reflects the complex interactions among various inputs and Policy Drivers.

The 2015 Study is the third consecutive potential study conducted by the Navigant team on behalf of the California Public Utilities Commission (CPUC). Navigant conducted the 2011[8] study which informed the 2013-14 IOU program goals and the 2013 Study[9] which was used to inform the 2015 goals for California IOUs. The model developed in the 2013 Study serves as the methodological basis for this study. As such, the 2015 study is considered an "update study" relative to the 2013 Study.

The 2015 Potential and Goals Study supports four related efforts:

1. Inform the CPUC as it proceeds to adopt goals and targets, providing guidance for the next IOU energy efficiency portfolios. The potential model is a framework that facilitates the stakeholder process. The model helps build consensus for goals by soliciting agreement on inputs, methods, and model results.
2. Guide the IOUs in portfolio planning and the state' principal energy agencies in forecasting for procurement, including the planning efforts of the CPUC, California Energy Commission (CEC), and California Independent System Operator (CAISO). Although the model cannot be the sole source of data for IOU program planning activities, it can provide critical guidance for the IOUs as they develop their plans for the 2016 and beyond portfolio planning period. The study is also providing California's principal energy agencies with the tools and resources necessary to develop outputs in a manner that is most appropriate for their planning and procurement needs.
3. Inform strategic contributions to greenhouse gas reduction targets. As the rules and impacts of AB32 are gaining traction, the model must account for (greenhouse gas) GHG savings estimates. This will provide an opportunity to understand how extensively IOU programs and energy

[8] Navigant. *Analysis to Update Energy Efficiency Potential, Goals, and Targets for 2013 and Beyond - Track 1.* May 2012.
[9] Navigant. *2013 California Energy Efficiency Potential and Goals Study*. February 2014. The report is available at http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Energy+Efficiency+Goals+and+Potential+Studies.htm.

efficiency can help meet AB32 goals. Navigant will work with the CPUC and stakeholders to develop stretch GHG reduction scenarios.

4. Develop metrics for the CPUC's Energy Efficiency Strategic Plan update.[10] The Plan identifies a number of strategies that move beyond current approaches for energy efficiency resource deployment and lays the groundwork for their implementation. The 2015 Study is expected to inform, as well as be informed by the Plan, by helping to provide metrics, including projections of additional energy savings estimates, for the 2015 Strategic Plan Update Goals. This may include aligning the potential model with strategic plan initiatives, identifying appropriate metrics, characterizing the baseline, developing scenarios, and creating a tracking mechanism.

CPUC policy making informed and directed this study, as outlined in Rulemaking (R.) 09-11-014 and most recently by Decision (D.) 12-05-015, which provided guidance on the 2013-2014 energy efficiency portfolios. D.14-10-046 (Phase I of R.13-11-005) adopted energy efficiency savings goals for 2015 and Phase II of the proceeding will adopt goals for a three year period starting in 2016.[11] The study period spans from 2016-2024 based on the direction provided by CPUC and focuses on current and potential drivers of energy savings in IOU service areas. Analysis of energy efficiency savings in publicly owned utility service territories is not part of the scope of this effort.

The Navigant team and the CPUC have conducted outreach to stakeholders in the development of this model. The comments and questions raised during these meetings have informed the development of the PG Model.

1.2 Scope of this Study

The four primary uses of the 2015 and Beyond Potential Study correspond to the four distinct tasks that will be used throughout the project:

- **Task 1 Potential and Goals Study Update.** This task will inform the CPUC as it proceeds to adopt goals for future IOU energy efficiency portfolios.
- **Task 2: Additional Achievable Energy Efficiency (AAEE) Savings Forecast.** This task will develop savings forecasts for use by CPUC, CEC, and CAISO in long term planning exercises.
- **Task 3: Energy Efficiency Targets for Greenhouse Gas Reductions.** This task will quantify how extensively IOU programs and energy efficiency can help meet AB32 goals.
- **Task 4: Metrics to Support the Strategic Plan Update.** This task will help provide metrics, including projections of additional energy savings estimates, for the 2015 Strategic Plan Update Goals.

The Navigant team is contracted through 2018 to support the development of the PG Model and provide results for each of the four above listed tasks. This report represents the first of multiple updates to the potential study that will occur through 2018. This report focuses on Task 1: Potential and Goals Study Update. Specifically, this report represents the first stage of Task 1 updates (Stage 1). The CPUC and

[10] More information on the Plan can be found at: http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/eesp/
[11] Note that the 2016-2018 period is tentative and will ultimately be determined in Phase II of R.13-11-005.

Navigant worked together to determine the appropriate scope of Stage 1 updates given the regulatory timeline for setting 2016 and beyond goals.

1.2.1 Stage 1

Stage 1 of Task 1 is primarily a data update to the PG model to inform 2016 and beyond goals; it is the sole topic of this report. The scope of Stage 1 is to:

- Maintain the 2013 PG Model methodology, infrastructure, architecture, and types of output;
- Correct minor issues where the 2013 PG model methodology is not aligned with current CPUC policy; and
- Rely on new secondary data sources to update the PG model with the latest available information to better inform the 2016 and beyond goal setting process.

The majority of the effort undertaken by the team on Stage 1 was to review and incorporate the latest available data into the study. The CPUC provided the following high level direction to Navigant throughout the data update process:

- Database for Energy Efficient Resources (DEER) data must be incorporated for high impact measures including the DEER2014 Update and DEER2015 Update.[12]
- 2010-12 Evaluation, Measurement, and Verification (EM&V) impact studies should further update DEER data for residential and commercial measures.
- 2010-12 EM&V evaluations should be used to inform updates to Codes and Standards (C&S) analysis, behavior program analysis, and financing analysis.
- The latest California appliance saturation survey studies should be relied upon for key market data.
- In regards to IOU workpapers, the Navigant team should only rely upon those reports that went through a rigorous CPUC review process (however, un-reviewed workpapers could be used to characterize emerging technologies).
- In regards to Industry Standard Practice (ISP) studies, the Navigant team should only rely upon those that are CPUC vetted and approved.

The Navigant team conducted analysis on Stage 1 from November 2014 through June 2015. The majority of the analysis (data collection, model development, and results analysis) was conducted from November 2014 to March 2015. Given the short timeline of Stage 1, the various data update tasks were prioritized by the team along with CPUC input. Table 1-1 lists the Stage 1 key data update activities along with their assigned priority. The priority indicates the relative level of effort allocated to each update activity; high priority items obtained more attention and resources than low priority items. Data collection for high priority updates ended in December 2014 to allow the Navigant team the requisite

[12] The full DEER2016 cannot be incorporated into Stage 1 due to the timeline of the DEER2016 release relative to the timeline of Stage 1. However, the Navigant team did coordinate with the DEER team to best align the study to any new DEER changes and made some high priority adjustments to the potential study in responses based on a draft of DEER2016.

time to review and process the data. Medium and low priority updates continued to receive data through early February at which point data collection activities were stopped in order to deliver draft results on March 17, 2015. Additional, data updates in response to stakeholder comments and CPUC direction were made in early June of 2015, see Section 1.4 for more detail.

Table 1-1: Stage 1 Data Update Priorities

Key Data Update Activity	Stage 1 Priority
Update Residential and Commercial measures with the following data sources: DEER, 10-12 EM&V studies, the Measure Cost Study, and saturation studies	High
Update C&S savings analysis using the 2010-12 impact evaluation study, update methodology to match CPUC policy	High
Update Agricultural, Industrial, Mining, and Street-Lighting to incorporate the latest Industry Standard Practice studies	High
Incorporate the latest non-measure inputs regarding retail rates, building stocks, avoided costs, and utility program costs	High
Update Whole Building Energy Efficiency data using 2010-12 EM&V data, DEER data, CEC building code data, and other available studies	Medium
Update Emerging Technologies data assumptions, specifically review LED assumptions with regards to the California Lighting Quality Standards	Medium
Provide the ability to view measure level results from the model	Medium
Update Behavior and Conservation analysis with latest EM&V and utility data and coordinate with the ongoing CPUC behavior studies	Low
Update Financing analysis with latest EM&V data and coordinate with the ongoing CPUC financing studies	Low

Source: Navigant team discussions with CPUC Staff

1.2.2 Stage 2

Stage 2 will continue to update Task 1 and further refine the data, assumptions, and methodology used to inform the IOU goal setting process. Work on Stage 2 is expected to start in July 2015. The exact scope and timeline for Stage 2 has yet to be determined, the Navigant team is coordinate with the CPUC to better define the scope and schedule. Stakeholders will be invited to participate in the scoping process. The following items are possible updates for Task 1 in Stage 2 (pending further discussions with the CPUC):

- Integrate DEER2016 Update data
- Review Agriculture Industrial, Mining and Street Lighting data to better align with the California market
- Update savings from future codes and standards
- Add new advanced and emerging technologies to the study
- Consider modeling methodology changes as appropriate
- Update whole building initiatives with better cost and market applicability data

1.3 Types of Potential

Consistent with the 2013 Study, the 2015 Study forecasts energy efficiency potential at three levels for rebate programs:

1. **Technical Potential**: Technical potential is defined as the amount of energy savings that would be possible if the highest level of efficiency for all technically applicable opportunities to improve energy efficiency were taken, including retrofit measures, replace-on-burnout measures, and new construction measures. Technical potential represents the immediate replacement of applicable equipment-based technologies regardless of the remaining useful life of the existing measure. Consistent with industry best practices, technical potential does not and is not meant to account for equipment stock turnover. Technical potential represents the potential from individual, equipment based measures. It does not account for behavior programs, IOU claimable savings from codes and standards, or whole building initiatives. In this study, technical potential represents the remaining opportunities for energy efficiency relative to the state of the market as of 2013.
2. **Economic Potential**: Using the results of the technical potential analysis, the economic potential is calculated as the total energy efficiency potential available when limited to only cost effective measures.[13] All components of economic potential are a subset of technical potential. Similar to technical potential, economic potential does not account for equipment stock turnover. The technical and economic potential represent the total energy savings available each year that are above the baseline of the Title 20/24 codes and federal appliance standards.
3. **Market Potential**: The final output of the potential study is a market potential analysis, which calculates the energy efficiency savings that could be expected in response to specific levels of incentives and assumptions about policies, market influences, and barriers. All components of market potential are a subset of economic potential. Some studies also refer to this as "achievable potential." Market potential is used to inform the utilities' energy efficiency goals, as determined by the CPUC.

Market potential can be represented three different ways; each is based on the same data and assumptions though each serve separate needs and provide necessary perspectives.

1. **Incremental savings** represent the annual energy and demand savings achieved by the set of programs and measures in the first year that the measure is implemented. It does not consider the additional savings that the measure will produce over the life of the equipment. A view of incremental savings is necessary in order to understand what additional savings an individual year of energy efficiency programs will produce. This has historically been the basis for IOU program goals.

[13] The default assumption for this study includes all non-emerging technologies with a total resource cost (TRC) test of 0.85 or greater; emerging technologies are included if they meet a TRC of 0.5 in a given year and also achieve the TRC for non-emerging technologies (0.85) within ten years of market introduction. The model includes savings from measure bundles commonly adopted for low income programs; low income programs generally have a TRC less than 0.85 and are not required to be cost effective. These measure bundles are thus included for the purposes of calculating economic potential.

2. **Cumulative savings** represent the total savings from energy efficiency program efforts from measures installed since 2013 including the current program year, and are still active in the current year. It includes the decay of savings as measures reach the end of their useful lives. Cumulative savings also account for the timing effects of codes and standards that become effective after measure installation. This view is necessary for demand forecast, but creates challenges in accounting for IOU program goals.
3. **Life-cycle savings** refer to the expected trajectory of savings from an energy efficiency measure (or portfolio of measures) over the estimated useful life of the measure(s), taking account of any natural decay or persistence in performance over time. Whereas cumulative savings are a backward look at all measures installed in the past that are producing current savings, life-cycle savings accounts for all future savings from measures installed in the current year. Life-cycle savings is used to inform cost-effectiveness evaluations and could be an appropriate basis for IOU program goals.

A large number of variables drive the calculation of market potential. These include assumptions about the manner in which efficient products and services are marketed and delivered, the level of customer awareness of energy efficiency, and customer willingness to install efficient equipment or operate equipment in ways that are more efficient. The Navigant team used the best available current market knowledge and followed these guidelines in developing the recommended market potential:

1. Provide a view of market potential where data sources and calculation methods are transparent and clearly documented.
2. Avoid assumptions and model design decision that would establish goals and targets that are aspirational, but for which the technologies or market mechanisms to attain these goals may not yet be clearly defined.

With these precepts in mind, the Navigant team considers that the market potential presented in this study is a viable basis for energy efficiency forecasting to which load forecasters, system planners, and resource procurement specialists could agree. However, this study may not capture the upper bound on the total amount of energy efficiency that can be achieved. There may be additional energy savings to capture, particularly from systems efficiency and behavior change, which could not be reliably quantified based on past evaluation results available at the time of this study.

1.4 Changes relative to the May 2015 Draft Release

Several data updates have been made to the potential study since the May 2015 release. A draft version of DEER2016 was published for the first time; the release coincided with the potential study's May 2015 release. While the Navigant team was in communication with the DEER team prior to the release, final impacts of key data were unavailable to the Navigant team during the development of MICS. Several updates have been made to the potential study as a result of the DEER team's review of 2010-12 EM&V data and incorporation into DEER2016. Additionally, Navigant reviewed key data sources for the AIMS sectors as well as IOU Low Income Programs. As a result of this data review, the following updates have been made:

- The EUL for all residential CFL measures (basic, specialty, and reflector in indoor and outdoor applications) have been decreased to 3.5 years (previous values ranged from 4.5-11 years depending on the measure). This update was made based on the CPUC's uncertain measure review.[14] This decrease in EUL has two effects: 1) stock turnover of bulbs in the residential sector increases thus slightly increasing the future potential of LEDs, and 2) cumulative savings in the residential sector decreases in future years as CFL savings can only be counted on for 3.5 years.
- Commercial lighting hours of use assumptions have been updated in DEER2016. HOU assumption vary by building type and proportionally impact unit energy savings. In some building types the team observed a 50% decrease in HOUs relative to DEER2015 while other building types remained similar or slightly increased. These changes applied to CFLs, linear fluorescents, and their respective LED equivalents. The net impact of these HOU changes is a decrease in commercial lighting potential. These impacts go into effect starting in 2016 thus calibration is not affected.
- DEER2016 updated the unit energy savings assumptions and net to gross assumptions for residential refrigerator recycling. The unit energy savings decrease on the order of 50% while net to gross increased slightly. The net impact is a significant reduction in savings from residential refrigerator recycling relative to the May 2015 results. These impacts go into effect starting in 2016 thus calibration is not affected.
- Based on verbal and written comments from stakeholders regarding the results from the AIMS sectors, Navigant reviewed key inputs in greater detail. Navigant found a minor update to the AIMS sector was warranted to use the latest available building stock, energy consumption, and building type distribution data available from the CEC. The update lead to a slight decrease in IOU market potential savings.
- Navigant worked with CPUC's low income staff to review and revise the input assumptions regarding low income programs. Savings per participant and estimated number of participants were updated in the model. A key change relative to the May 2015 release is the new assumption that low income programs in their current form will stop operation after 2020, no potential from low income is forecasted in 2021 or beyond. For additional details regarding data updates see Section 3.8.

Navigant made an additional downward adjustment to SDG&E's whole building energy savings at the direction of the CPUC. CPUC Decision 14-10-046 says in regards to whole building savings for SDG&E:

> *"It is going to take some "ramping-up" to achieve such a dramatic increase in savings. Accordingly, we have adjusted SDG&E's 2015 goal to reflect 120% of SDG&E's recent annual savings claims for commercial whole building retrofit programs. This considers (but does not require) a linear, five-year ramp up to the level of savings the draft 2013 Study forecasts for SDG&E."*

The 2015 study shows a decreased savings potential from whole building initiative relative to the 2013 study; however, Navigant made a further adjustment to SDG&E's potential to remain consistent with D.

[14] CPUC. *Ex Ante Update for ESPI Uncertain measures - Compact Fluorescent Lamps 30 Watts and Less.* May 2015.

14-10-046. This adjustment was made based on a 4-year ramp starting in 2016 (similar to the previous 5-year ramp methodology in which 2015 was the first year of the ramp). This ramp assumes 2015 whole building savings for SDG&E are equivalent to the adjusted value found in the SDG&E's 2015 goal and 2019 whole building savings are equal to the 2019 forecast from the PG study. A linear ramp is used between these two years. The result is a small adjustment to SDG&E potential in 2016 through 2018.

1.5 Contents of this Report

This report documents the data relied upon by and the results of the 2015 and Beyond Potential and Goals Study – Stage 1. It does not discuss Task 2, Task 3, or Task 4.

- **Section 2** provides an overview of the study's methodology. Note that the majority of the study's methodology is the same as the 2013 study. Section 2 in many instances refers readers to the 2013 Study for more details on the methodology.
- **Section 3** provides details on the data update process for each key area of the study. Section 3 describes the data sources and process taken to incorporate the data into the PG Model.
- **Section 4** provides the 2015 PG Model results.
  - Section 4.1 discusses the statewide (all IOUs combined) technical, economic and market potential in California.
  - Section 4.2 contains the incremental market potential for each IOU, these are the basis for the IOU goal setting process.
  - Section 4.3 documents the effects of energy efficiency financing on the market potential.
  - Section 4.4 describes how readers can access detailed results from the PG study include end use and sector specific results for each IOU.
  - Section 4.5 compares the results of this study to the results of the 2013 Study.
- **Appendices** provide additional details for key topic areas.

Aside from this report, the following are available to the public:

- **2015 PG Model File** – an Analytica based file that contains the PG model used to create the results of this study;
- **2015 PG Results Viewer** – a spreadsheet viewer that contains detailed results at the measure level for the mid-case scenario (the basis of the results of this study); and
- **2015 PG MICS** – a spreadsheet version of the Measure Input Characterization System documenting all final values for all measures used in the model.

These additional documents and files can be found on the CPUC's website.[15]

[15] http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Energy+Efficiency+Goals+and+Potential+Studies.htm

2. Study Methodology

2.1 Modeling

The primary purpose of the 2015 Study is to provide the CPUC with information and analytical tools to engage in goal setting for the next IOU energy efficiency portfolio. In addition, this study informs forecasts used for procurement planning. The model itself does not establish any regulatory requirements. This section provides a brief overview of the modeling methodology used for the 2015 Potential and Goals Study. The modeling methodology remains the same as that used in the 2013 Study. For more information on the specific methodology for different parts of the model, please reference the 2013 Study report.

The 2015 model forecasts potential energy savings from a variety of sources within six distinct sectors: Residential, Commercial, Agricultural, Industrial, Mining, and Street Lighting. Within some or all of the sectors, sources of savings include:

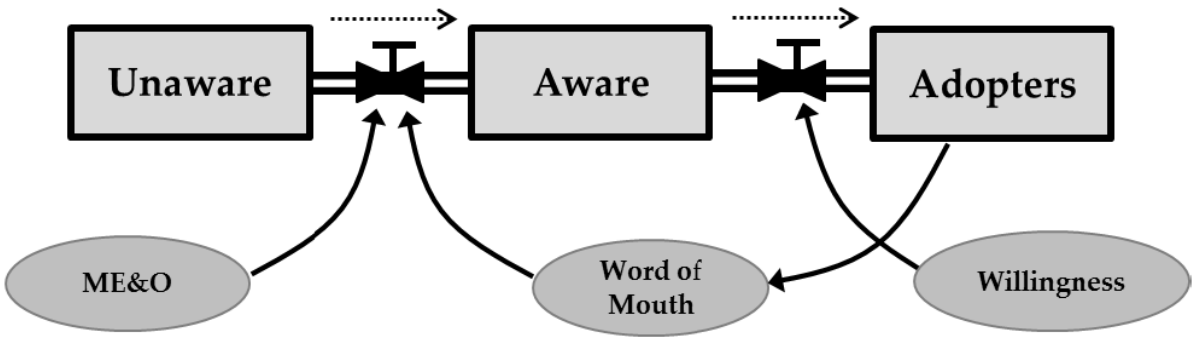
- Emerging Technology – Emerging technologies were examined for the Residential, Commercial, and Street-lighting sectors. These sectors are modeled using individual measures for specific applications.
- Behavior - For the purposes of this study, the Navigant team defines behavior-based initiatives as those providing information about energy use and conservation actions, rather than financial incentives, equipment, or services.
- Financing - Financing has the potential to break through a number of market barriers that have limited the widespread market adoption of cost-effective energy efficiency measures. The PG Model estimates the incremental effects of introducing energy efficiency financing on energy efficiency market potential and how shifting assumptions about financing affect the potential energy savings.
- Whole Building - In the case of whole-building initiatives, the "measure" is characterized for the building retrofit or house retrofit rather than for specific technology or end uses. Whole building initiatives are modeled for the Residential and Commercial sectors.
- Low Income – The methodology for the low-income sector remains unchanged from the 2013 Study. Data was updated to reflect the most recent information available from the CPUC regarding savings per participant and forecasted participants.
- Codes and Standards - Codes and standards are implemented and enforced either by federal or state governmental agencies. Codes regulate building design, requiring builders to incorporate high-efficiency measures. Standards set minimum efficiency levels for newly manufactured appliances. The Navigant team assessed energy savings potentials for three types of C&S:
    - Federal appliance standards
    - Title 20 appliance standards
    - Title 24 building energy efficiency codes

Consistent with the 2013 Study, the 2015 PG Model forecasts three levels of energy efficiency potential (technical, economic, and market) as described earlier in section 1.3 To estimate the market potential for the Residential, Commercial, Mining, and Street Lighting sectors, the model employs a bottom-up

dynamic Bass Diffusion approach to simulate market adoption of efficient measures. The bass diffusion model is illustrated in Figure 2-1 and contains three parameters:

- ***Marketing, education, and outreach*** (ME&O) moves customers from the *unaware* group to the *aware* group at a consistent rate annually. Unaware customers, as the name implies, have no knowledge of the energy efficient technology option. Aware customers are those that have knowledge of the product and understand its attributes. ME&O is often referred to as the "Advertising Effect" in Bass Diffusion modeling.
- ***Word of mouth*** represents the influence of adopters (or other aware consumers) on the unaware population by informing them of efficient technologies and their attributes. This influence increases the rate at which customers move from the unaware to the aware group; the word-of-mouth influence occurs in addition to the ongoing ME&O. When a product is new to the market with few installations, often ME&O is the main source driving unaware customers to the aware group. As more customers become aware and adopt, however, word of mouth can have a greater influence on awareness than ME&O, and leads to exponential growth. The exponential growth is ultimately damped by the saturation of the market, leading to an S-shaped adoption curve, which has frequently been observed for efficient technologies.
- ***Willingness*** is the key factor affecting the move from an aware customer to an adopter. Once customers are aware of the measure, they consider adopting the technology based on the financial attractiveness of the measure. The PG Model applies a levelized measure cost to assess willingness; the levelized measure cost considers upfront cash outflows as well as cash outflows

Figure 2-1: The Bass Diffusion Framework is a Dynamic Approach to Calculating Measure Adoption



Source: Adapted from Sterman, 2000.

The Navigant team calculated energy efficiency potential in the industrial and agricultural sectors using a top-down supply curve approach as detailed in the 2013 Study report.

Like the 2013 PG model, the 2015 model was developed in the Analytica software platform. The inputs and user interface are designed for customizability and ease of use. Figure 2-2 depicts a screenshot of the model user interface.

Figure 2-2: The 2015 Potential Goals Model User Interface

2.2 *Methodology Changes Relative to 2013 Study*

As previously mentioned, the modeling methodology remains largely the same as the 2013 study. Table 2-1 lists the key modeling methodology topics, along with the relevant methodology sections from the 2013 study. Readers should reference the 2013 study for additional modeling methodology details. The only noted methodology change from the 2013 study is the treatment of codes and standards; this difference is further explained following the table.

Table 2-1: Comparing 2015 and Beyond Methodology to 2013 Study

Methodology Topic	Modeling Methodology used in this Study	2013 Study Relevant Methodology Sections
Forecasting Adoption of Rebated Measures	Same as 2013 Study	3.3.1 3.3.2.1
Agriculture, Industrial, Mining and Street Lighting Special Considerations	Same as 2013 Study	Section 4 Appendix G – J Appendix T
Emerging Technologies Special Considerations	Same as 2013 Study	3.1.1.1
Whole Building Initiatives Special Considerations	Same as 2013 Study	3.3.2.3 Appendix E
Modeling Behavior Energy Efficiency Initiatives	Same as 2013 Study	3.3.2.5
Modeling Energy Efficiency Financing	Same as 2013 Study	3.3.2.4 Appendix F
Modeling Codes and Standards (Impact on IOU Rebate Programs)	Same as 2013 Study	3.3.2.2 Appendix D.1 Appendix D.2
Modeling Codes and Standards (IOU Attributable Savings)	Modified relative to 2013 Study	3.3.2.2 Appendix D.3

Source: Navigant team analysis (2015)

The 2015 PG Model's analysis of IOU attribute Codes and Standards (C&S) savings follows the same methodology as that used in the 2013 study with one update. Some new California standards supersede efficiency levels set by earlier standards. Two options are available to model the IOU attributable savings these types of standards:

- **Layering:** The first standard produces the first "layer" of savings and each later standard adds another layer of savings.
- **No Layering:** Savings from earlier superseded standards end when a new, more stringent standard takes effect. Only incremental savings from the most recent standard are included.

The CPUC 's Evaluation Study[16] used the Integrated Standards Savings Model[17] developed by CADMUS and DNV GL. Commission staff and evaluators reviewed all of the codes and standards being evaluated in the ISSM model. To qualify as an instance of layering, standards must be adopted separately (not at the same time, as happens when one standard includes two tiers that take effect at different times).

[16] Cadmus, Energy Services Division and DNV GL. *Statewide Codes and Standards Program Impact Evaluation Report For Program Years 2010-2012.* August 2014.
[17] Cadmus, Energy Services Division and DNV GL. *Integrated Standards Savings Model (ISSM).* Last accessed: January 2015.

Additionally, the superseding code or standard must regulate the same feature(s) of a product.[18] See section 2.2.2 of the Evaluation Study for further details.

Stage 1 uses no layering when calculating results. This is a methodology change relative to the 2013 study which did include layering in accounting for IOU attributable savings. This change is made to the methodology to better align with CPUC policy regarding savings accounting for C&S. The measures that were superseded by later standards and thus are affected by this methodology change were General Service Incandescent Lamps, Tier 2 and Consumer Electronics – TVs.

2.3 Model Calibration

Like any model that forecasts the future, the PG model faces challenges with validating results, as there is no future basis against which one can compare simulated versus actual results. Calibration, however, provides both the developer and recipient of model results with a level of comfort that simulated results are reasonable. Calibration is intended to achieve three main purposes:

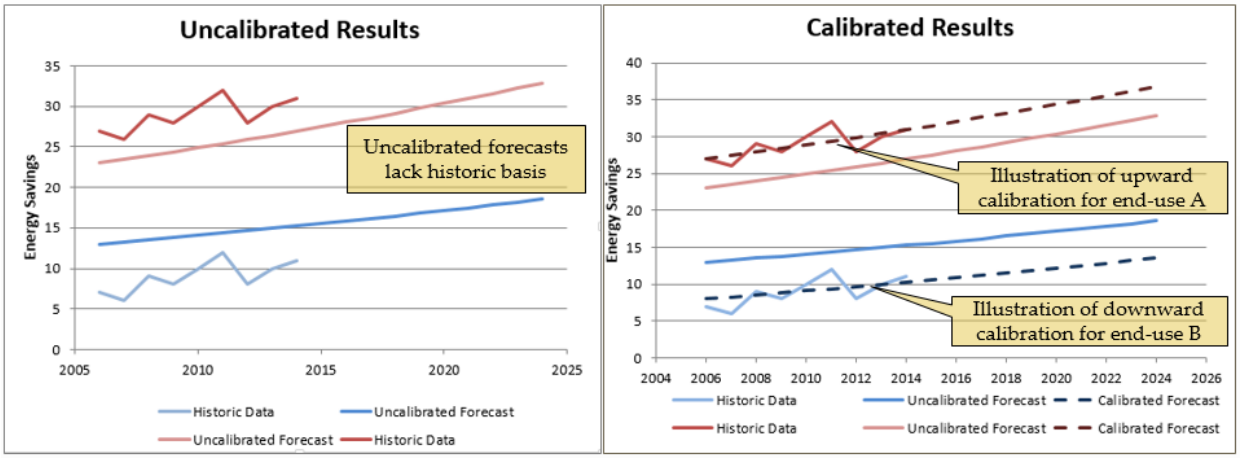
- Anchors the model in actual market conditions and ensures that the bottom-up approach to calculating potential can replicate previous market conditions;
- Ensures a realistic starting point from which future projections are made; and
- Accounts for varying levels of market barriers across different types of technologies. The model applies general market and consumer parameters to forecast technology adoption. There are often reasons that markets for certain end uses or technologies behave differently than the norm-both higher and lower. Calibration offers a mechanism for using historic observations to account for these differences.

The PG model is calibrated by reviewing portfolio data from 2006 up through 2012 to assess how the market has reacted to program offerings in the past. The Navigant team used ex-post EM&V data from 2006-2012 as the calibration data and also compared results to the 2013-2014 compliance filing data. The 2013-2014 data was not incorporated into the model calibration because the evaluated data set is not yet available. The Navigant team used the calibration data to adjust willingness and awareness parameters that drive measure adoption over the modeling period. This calibration method (a) tracks what measures have been installed or planned for installation over an historic eight-year period and (b) forecasts how remaining stocks of equipment will be upgraded, including the influence of various factors such as new codes and standards, emerging technologies, or new delivery mechanisms (e.g., financing or whole-building initiatives). This calibration approach is not applied to emerging technologies, as there is no historical basis to adjust future adoption for these technologies.

Figure 2-3 provides a conceptual illustration of how the calibration process affects market potential.

[18] Cadmus, Energy Services Division and DNV GL. *Statewide Codes and Standards Program Impact Evaluation Report For Program Years 2010-2012.* August 2014.

Figure 2-3: Conceptual Illustration of Calibration Effects on Market Potential



Source: Navigant team analysis 2015.

Calibration provides a more accurate estimate of the current state of customer willingness, market barriers, program characteristics and remaining adoption potential. Although calibration provides a reasonable historic basis for estimating future market potential, past program achievements may not perfectly indicate the full potential of future programs. Calibration can be viewed as holding constant certain factors that might otherwise change future program potential, such as:

- Consumer values and attitudes toward energy efficient measures;
- Market barriers associated with different end uses;
- Program efficacy in delivering measures; and
- Program spending constraints and priorities.

Changing values and shifting program characteristics would likely cause deviations from market potential estimates that are calibrated to past program achievements. For more details on the necessity of calibration, the data basis of calibration, effects of calibration, and interpreting calibration please see Appendix A. The appendix also addresses the irrelevance of an "uncalibrated" forecast while offering a supporting discussion about scenario analyses not directly related to the process of calibration but relevant to stakeholder concerns about the interpretation of calibrated results.

2.4 Scenarios

The PG model can run numerous scenarios based on changes to key variables. The 2015 PG Model maintains the same scenario variable options as the 2013 PG model (additional information is available in section 3.3.4 of the 2013 Study). This report presents the results for the mid-case scenario.

- The mid-case scenario has historically been used to inform the IOU goal setting process.
- The mid case scenario is the default setting that the PG model uses to produce results.
- The mid-case scenario in this report retains the same assumptions used in the mid-case scenario in the 2013 study.

» The mid-case scenario is based on population, consumption, and economic inputs defined in the mid-case of the California Energy Commission's 2014 Integrated Energy Policy Report (IEPR).

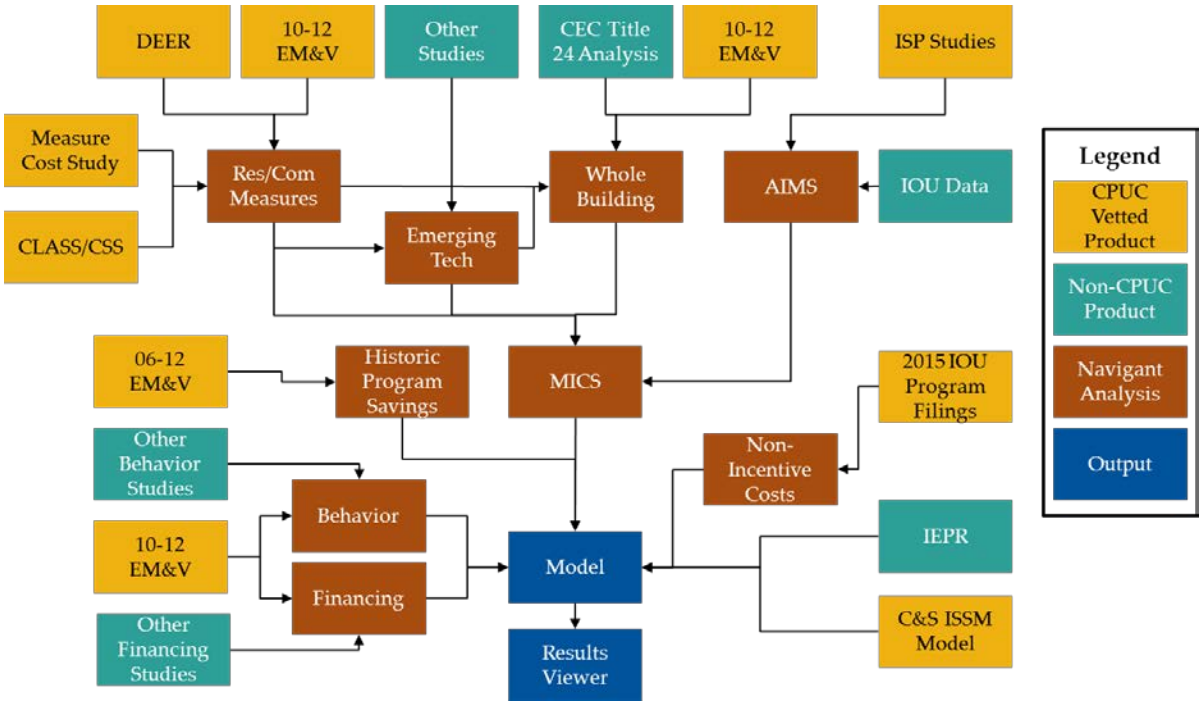
The Navigant team is in the process of developing alternate scenarios. The 2013 study produced additional scenarios (referred to as Additional Achievable Energy Efficiency [AAEE]) to support the 2013 IEPR update process. The CPUC, CEC, and CAISO collaborated to develop an estimate of the energy efficiency savings forecast that could be realized through utility programs that are incremental to the savings already incorporated in the IEPR baseline forecast. The Navigant team will continue to work with the CEC to define the appropriate low and high scenarios to use.

3. Data Sources

As mentioned previously, Stage 1 of Task 1 (Potential and Goals Study Update) is primarily a data update to the PG model to inform 2016 and beyond goals. The majority of the effort undertaken by the team on Stage 1 was to review and incorporate the latest available data into the study.

The data sources relied upon in Stage 1 are vast and varied. Figure 3-1 below illustrates the various produces relied upon for data that feed Navigant analysis that ultimately informs the output of this study. Throughout the data update process, the Navigant team sought to rely upon CPUC vetted products as much as possible. However, in several cases, the team needed to seek alternate data sources where CPUC products did not provide the necessary information. This chapter describes the data update process and sources for key topic areas. The discussion only focus on new data used to inform the Stage 1 of the 2015 Study. In some cases data was not updated and data from the 2013 study was "passed through" to Stage 1; each of the following sections describes what data was "passed through" from the 2013 study.

Figure 3-1: Stage 1 Data Map



3.1 Global Inputs

Global inputs are macro-level model inputs that are not specific to any measure, but rather apply to market segments or sectors. Navigant reviewed the data source for each of these inputs to ensure that the most recent data is utilized for 2015 PG Model update. Table 3-1 provides an overview of all the

global inputs within the 2015 model, whether or not the input was updated, and the data source for that update. Each item in Table 3-1 is discussed in further detail in the subsections that follow the table.

No updates were made to the avoided costs, which come from each IOU's Avoided Cost model. Navigant will review these Avoided Cost models again Stage 2 to check for updates.

Table 3-1: Overview of Global Inputs Updates and Sources

Global Input *(description)*	Updated in Stage 1?	Data Source for Update
Building Stocks *(households, floor space, consumption)*	Yes	CEC - *2014 Integrated Energy Policy Report (IEPR) Update and Demand Forecast Forms.* Adopted Feb. 2015. Excel Demand Forecast Forms available at: *http://www.energy.ca.gov/2014_energypolicy/documents/index.html#adoptedforecast*
Retail Rates *($/kWh, $/therm)*	Yes	
Sales Forecasts *(GWh, MW, and MM Therms)*	Yes	
Avoided Costs *(Avoided energy and capacity costs)*	No	No Update in Stage 1, "passed through" from 2013 Study
Historic Program Accomplishments *(Used for calibration)*	Yes	CPUC - *EE Program Tracking Database* Accessed: November 2014
Non-Incentive Program Costs *(formerly Admin. Costs)*	Yes	CPUC - 2015 IOU Planning Submissions - *IOU-2015-Filing-Review-4-17-204.xlsm* Accessed: March 2015

3.1.1 Building Stocks

Building stocks are the total "population" metrics of a given sector, though represented by different metrics for most sectors. Residential building stocks are based on number of households in an IOU's service territory. Commercial building stocks are represented by total floor space for each commercial building type. Industrial and agricultural building stocks are represented by energy consumption. Mining and Street lighting stocks are the number of pumps and streetlights respectively. The residential, commercial, industrial and agriculture building stock metrics are derived from the CEC's IEPR, which is updated yearly by the CEC. Navigant updated the building stocks to reflect the recently released IEPR 2014, adopted by the CEC in February 2015. Sources for mining and street lighting building stocks are discussed further in section 3.4.

Navigant recognizes that within the CEC's IEPR forecast, PG&E and SCE baseline demand forecasts include consumption from Publicly Owned Utilities (POUs) in addition to IOU consumption. The CEC provided Navigant with ratios to adjust the planning area consumption (found within IEPR) down to each IOU's actual service territory consumption for both PG&E and SCE. These ratios, based on 2014 IEPR, are referred to as Service Territory to Planning Area adjustment ratios and are detailed in Table 3-2.

Table 3-2: IEPR Electric Service Territory to Planning Area Adjustment Ratios

	Residential	Commercial	Industrial	Mining	Agriculture	Streetlights
PG&E	90.1%	83.0%	76.6%	86.2%	86.1%	92.0%
SCE	94.0%	91.8%	87.9%	95.7%	62.4%	99.7%

Source: California Energy Commission, 2015

Most POUs in CA do not offer any gas service (currently only the City of Palo Alto and Island Energy offer natural gas service). Due to this, these Service Territory to Planning Area ratios only apply to the electric forecasts of PG&E and SCE. Additionally, PG&E's Gas service territory is larger than its electric service territory to include the SMUD Planning Area, which is reflected within both the 2013 and 2015 PG Models.

3.1.2 Retail Rates and Sales Forecasts

The CEC's IEPR is also the source for retail rates and sales forecasts within the 2015 Study, utilizing 2014 IEPR for the electric rates and sales forecasts and 2013 IEPR for the gas rates and sales forecasts. This was because only electric rates and forecasts were updated in the recently released 2014 IEPR. Updates to the natural gas rates and forecasts are expected this later in 2015 and will be utilized in Stage 2 if they are available. As comparison, the 2013 Study utilized the 2013 IEPR for its sales forecasts and retails rates for both electricity and natural gas. The aforementioned Service Territory to Planning Area ratios were applied to the PG&E and SCE sales forecasts as well.

3.1.3 Historic Rebate Program Achievements

One of the Residential and Commercial sector inputs important for calibration purposes is the historic rebate program achievements for each of the IOUs. These include the ex-post gross program achievements from both the 2006-2009 and 2010-2012 (06-09 and 10-12 hereinafter) program cycles as reported and evaluated by the CPUC. For both the 2013 and 2015 Studies, Navigant obtained these achievements from the CPUC's Standard Program Tracking Database (SPTdb). These achievements are used to inform the historic modeling period and used to calibrate future model projections to account for past program activities. Additional discussion of the calibration process can be found in Appendix A.

The CPUC requires that ex-post gross achievements be utilized whenever possible. In the 2013 Study, the evaluation of the 06-09 program cycle had already been complete and the gross ex-post achievements were utilized in the 2013 Study. These 06-09 achievements were unchanged in Stage 1.

For Stage 1, the historical program achievements for the 10-12 program cycle were updated. The 10-12 program cycle had not been fully reported or evaluated when calibration data was collected for the 2013 PG Study. These evaluations have since completed and the data was obtained in November 2014 for use in Stage 1. The 2013-14 evaluated program achievements are not yet available. Table 3-3 provides the updated 2010-2012 gross ex-post savings utilized in Stage 1.

Table 3-3: 2010-2012 IOU Portfolio Gross Ex-Post Program Savings

	Energy Savings (GWh)		Gas Savings (MM Therms)	
	RES	COM	RES	COM
PG&E	1,743.7	1,249.7	-19.3	23.1
SCE	2,312.4	1,235.1	NA	NA
SCG	NA	NA	24.4	30.1
SDG&E	308.3	300.6	-0.6	7.0

Source: Navigant analysis of Standard Program Tracking Database. 2014 (includes HVAC Interactive Effects)

Appendix A contain tables detailing residential and commercial end use level historic achievements for all years from 2006-2012. Navigant mapped its modeling end-uses to those found within SPTdb, therefore end-use level data may not match exactly. Some program savings were not modeled (such as 'C&S', 'other' or 'unknown' programs) and those savings are included as 'NA' in these tables. Additionally, CFL upstream lighting savings were split between the Residential and Commercial sectors only (52% and 48% respectively) based on the KEMA's Final Evaluation Report: Upstream Lighting Program prepared for the CPUC.[19]

3.1.4 Non-Incentive Program Costs

Non-incentive program costs underwent a thorough review and update based on the 2015 IOU Compliance Filings submitted to the CPUC and found on the DEER website.[20] The 2015 Compliance Filings were utilized since these are most indicative of future non-incentive program costs. These costs were referred to as simply "Administrative Costs" in the 2011 and 2013 Studies, however, this instilled confusion because these include more than simply utility administrative costs. The title was therefore changed to non-incentive program costs, and includes administrative, market/outreach, and implementation (customer service) costs, taken from the 'Program Summary' tab of each IOU's 2015 compliance filings. State and local government partnerships are excluded because they are target exempt programs. Due to high variation in of costs in the agricultural and industrial sectors, a weighted average of Non-Incentive Program Costs for these sectors was applied to the all of AIMS. Table 3-4 provides an overview of the Non-Incentive Program Costs utilized in Stage 1.

[19] CPUC. *Final Evaluation Report: Upstream Lighting Program Volume I.* Prepared by KEMA, Inc., Feb. 2010

[20] Available at *ftp://ftp.deeresources.com/E3CostEffectivenessCalculators/2015IOUsubmissions/* Last Accessed: March 2015

Table 3-4: Non-Incentive Program Costs Summary – 2015 Compliance Filings

	Energy - $/kWh Saved			Gas - $/Therm Saved		
	RES	COM	AIMS	RES	COM	AIMS
PG&E	$0.164	$0.147	$0.095	$3.879	$3.393	$1.637
SCE	$0.141	$0.166	$0.216	NA	NA	NA
SCG	NA	NA	NA	$6.580	$9.536	$13.063
SDG&E	$0.201	$0.095	$0.234	$5.627	$2.262	$7.710

Source: Navigant analysis of 2015 IOU Compliance Filings

3.2 Residential and Commercial Measure Characterization

This section provides an overview of the Navigant team's approach to updating the Residential and Commercial Measure Characterization used in Stage 1. The approach used for the 2013 Study is carried over for the 2015 Study. For the 2013 Study, the Navigant team compiled an extensive set of measure-level data for the two sectors into an online database. To develop the 2013 study measure-level data, the Navigant team combined information from multiple versions of the Database for Energy Efficient Resources (DEER),[21] the Frozen Ex Ante (FEA) database,[22] various IOU workpapers, and saturation studies. Navigant's Measure Input Characterization System (MICS) Online provided a platform for stakeholders to access, review, and provide feedback on measure characterization data. For additional detail regarding the key input variables and initial data sources in the MICS, please refer to the 2013 Study.

For Stage 1 of the 2015 Study, Navigant developed a methodology to refresh the existing MICS with data published after the 2013 Study was completed. The overall architecture of the MICS remained largely the same from 2013 to 2015. This section provides additional detail on the types of measure-level data updates and the sources of each type of input.

The MICS database houses approximately 65,000 unique rows of Residential and Commercial measure characteristics that allow the calculation of technical, economic, and market potential for each measure by climate zone, building type, and service territory. Each of the 65,000 rows of data consists of 87 data parameters that define the measure.

[21] The Database for Energy Efficient Resources (DEER) contains information on energy efficient technologies and measures. This information includes energy consumption and savings, costs, and other supporting data required to calculate cost-effectiveness and willingness. DEER has been developed for the CPUC through funding from California ratepayers. Interested parties can access DEER at www.deeresources.org.

[22] The FEA (Frozen Ex Ante) is a database developed for the CPUC to house all approved measure-level ex ante data. This includes data on DEER and non-DEER measures. The FEA is housed by the CPUC's Energy Division (ED) on an internal server; access to the FEA data can be requested from ED.

3.2.1 DEER Data

Many of the measures in the MICS developed in the 2013 Study relied on DEER data. Since the 2013 Study was completed, DEER was updated and approved by the CPUC twice due to changes in applicable codes and standards and other minor requests.[23] As such, Navigant updated affected MICS measures with the most recent DEER data. The following DEER updates were included in Stage 1:

- DEER2014 Update: This update was the result codes and standards changes, particularly the California Title 20 Appliance Efficiency Regulations and the California Title 24 Building Energy Efficiency Standards. DEER2014 impacted ex ante unit energy savings for HVAC measures, lighting measures, water heating measures, and other weather-sensitive measures.
- DEER2015 Update: An incremental update to DEER2014 based on United States Code of Federal Regulations, this update affected specific technology groups included in the MICS. The technology groups included split and package air conditioning equipment, water heaters, and gas furnaces.

Navigant collaborated with the Ex Ante Team to fully understand the updates and coordinate the incorporation of the DEER2014 Update and DEER2015 Update data. This collaboration ensured Navigant had the most up-to-date DEER data available for the affected measures and could direct any necessary changes to fundamental structure of those measures. For each affected measure, Navigant extracted data from the DEER database and reconstructed the MICS measure workbooks with the new data. Where necessary, Navigant modified the code and efficient equipment specifications in the measure definitions to match those of the updated unit energy savings data. For more information regarding the integration of DEER data into the MICS, please refer to the 2013 Study.

More recently a draft version of DEER2016 has been released. The CPUC requested Navigant make several critical updates to MICS in response to DEER2016. These updates affected commercial lighting and refrigerator recycling measures (previously discussed in Section 1.4). The team was unable to incorporate the full DEER2016 into Stage 1 due to the timeline of the DEER2016 release relative to the timeline of Stage 1.

3.2.2 2010-12 EM&V Data

Because of the high volume of data in the MICS, Navigant developed a method to prioritize the measure updates based on EM&V data for Stage 1. In general, Navigant selected measures that contributed the greatest to the potential impact in the 2013 Study. Defined as High Impact Measures (HIMs), these measures represented 90% of the potential impact within each sector (Residential and Commercial) and fuel type category (electric and gas).

Table 3-5 presents a count of the measures by Sector, Fuel Type, and End-Use Category included in the EM&V update priority list. Although the list contains most of the updated measures, measures with lower potential impact were also included if they were analogous or related to HIMs. For example, if the baseline unit energy consumption for an HIM changed, the baseline unit energy consumption for all

[23] Updates to DEER outside of the DEER Update process can be found on the change log at http://deeresources.com/files/deerchangelog/deerchangelog.html.

related measures was changed regardless of the potential impact. These corollary updates help to maintain consistency throughout the MICS measures.

Table 3-5: Residential and Commercial Measures Included in the Stage 1 EM&V Data Update

Sector	Fuel Type	Use Category Definition	Use Category Examples	Measure Count
Com	Electric	Lighting	Linear Fluorescents, CFLs, Occupancy Sensors, High-Bay T5s, HIDs	13
Com	Electric	HVAC	A/C and Heating Units, Chillers	7
Com	Electric	Plug-in Appliances/Electronics	Vending Machine Controls, Desktop Computer Power Management	2
Com	Electric	Service/Non-Equipment	HVAC Fault Detection and Diagnostics	1
Com	Electric	Whole-building	HVAC Energy Management Systems	1
Com	Gas	HVAC	Boilers, Thermostats, Furnaces	6
Com	Gas	Service Hot Water	Pipe and Tank Insulation	2
Com	Gas	Whole-building	HVAC Energy Management Systems	1
Com	Gas	Food Service	Fryers	1
Res	Electric	Lighting	CFLs, Plug-In Fixtures, Seasonal Lighting	11
Res	Electric	Plug-in Appliances/Electronics	Refrigerator Recycling, Computer Monitors, Variable Speed Pool Pumps	4
Res	Gas	Service Hot Water	Storage Water Heaters, Instantaneous Water Heaters	2
Res	Gas	HVAC	Furnaces, Duct System Repair	2
Res	Gas	Plug-in Appliances/Electronics	Clothes Washers	1

Source: Navigant team analysis (2015)

Table 3-6 presents the EM&V studies Navigant reviewed and sourced for relevant data updates in Stage 1. Navigant focused the updates on the following key measure parameters:

- Unit energy savings (or factors that contribute to unit energy savings, such as hours of use)
- Equipment specification distributions (e.g., CFL wattages to calculate a weighted average lamp wattage)
- Measure costs
- Measure densities

Navigant engaged the primary authors of the studies during the process to facilitate data transfer and understanding of the available data. The coordination resulted in Navigant's retrieval of data from the full impact evaluation and study databases beyond the data available from within the written report.

Notably, the available studies did not have data applicable to all HIMs, thus some HIMs remained unchanged from the 2013 Study. Similarly, the MICS measures are built from many parameters, and not all parameters are within the scope of or were updated during the EM&V studies. Thus, some parameters of MICS measures remained unchanged from the 2013 Study. Given the timeline of Stage 1, Navigant updated measures based on the EM&V results conservatively, updating measure parameters for which there was a high degree of certainty that the new data were consistent with and an exact matches to the existing parameters.

Table 3-6: EM&V Studies Used for Stage 1 Measure Updates

Author	Study Title	Publication Date	Relevant Data
DNV GL	*Appliance Recycling Program Impact Evaluation*	October 2014	Unit energy savings and net to gross for refrigerator recycling measure
DNV GL	*California Upstream and Residential Lighting Impact Evaluation Final Report*	August 2014	Residential lighting HOU; lamp wattage distributions
DNV GL	*Residential On-site Study: California Lighting and Appliance Saturation Survey (CLASS 2012)*	November 2014	Residential density data
Itron, Inc.	*2010-2012 WO017 Ex Ante Measure Cost Study Final Report*	May 2014	Full measure cost data
Itron, Inc.	*California Commercial Saturation Survey*	August 2014	Commercial density data; lamp wattage distributions
Itron, Inc.	*Nonresidential Downstream Lighting Impact Evaluation Report*	August 2014	Commercial lighting HOU

3.2.3 Key Updates and Outcomes in Stage 1

This section describes observations and outcomes from key updates to the MICS. The studies referenced are those listed in Table 3-6.

- DEER Weather-Dependent Measures: Generally, the updates to weather-dependent measures based on the DEER2014 Update data resulted in relatively minor changes to unit energy savings values.
- Commercial Lighting: DEER2014 Update affected equivalent full load hours for commercial lighting measures, as well as HVAC interactive effects due to the update of weather files. Market-weighted average wattages were updated based on Commercial Saturation Survey (CSS) data. The updates resulted in changes to unit energy savings and effective useful life values. Additional adjustments were made in response to updated HOU data in DEER2016.
- Residential CFLs: Hours of use and market-weighted average wattages were updated based on EM&V results and CA Lighting and Appliance Saturation Survey (CLASS) data. Measure costs were updated based on the Measure Cost Study. EUL was updated based on the CPUC's uncertain measure review.[24] The changes to the MICS characterization influenced the potential results because of the high contribution to overall energy savings of this measure.

[24] CPUC. *Ex Ante Update for ESPI Uncertain measures - Compact Fluorescent Lamps 30 Watts and Less.* May 2015.

» Measure Densities: With the updates to CSS and CLASS, measure densities in MICS were updated to reflect the most recent market saturation and survey data. Densities do not affect unit energy savings or measure costs, but they inform the model calibration and forecast procedures. Nearly all measures in Stage 1 received updated density values, and those values had an important role in the overall measure characterization for Stage 1.

3.2.4 MICS Database and Documentation

A complete MICS database is available through the CPUC website.[25] The database includes detailed descriptions and full characterizations of all measures in the 2015 PG Model. Users can download an Excel workbook that contains the following three tabs:

» Field Definitions: This tab includes a list of the data fields included in the MICS Master Build with a brief description of the fields.

» Measure Update Data Sources: This tab includes a table of the unique measures by sector and fuel type in the MICS Master Build. The table shows the Efficient Case, Base Case, and Code Case for each measure, as well as the relevant data sources used in the Stage 1 update.

» MICS Master Build: This tab includes the complete line-level detail for all sectors included in the 2015 PG Model.

3.3 Emerging Technologies

The Stage 1 update for Emerging Technologies (ETs) maintained the same measure list as the 2013 Study and focused on only updating the inputs to the 2015 PG Model where the Navigant team had better information or data availability.

For the purposes of this study, ETs are classified as meeting one or more of the following criteria:

» Not widely available in today's market but expected to be available in the next 1-3 years;

» Widely available but representing less than 5% of the existing market share; and/or

» Costs and/or performance are expected to improve in the future.

Appendix B.4 includes a full list of the ETs modeled, their descriptions, and key ET inputs. The table is organized by End Use category (e.g., Appliance Plug Loads, HVAC, etc.).

3.3.1 Overview of Updates

ETs were only examined for the Residential and Commercial sectors. These sectors are modeled using individual measures for specific applications.

The Navigant team relied on data from various sources to update each ET:

» The Navigant team extrapolated or used directly cost and performance data from DEER where possible. In some cases, some ETs had already been characterized in DEER since the 2013 Study.

[25] http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Energy+Efficiency+Goals+and+Potential+Studies.htm

For such cases, the Navigant team continued to call these measures ETs to be consistent with the last study (e.g. 0.98 AFUE Gas Furnace).

» IOU workpapers and other case studies provided additional cost and performance data.

» 2010 – 2012 EM&V studies[26] such as "Work Order 017 Ex Ante Measure Cost Study "provided more California-specific data.

» In absence of any California-specific verified data, the Navigant team leveraged data from national studies published by the U.S. Department of Energy (DOE) and the Pacific Northwest National Lab (PNNL) and adjusted to California specific values based on regulatory and market conditions.

» DOE standards and rulemaking review ensured the maximum technically feasible energy efficiency level for many measures and end uses remained same.

» Energy Star's qualified products list and shipment data provided market saturation data.

While the measure categories remained same, their definitions were updated in some cases to reflect the market conditions more closely where we had better data.

» LEDs were redefined based on CFL definitions update. LED definitions are linked to CFL definitions, which were updated based on 2010 – 2012 EM&V studies.

» Residential Water heaters were updated from 0.77 Energy Factor (EF) to 0.82 EF due to the addition of 0.82 EF water heater measure to DEER. If a measure with same or higher efficiency than the corresponding ET efficiency was included in DEER since the 2013 Study, Navigant set the minimum efficiency of the ET to match the highest efficiency description in DEER for applicable measures.

» Self-Contained Refrigerator measure was redefined to be 15% less than energy code due to redefinition of Energy Star products.

» Dishwasher measure was redefined to be EF>1.0 compared to previous round, based on code and competing conventional energy efficient measure update.

» Commercial Refrigeration Fiber Optic LED lighting measure was eliminated. LED display lights have become a standard practice for display case replacements.

Some ETs (along with some conventional technologies) are expected to decrease in cost over time. The Navigant team developed four cost reduction profiles that could apply to various ETs (and non-ETs) in the 2013 Study (see 2013 Study Appendix A). These cost reduction vectors were qualitatively assigned to each ET based on various market drivers that could drive the cost down. Navigant revised these cost reduction assignments based on the further market intelligence developed for the ET measures since the 2013 study (see Appendix B.4).

[26] *2010-2012 WO017 Ex Ante Measure Cost Study.*
2010-2012 WO013 Residential Lighting Process Evaluation and Market Characterization.
2010-2012 WO028 California Upstream and Residential Lighting Impact Evaluation.

3.3.2 Updates for LEDs

The Navigant team also updated data on the cost reduction and performance improvement profiles for LED technologies. LED costs have declined rapidly in recent years (a 50% reduction in market average price from 2011 to 2015) and are expected to continue to decrease in the foreseeable future. Meanwhile, LED efficacy has been increasing and is expected to increase over 40% from 2015 to 2024. This efficacy change will continue to decrease the wattage requirements of LEDs in the future. The PG Model reflects both of these trends.

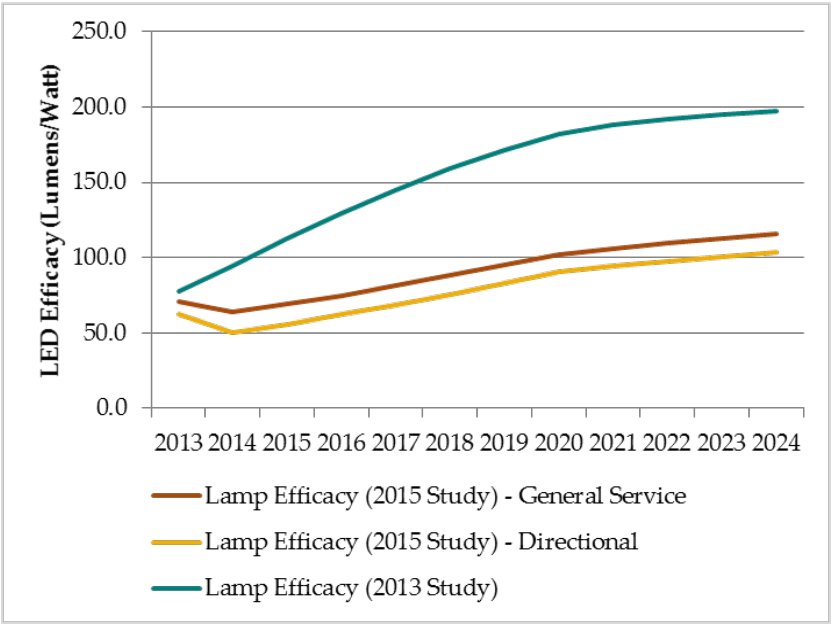
LED efficacies were updated to reflect market average products and LED efficacies have dropped compared to the 2013 Study. Previous data[27] used in the 2013 Study represented the "best performers" in the market which was based on U.S. DOE technology targets and did not represent the majority of products in the market. New data[28] in Stage 1 represents the average performance and cost which are based on historical data for LEDs. Stage 1 also uses efficacy and cost data specific to LED applications (i.e. General Service and Directional), which allowed Navigant to map the efficacy data to each LED measure more precisely. The mapping of each LED measure to its definition and application can be found in Table B-2 in the Appendix B. LED costs were also updated to market average products based on the most recent DOE pricing study[29] conducted by PNNL.[30]

Then, these LED efficacies and prices were further adjusted to represent LEDs that meet the California Energy Commission's Voluntary Quality LED Lamp Specification[31]. The specifications are based on enhancements to the ENERGY STAR standard with a particular focus on improvements to the color temperature, consistency, and color rendering (with requirements for Color Rendering Index (CRI) greater than or equal to 90). The specification applies to screw-base and bi-pin A-lamp, flame-tip, globe, and spotlight lamps. After December 11, 2013, compliance with the specification for LED lamps became mandatory for IOU incentive program eligibility (this followed a one-year "transition period" that began when the specification came into effect on December 11, 2012). Additional details on the adjustments and data sources can be found in Appendix B.

Figure 3-2 and Figure 3-3 illustrate the resulting difference in LED efficacies used in both studies from 2013 to 2024. The small drop in the LED lamp efficacies from 2013 to 2014 shown in Figure 3-2 is due to the Voluntary Quality LED Lamp Specification going into effect in 2014. Figure 3-4 and Figure 3-5 illustrate the resulting difference in LED prices used in both studies from 2013 to 2024. Additional details on which LED measure are General Service and which are Directional can be found in Table B-2 in the Appendix B.

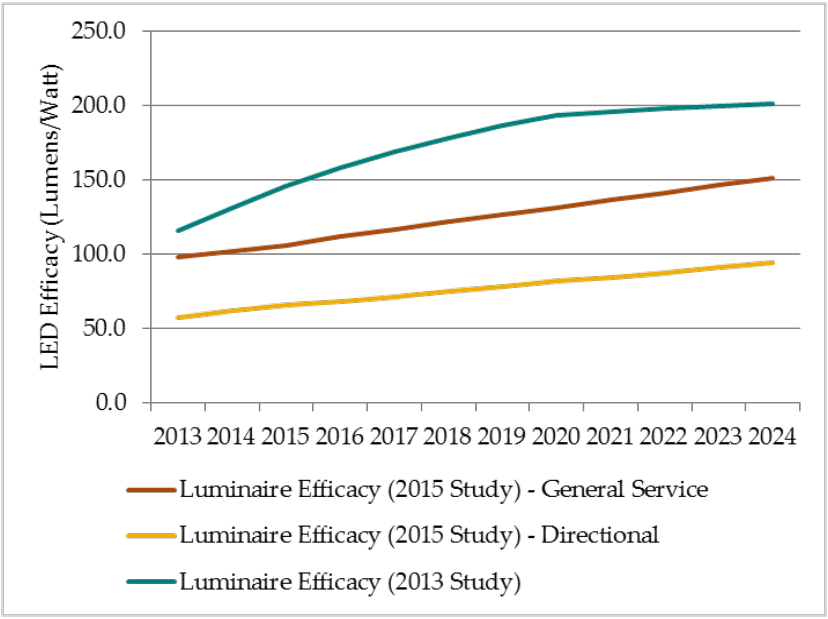
[27] Navigant. *Energy Savings Potential of Solid-State Lighting in General Illumination Applications.* Prepared for the U.S. Department of Energy, January 2012.
[28] Navigant. *Energy Savings Forecast of Solid-State Lighting in General Illumination Applications.* Prepared for the U.S. Department of Energy, August 2014.
[29] Pacific Northwest National Laboratory. *Solid-State Lighting Pricing and Efficacy Trend Analysis for Utility Program Planning.* Prepared for the U.S. Department of Energy, October 2013.
[30] Although the CPUC Ex Ante Measure Cost Study examined some LED technologies, the information contained in the report was collected in 2013 and is already obsolete because of the rapid evolution of the LED market.
[31] http://www.energy.ca.gov/2012publications/CEC-400-2012-016/CEC-400-2012-016-SF.pdf

Figure 3-2: LED Technology Improvements (Lamps)



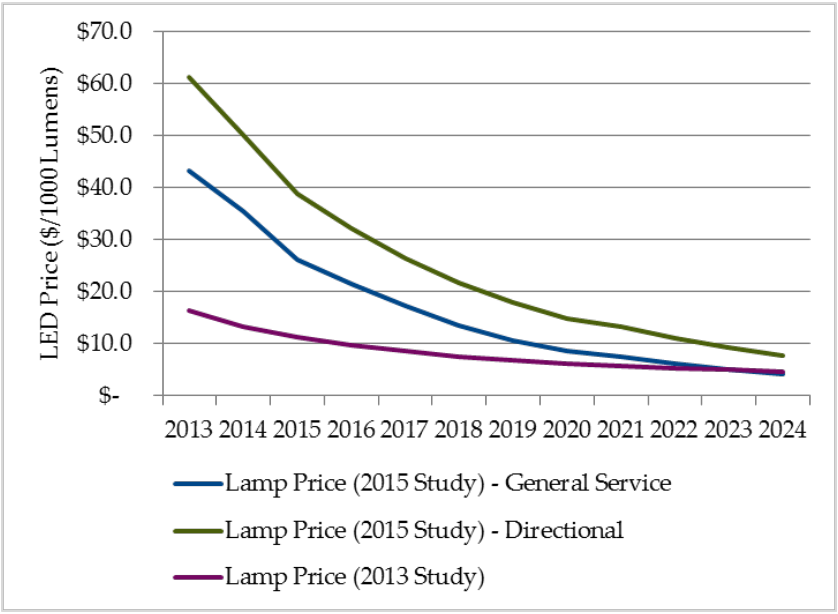
Source: Navigant team analysis 2015.

Figure 3-3: LED Technology Improvements (Luminaires)



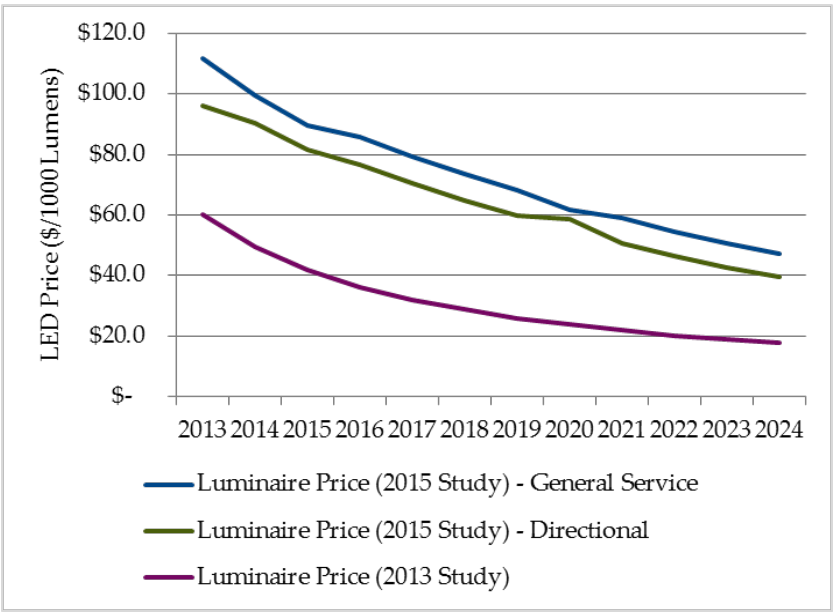
Source: Navigant team analysis 2015.

Figure 3-4: LED Cost Reduction Profiles (Lamps)



Source: Navigant team analysis 2015.

Figure 3-5: LED Cost Reduction Profiles (Luminaires)



Source: Navigant team analysis 2015.

3.3.3 Emerging Technology Risk Factor

In the 2013 Study, the Navigant team assigned a risk factor to each ET to account for the inherent uncertainty in the ability for ETs to produce reliable future savings. Actual future adoption of ETs will vary depending on technology. Some ETs may gain large customer acceptance, capture significant

market shares, and generate large savings, while others may falter achieving no market share and no savings. It is impossible to pre-determine which ETs will succeed and which will fail. The ET risk factor acts to de-rate the market adoption of each individual ET. The result is a total ET savings value that is representative of what can be expected of the group of ETs. In Stage 1, the Navigant team revised the risk factors based on the same qualitative metrics that were used previously which included market risk, technical risk, and data source risk. The framework for assigning the risk factor is shown in the 2013 Study.

Navigant's logic for revising the risk factors was based on the success of the measure meeting one or more of the following criteria since the 2013 Study:

- Has overcome some of the market barriers identified previously;
- Has established strong distribution channels;
- Has resolved remaining technology issues ; and/or
- Has produced evaluated energy savings that are equal to current (unevaluated) savings claims.

Appendix B.4 includes the final selected risk factors for each ET.

3.4 Agriculture, Industrial, Mining and Street-lighting (AIMS) Measure Characterization

For Stage 1 of the 2015 Study, Navigant built on the findings developed during the 2013 Study. In the 2013 study, Navigant developed approaches and detailed potential for each of the Agriculture, Industrial, Mining, and Street Lighting (AIMS) sectors.

3.4.1 Overview of AIMS in the 2013 PG Study

The Industrial sector uses a top-down approach to calculate industrial sector potential based on energy efficiency supply curves. This was accomplished by using a variety of data sources, including the Department of Energy's (DOE's) Industrial Assessment Center (IAC). The DOE-sponsored IAC database which provides thousands of industrial measure recommendations and installments based on engineering efficiency audits performed at thousands of industrial facilities. The team used approximately 15,000 energy efficiency recommendations from approximately 10,000 assessments IAC database completed from 2004 to 2012 as the core measure list.[32] The supply curves developed from these IAC measures were then adjusted and vetted using California specific data, including inputs from DEER, CPUC vetted workpapers, relevant inputs from the 2013 potential model Commercial sector inputs, and various sector specific California EM&V studies and market reports. A similar process was used to develop the Agriculture sector forecast. As a result, Navigant's Industrial and Agriculture sector potential forecasts are informed by 167 supply curves defining a specific combination of subsector, end-use, measure type, and fuel.

[32] The IAC database is substantially larger, containing more records than 10,000 assessments. However, the team screened the list for relevant measures and the 2013 Study Appendix provides more details the use of the IAC database.

Navigant's 2013 Study AIMS effort also established the framework to facilitate active and meaningful stakeholder interaction. Specifically, the 2013 Study effort for AIMS started the Industry Standard Practice (ISP) vetting exercise through a detailed ground-floor-level review of the individual codified IAC recommendations to determine their applicability in California. For example, the Navigant and stakeholder team considered established ISP, Title 20/24, local Air Resource Board (ARB, AB32, etc.)[33] positions, Occupational Safety and Health Administration (OSHA) requirements,[34] and other positions on maintenance processes from established IOU programs.[35] These activities accompanied other vetting exercises where potential estimates were reviewed through a comparative metrics exercise that leveraged IOU compliance filings,[36] industrial market characterization reports,[37] and other secondary studies on end-use-specific potentials and forecasts. Navigant conducted these reviews with representatives from the IOUs, the Ex Ante Team, as well as industry subject matter experts (SMEs).

Specific attention was paid to the Mining sector, where several highly developed ISP reports were available and were used to make significant reductions in initial energy effeciency potential forecasts for that sector, mostly addressing ISPs in the oilfield market. From these studies, Navigant developed measures and potential model inputs that were informed by oil and gas energy efficiency experts,[38] California statewide oil and gas extraction statistics,[39] and additional secondary sources. Inputs were also vetted with the Ex Ante Team to account for ISPs among major and minor oil extractors.

Finally, Navigant developed potential for the Street Lighting sector in the 2013 Study. This effort largely relied on IOU-supplied street lighting inventories that include detailed information on lamp counts, lamp types and technologies, lumens, and wattages. Navigant paired these comprehensive details with other secondary sources to estimate potential for the 2013 Study.

Additional details on the 2013 Study can be found at the CPUC's Energy Efficiency Potential and Goals Study webpage.[40]

[33] Assembly Bill 32: Global Warming Solutions Act. Air Resources Board. Accessed June 20, 2014. http://www.arb.ca.gov/cc/ab32/ab32.htm
[34] OSHA. Hot Surfaces, 1910.261(k)(11). Accessed June 20, 2014. https://www.osha.gov/pls/oshaweb/owalink.query_links?src_doc_type=STANDARDS&src_unique_file=1910_0261&src_anchor_name=1910.261(k)(11)
[35] 2013-2014 Statewide Customized Retrofit Offering Procedures Manual for Business. Table 1.4.2 Summary of Ineligible Measures. Last Accessed June 20, 2014. http://www.aesc-inc.com/download/spc/2013SPCDocs/PGE/Customized%201.0%20Policy.pdf
[36] 2013-14 Energy Division Investor-owned Utilities Compliance Filing Reviews. Last Accessed June 20, 2014. http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/2013-14+IOU+Compliance+Filing+Reviews.htm
[37] KEMA. Industrial Sectors Market Characterization. Metalworking Industry. Last Accessed June 20, 2014. http://calmac.org/publications/Final_metalworking_market_characterization_report.pdf
[38] Navigant team conference meeting with GEP staff via telephone. Global Energy Partners, an EnerNOC Company. (2012). Meeting on November 30, 2012.
[39] CA Dept. of Conservation. 2009 Annual Report of the State Oil and Gas Supervisor. Last accessed: March 2015. ftp://ftp.consrv.ca.gov/pub/oil/annual_reports/2009/PR06_Annual_2009.pdf
[40] CPUC. Energy Efficiency Potential and Goals. Last accessed April 2015. http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Energy+Efficiency+Goals+and+Potential+Studies.htm

3.4.2 2015 Study: Building on the 2013 Study

Stage 1 continued to use the same methodology as the 2013 Study; the team focused on updating inputs. Navigant completed several detailed data gathering and analyses activities to further develop the 2013 AIMS model framework, including the following critical tasks:

- Incorporated recently-completed and published ISP studies that have been reviewed, vetted, and deemed eligible for consideration by the CPUC. Navigant also relied on CPUC guidance and input to establish the list of ISP studies to consider for Stage 1.
- Reviewed the IAC database for recent updates and additions.
- Reviewed other critical data sources for any significant updates. These included the California Integrated Energy Policy Report (IEPR) consumption and retail rate forecast data[41] and sector-specific data such as IOU street lighting inventories.
- Held formal and informal meetings and discussions with stakeholders (e.g., Demand Analysis Working Group [DAWG] Webinar on AIMS Updates). These meetings informed the Stage 1 efforts, but also identified critical issues for consideration in advance of the Stage 2 efforts.
- Reviewed the process by which ISPs are developed and used within the inputs for Industrial, Agriculture, and Mining. This included reviewing secondary sources, IOU-supplied data, and exploring alternative approaches to accounting for ISPs. These topics will be further reviewed during Stage 2.

The following sections provide additional overview of the activities carried out for each AIMS sector for the Stage 1 update. Appendix C provides further details and analyses findings.

3.4.2.1 Industrial

The Navigant team considered the full range of inputs for the Industrial sector to determine where new data sources exist and where existing data sources received significant updates since the 2013 Study.

Stage 1 updates and analysis activities included a review of recently-released ISP studies from the CPUC. Navigant mapped ISPs into the potential inputs based on the studies' relationships to the measures and end-uses, sub-sectors, and in consideration of measure equipment densities (i.e., measure saturation/density, sub-sector applicability, etc.). These ISP-related activities updated a selection of measure de-ratings previously estimated in 2013. This review process also vetted the measures (defined as assessment recommendation codes [ARCs] sourced from the Industrial Assessment Center [IAC]). This vetting exercise supplemented similar reviews completed for the 2013 Study and confirmed the inputs and de-ratings established in 2013.

The team also reviewed other sources for updates to the inputs. Those include the IAC database, the California IEPR, the California Quarterly Fuel and Energy Report (QFER), and IOU planning documents such as IOU Compliance filings. Appendix C.1 notes where updates occurred.

[41] CEC. California Energy Demand 2015-2025 Final Forecast Mid-Case Final Baseline Demand Forecast Forms. Last accessed: March 2015.
http://www.energy.ca.gov/2014_energypolicy/documents/demand_forecast_sf/Mid_Case/

3.4.2.2 Agriculture

Similar to the Industrial sector, the Navigant team considered the full range of inputs and sources for the Agriculture sector to determine where new data sources exist and where existing data sources received significant updates since the 2013 Study. The Agriculture sector relies on IAC, QFER, and IEPR data. DEER and the Commercial sector Study effort also inform the Agriculture sector.

The Agriculture sector methodology is similar to the Industrial sector. The Agriculture inputs also rely on the updated Industrial sector measure de-ratings in order to reflect ISPs, program eligibility considerations, and other constraints that prevent Agriculture programs from claiming certain savings.

Navigant also accounted for the impacts of drought conditions after it correlated energy consumption increases with drought years. For example, during drought conditions water tables are lower and more energy is required of irrigation pumps to lift water to the surface. The team normalized forecast data to represent typical energy consumption in non-drought years. This was critical given that the PG Model estimates potential as a percent of energy consumption.

Finally, the other sources reviewed for the Industrial sector were also reviewed for the Agriculture sector and updates are noted in Appendix C.2.

3.4.2.3 Mining

Following the Industrial and Agriculture sectors, Navigant conducted a similar review of inputs and sources for the Mining sector. However, unlike the Industrial and Agriculture sectors, the Mining sector relies on an approach more similar to the Residential and Commercial sectors. Inputs are developed from the bottom up and define specific measures instead of more broadly defined end-uses.

Navigant determined that there are no significant updates for measure-specific parameters such as baseline and measure level efficiencies or equipment costs. However, Navigant reviewed the range of sources to both vet the 2013 Study inputs as well as identify any new or updated sources to consider that apply to the market more generally. For example, Navigant observed increasing trends in enhanced oil recovery (EOR) techniques. This relates to injecting pumps and process steam boilers where, over time, more energy in the form of injected water and steam are needed to extract oil that is becoming harder to reach. Stage 1 inputs were updated to reflect this trend.

3.4.2.4 Street Lighting

Navigant also reviewed the inputs for the Street Lighting sector as part of the Stage 1 effort. The 2015 Study generally maintains the methodology developed for the 2013 Study. Namely, Navigant used the IOU-supplied inventories and consumption data from the 2013 Study to estimate baseline and energy efficient measures for customer owned and IOU owned lamps. Navigant also requested and received

2015 street lighting inventories and consumption data from the IOUs and leveraged this data for vetting the inputs.

The most significant change to the inputs includes accounting for forecasted improvements in LED efficacies. The 2013 Study only accounted for forecasted LED cost reductions.

Finally, similar to the 2013 Study approach, the Stage 1 results reflect lamps owned by both customers and IOUs. However, Table 3-7 and Table 3-8 show owner-related metrics so that potential for a given group can be estimated separately.

Table 3-7: Percentage of Baseline and Efficient Street Lamps by Utility

Year	Efficient Lamps (%)*			Baseline lamps (%)**		
	PG&E	SCE	SDG&E	PG&E	SCE	SDG&E
2013	4%	1%	23%	96%	99%	77%
2015	26%	1%	31%	74%	99%	69%

**LED Lamps*
***Non-LED Lamps*
Source: Navigant team analysis of IOU-provided lamp inventories (2015)

Table 3-8: Percentage of Customer Owned and Utility Owned Street Lamps

Year	Customer Owned (%)			Utility Owned (%)		
	PG&E	SCE	SDG&E	PG&E	SCE	SDG&E
2013	74%	17%	81%	26%	83%	19%
2015	76%	15%	81%	24%	85%	19%

Source: Navigant team analysis of IOU-provided lamp inventories (2015)

3.5 Whole Building Initiatives

Whole-building initiatives aim to deliver savings to residential and commercial customers as a group of multiple efficiency measures that are all installed at the same time. Similar to the 2013 Study, Stage 1 of the 2015 Study includes the same whole-building initiatives. Stage 1 data updates are indicated in Table 3-9 below.

Table 3-9: Whole-Building Measures Stage 1 Updates

Whole-Building Measure Name	Stage 1 Data Updates
Commercial New Construction Level 1	Same as 2013 Study
Commercial New Construction Level 2	Same as 2013 Study
Commercial New Construction Level 3	Same as 2013 Study
Commercial New Construction ZNE	Updated data
Commercial Renovation Level 1 – 14% Savings	Updated data
Commercial Renovation Level 2 – 28% savings	Updated data
Residential New Construction Level 1	Same as 2013 Study
Residential New Construction Level 2	Same as 2013 Study
Residential New Construction Level 3	Same as 2013 Study
Residential New Construction ZNE	Updated data
Residential Renovation Energy Upgrade CA - Basic Path (MF only)	Updated data
Residential Renovation Energy Upgrade CA - Flex Path (SF Only)	Updated data
Residential Renovation Energy Upgrade CA - Advanced Path (SF Only)	Updated data

Source: Navigant team analysis, 2015

In the 2013 Study, the Navigant team developed estimates of energy savings and costs for each whole-building measure listed in Table 3-9 and described in Appendix E of the 2013 Study report. The following sections discuss the key updates made to date in the 2015 Study. The final values for savings, cost, measure life, and other key model inputs can be found in the MICS spreadsheet.

3.5.1 Commercial and Residential New Construction ZNE

Table 3-10 provides the Commercial and Residential New Construction ZNE updated sources for Stage 1. PG&E is in the process of conducting a ZNE study, results of which will be incorporated into Stage 2.

In general, baseline construction costs increased slightly since the 2013 Study, which is reflective of the recovery of the construction industry over the last few years. For single family homes, baseline electricity, electric demand and natural gas consumption (kWh/sf, kW/sf and therms/sf) decreased slightly. For multi-family homes, baseline electricity consumption (kWh/sf) increased by about 40 percent. Baseline electric demand (kW/sf) and natural gas demand (therms/sf) for multi-family homes both decreased.

Table 3-10: Commercial and Residential New Construction ZNE Data Updates

Data Items	Data Source
Baseline construction costs	Reed Construction Data Inc., RS Means Square Foot Estimator: http://www.rsmeansonline.com
2013 Title 24 Residential Code-Baseline Energy Consumption	Single and multi-family electricity, electric demand and natural gas consumption updated by California Energy Commission, CBECC-Res 2013 Std. Design Results, January, 2015.

3.5.2 Commercial Renovation Level 1 and Level 2

In the 2013 Study, Commercial Renovation Level 1 and Level 2 bundles were developed by the Navigant team. Data was developed for each IOU territory and each building type. A "bundle" of measures was assembled for each initiative that represents the weighted average installation of measures by a typical participant. In assembling these bundles, only measures from the MICS were eligible for inclusion in these bundles.[42] Each bundle was developed to include gas and electric measures, assuming no overlap between the two fuel types.

Stage 1 updated the 2013 Study bundles to reflect the latest Commercial MICS measure data, without altering the specific individual measures included in the bundles. The specific measures included in the bundles will be evaluated in Stage 2 of the 2015 Study.

3.5.3 Residential Renovation Energy Upgrade California

For the Residential Renovation Energy Upgrade California (EUC) measures, Navigant collaborated with DNV GL who conducted the *2010-2012 Whole House Retrofit Impact Evaluation*.[43] The EUC evaluation study and the EUC program tracking data detailed in Table 3-11 were used to provided updated information for Stage 1.

Table 3-11: Commercial Retrofit Level 1 and Level 2 Data Updates

Data Source Name	Data Source
Whole House Retrofit Impact Evaluation	CALMAC ID: CPU0093.01 http://www.calmac.org/publications/CPUC_WO46_Final_Report.pdf
CPUC 2013-2014 EUC Program Tracking Data	EDCentralServer.com, alltracking1314q7_wroadmap.sas7bdat

Stage 1 modeled the same three measure bundles as the 2013 Study which include: Basic Path, Flex Path and Advanced Path. Compared to the 2013 Study, Stage 1 data resulted in a decrease in electricity, demand and natural gas savings and an increase in the energy efficiency material cost.

[42] See 2013 Study Appendix Section E.1 for additional context on the sources of data for measures eligible for the bundles.

[43] DNV GL – Energy, 2014. *Whole House Retrofit Impact Evaluation. Evaluation of Energy Upgrade California Programs.* Work Order 46. Prepared for the California Public Utility Commission, Energy Division. Final Report: September 9, 2014. CALMAC ID: CPU0093.01, http://www.calmac.org/publications/CPUC_WO46_Final_Report.pdf

- **Basic Path:** Whole House Retrofit Impact Evaluation study did not include multifamily homes, so the data for calculating Basic Path savings remained the same as the 2013 Study.
- **Flex Path:** The Flex Path savings were developed from the impact evaluation report, but in 2010-12 most retrofits were either Advanced or Basic. The Flex path savings were developed by assuming a weighted average of 2/3 Advanced and 1/3 Basic to make up Flex. The reasoning behind this assumed weighting was the measures that were installed with high frequency in 2010-12 Advanced were similar to the Flex options in roughly two-thirds of the cases, while the remaining third of the Flex options resembled the Basic path.
- **Advanced Path:** Whole house Retrofit Impact Evaluation data was used to update the electricity, electric demand, natural gas savings and energy efficiency cost data.

The measure saturation/density is another change worth noting. The measure saturations/densities were determined based on utility customer population data from Residential Appliance Saturation Study (RASS)[44] and Energy Information Administration (EIA)[45] records, final tracking data used for the impact analysis covering program years 2010-12, and the latest available tracking data for program years 2013-14. The data for the impact evaluation specifically checked for homes that had gas and electric or gas only and avoided double-counting customers. The available data for 2013-14 could not be fully de-duplicated in a similar manner, so the data was used with some slight adjustments based on the ratio of tracked records to unique customers from the impact evaluation. Between the 2013 Study and the 2015 Study, the efficienct technology density (number of EUC program participants/existing building stock) increased as additonal households particpated in the program.

Concern exists that the cost data reported for the program does not just include energy upgrade measures costs but general project retrofit costs that do not all impact energy savings. Additional efforts are already being made by the study team to further evaluate the true incremental costs for a EUC program participant.

3.6 Codes and Standards

Codes and Standards (C&S) impacts on energy efficiency potential are modeled two ways:

- C&S reduces the Unit Energy Savings (UES) for IOU rebated measures, thus decreasing the savings claimable by IOU programs
- IOUs can claim a portion of savings from C&S that come into effect through the IOU C&S advocacy programs.

[44] RASS 2009. Volume 1: Methodology. Table 2-2A-B Individually Metered Sample Design. http://websafe.kemainc.com/rass2009/Uploads/2009_RASS_Volume%201_%20FINAL_101310.pdf
45 RECS Survey Data 2009. Household Demographics by Year of Construction. Table HC9.3 Household Demographics of U.S. Homes, By Year of Construction, 2009. http://www.eia.gov/consumption/residential/data/2009/#undefined

3.6.1 Impacts of C&S on IOU Programs

As new C&S come into effect, the code basis above which IOUs may claim energy savings changes. As high efficiency C&S come into effect, code baselines increase and claimable unit energy savings decrease. The impact of C&S on UES over time is represented by a time series set of multipliers. The time series multipliers are referred to as the "C&S vectors".

A "vector" of impact percentages was developed for each incentive program measure to capture the impact of C&S in each year. C&S impact vectors are used as the input to the PG Model to assess the total impact of new state and federal standards to potentials of incentive programs. C&S vectors are multiplied by the UES values to create a time series of above-code, claimable UES for use in the model. For incentive program measures not affected by any new standards, values of the impact percentages are 100%. As new C&S come into effect, impact percentages below 100% are derived. In some cases impact percentages can drop to 0% (if the new code is equal to or surpasses the efficiency level of the measure). The methodology for determining impact percentages remains unchanged from the 2013 study.

MICS unit energy savings values in Stage 1 represent the unit energy savings of a measure in 2015. Thus, code vectors are built such that vectors equal 100% in 2015 and decline in value over time as new C&S come into effect. In some special cases the C&S vector is less than 100% in 2015 (if the measure in MICS was not updated to reflect current codes in 2015).

Updates to the MICS data as well as the passing of new C&S required updates to the C&S vectors in Stage 1. New C&S considered in this study include 2015 and 2018 Federal Residential Clothes Washers Energy Conservation Standards[46] and 2018 Federal General Service Fluorescent Lamps Energy Conservation Standards[47].

The C&S impact vectors for each measure are listed in Appendix D.

3.6.2 Net IOU Attributable C&S Savings

The CPUC 's 2010-12 C&S impact evaluation study[48] used the Integrated Standards Savings Model (ISSM)[49] developed by CADMUS and DNV GL to estimate net IOU attributable C&S savings. For C&S that were modeled in ISSM, the 2015 PG Model uses ISSM data. For all other C&S, the 2015 PG Model uses data from the 2013 Potential and Goals Study[50]. The 2013 model leveraged data from the 2006-08 impact evaluation. Table 3-12 lists the scope of each of the past to C&S evaluation studies in terms of the number and types of codes and standards evaluated. The 2015 potential adds new data on 40 codes and standards from the 10-12 evaluation; this is data that was not available in the 2013 study. A full list of

[46] http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/39
[47] http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/70
[48] Cadmus, Energy Services Division and DNV GL. *Statewide Codes and Standards Program Impact Evaluation Report For Program Years 2010-2012.* August 2014.
[49] Cadmus, Energy Services Division and DNV GL. *Integrated Standards Savings Model (ISSM).* Last accessed: January 2015.
[50] Navigant Consulting, Inc. *2013 California Energy Efficiency Potential and Goals Study*. February 2014.

the modeled C&S, their compliance rates, effective dates, and policy status (on the books, possible, or expected) are listed in Appendix D.

Table 3-12: C&S Groups and Evaluation Scope

IOU C&S Group	Number and Type of Codes and Standards	Evaluation Scope
2005 Title 20	22 appliance standards	2006-2008 PY Evaluation
2006-2009 Title 20	11 appliance standards	2010-2012 PY Evaluation
Federal	7 appliance standards	2010-2012 PY Evaluation
2005 Title 24	19 building codes	2006-2008 PY Evaluation
2008 Title 24	22 building codes	2010-2012 PY Evaluation

Source: Cadmus, Energy Services Division and DNV GL. Statewide Codes and Standards Program Impact Evaluation Report for Program Years 2010-2012. August 2014.

The 2013 study made use of "realization rates" in forecasting savings from unevaluated C&S. These realization rates were determined as part of the 2011 Potential and Goals Study. The realization rates were only applied to unevaluated C&S and were based on evaluated C&S (from the 2006-08 evaluation period). Stage 1 removes the use of realization rates (setting them to 100%) as the ISSM used in the 2010-12 evaluation does not include realization rates for unevaluated C&S. This allows the potential study to better align with EM&V data.

As previously noted in section 2.2, the 2015 study uses no layering when analyzing net IOU attributable C&S savings. This is change in methodology relative to the 2013 study.

3.7 Behavior Energy Efficiency

Updates to the behavior model used best available data for existing behavior programs, while considering the difference between operational, or usage-based, and equipment savings. For both residential and non-residential behavior, the team used the same methodology and parameters as the 2013 study. This included using building operator certification (BOC) and home energy report (HER) programs as the representative programs. The team reviewed over 75 sources (listed in Appendix E. , as well as stakeholder comments. Table 3-13 summarizes the parameters for each sector, as well as the key sources driving the Stage 1 updates for each parameter.

Table 3-13: Summary of Behavior Model Parameters and Stage 1 Update Key Sources

Non-Residential		Residential	
Parameter	Key Source(s)	Parameter	Key Source(s)
% of floor space impacted	Assessment of commercial building stock data	Participation rates	CPUC data on current and planned CA IOU participation rates (HER programs)
Usage-based savings per 1,000 square feet	Research Into Action and Energy Market Innovations, *Summary Of Building Operator Certification Program Evaluations*, November 2011; and others	Savings rates (kWh and therms) per household	Most recent available CA IOU HER program evaluations (except SCG)
		Portion of household savings from usage-based behavior	Review of 21 sources addressing the topic (nationwide)

3.7.1 Non-Residential Behavior Model Updates

For the Stage 1 update the team reviewed recent studies evaluating BOC programs and also revisited studies reviewed for the 2013 model.[51] Some of the recent studies were explicit about energy savings and reductions in energy densities associated with changes in operating practices in contrast to savings that result from equipment upgrades, while other reports didn't distinguish between which of these two activities generated savings.

The aggregate impact of this research resulted in the team increasing the savings in electricity associated with changes in operating practices from 41 to 58 kWh per thousand square feet of participating building space. This was based largely on a 2011 Energy Market Innovations, Inc and Research into Action report which clearly analyzed and documented the energy savings associated with changes in operating practices that result from BOC programs.[52] The team did not find a compelling reason to increase natural gas savings associated with building operator training.

In addition to increasing the savings per unit of building area, the team also adjusted the forecast of market penetration of operator training to suggest that BOC practices will reach higher levels of saturation within the study timeframe. The increased level of participation will be driven by those organizations that operate portfolios of buildings, such as city, county, state and federal governments, and institutional organizations like the primary and secondary education sectors, and operators of large commercial buildings portfolios, such as real estate investment trusts. For example, a 2014 study

[51] All four IOUs began offering BOC training in 2002. Research Into Action, *Evaluation of the 2002 Statewide Building Operator Certification And Training Program*, November 2003, Pacific Gas & Electric. BOC was introduced in the 2011 potential study as being the most direct estimate of 'behavioral savings', however these types of program do not represent the universe of programs that achieve operational savings.

[52] Research Into Action, BOC-Expansion Initiative Market Progress Evaluation Report #1, April 2014 , Northwest Energy Efficiency Alliance

indicated that approximately 40% of BOC training involves staff associated with government and institutional facilities.[53] The BOC saturation estimates used in the 2015 update forecast that by 2026 training will impact roughly 3.5% of commercial building space annually, with cumulative training impacting roughly 23% of commercial space.

Based on a recent report recommending 5 years, the team did not revise its 2013 model assumption (also 5 years) on persistence of training impacts.[54] Lastly, the team did not increase the gas savings estimates because there wasn't compelling research to support such a change. Table 3-14 summarizes the non-residential inputs for the 2013 and 2015 models.

Table 3-14: Non-Residential Inputs for 2013 and 2015 Studies

Non-Residential Inputs	2013 Study	2015 Study
Portion to usage-based behavior (kWh/1,000 sq. ft.)	41	58
Portion to usage-based behavior (therms/1,000 sq. ft.)	5.6	5.6
2015% of commercial floor space impacted	0.95%	1.00%
2026% of commercial floor space impacted	3.00%	3.45%

Source: Navigant team analysis, 2015

3.7.2 Residential Model Updates

For the 2015 residential behavior model, the team updated the three model parameters included within the 2013 model based on data from each IOU's latest evaluation reports, correspondence with the CPUC as well as review of EM&V reports for similar programs (listed in Appendix E. . Below we summarize each of these parameters; 1) HER program participation, 2) HER savings results from billing analyses, and 3) an assessment of HER savings allocated to equipment and behavior-based usage.

1. **HER Program Participation:** The team updated HER program participation rates to reflect prior, current and anticipated HER program participation provided by the IOUs and the CPUC.[55] While participation in the HER programs may change over time (either due to attrition from program opt-outs or moving out of the service territory, or due to changes to program implementation such as adding new cohorts), there is no good way to forecast that specific change in participation beyond discussion with the IOUs. As such, we chose to apply the participation amounts at a constant rate based on conversations with the IOUs. However, the behavioral model uses IOU forecasted populations that increase over time (from 2016-2024). As

[53] Impact Evaluation of the California Statewide Building Operator Certification Program, CALMAC Study ID: CPU0069.01. Prepared for the California Public Utilities Commission by Opinion Dynamics Corporation, February 2014. Table 67. PY2010-2012 BOC Participants by Market

[54] Research Into Action, *BOC-Expansion Initiative Market Progress Evaluation Report #1*, April 2014 , Northwest Energy Efficiency Alliance

[55] CPUC. *SW EA Monthly Metrics Report All IOUs Oct 2014_111314.xlsx*. January 2014; CPUC. *Email from Valerie Richardson*. February 2015. Emails from each IOU in April 2015.

such, while we applied a constant participation rate as a percentage, the rate is multiplied by an increasing future population so the absolute number of actual HER participants increases over time.

2. **HER Percent Savings per Household from Billing Analysis:** The team applied per-household adjusted savings rates for each IOU from their respective 2013 program evaluation reports. For PG&E, we calculated a weighted average using each individual wave treatment participation numbers and per household savings percentages to derive a single value that could be applied across the full treatment population.[56] For SCE, we applied the average percent savings per household as reported in the latest evaluation report.[57] The gas savings rate for SCG is based on the Advanced Meter Semi-Annual Report from August 2014.[58] For SDG&E, we applied the average percent savings per household as reported in the latest evaluation report.[59]
3. **Allocation of Equipment or Behavior based savings:** While billing analyses do a good job of determining a per-household savings rate, the data cannot show what percent of the savings come from installation of energy efficient equipment or changes in behavior. To account for this, previous iterations of the PG study estimated the percent of the HER program savings assumed to be from behavior change to ensure that the model appropriately counted only behavior based changes.[60] Upon review of the recent EM&V studies cited in Appendix E. , we determined that this factor is no longer needed for two reasons: 1) utility rebated equipment is already discounted from the evaluated savings estimates percent via double counting analyses[61], and 2) program evaluations establish that the remaining savings, which consists of usage based and non-utility rebated equipment based savings, is the true influence of the behavior program.

As a result of these updates, the model increased the estimate of electricity and gas savings associated with residential behavioral programs. The increases are primarily due to the increase in participation rates and the removal of the equipment vs. behavior calculation. Table 3-15 summarized the residential inputs for the 2013 and 2015 models.

[56] The PG&E EM&V report does not provide an aggregate percent savings per household value, we leveraged information from the following reports and correspondence with DNV-GL to derive this value. 2013 PG&E Home Energy Reports Program . n/a. DNV-GL. 2015; 2013 PG&E Home Energy Reports Program. n/a. NEXANT. 2015
[57] SCE's Home Energy Report Program Savings Assessment: Ex-Post Evaluation Results, Program Year 2013, Final Report. Applied Energy Group, October, 2014: CALMAC Study ID: SCE0365.01, pp. v.
[58] The current SCE behavior program is implemented as part of SCE's Advanced Metering Infrastructure deployment. As such, Navigant based the SCG savings estimates on the August 2014 Advanced Metering Semi-Annual report provided by SCE staff. Nexant, Evaluation of Southern California Gas Company's 2013-2014 Conservation Campaign Submitted to Southern California Gas Company, August 29, 2014.
[59] SDG&E Home Energy Reports Program, 2013 Impact Evaluation, ED Res 3.3, DNV-GL, October 2014, pp. 2.
[60] See the 2013 study for more details.
[61] Double-counting analysis identifies and removes any energy savings that occurred from HER participants participating in both an IOU-rebated program and HER program.

Table 3-15: Residential Inputs for 2013 and 2015 Studies

Residential Inputs	PG&E	SCE	SCG	SDG&E
Participation Rates 2014-2026 -- % of Residential Population				
Assumes constant rates of participation, applied to shifting number of customers in each IOU territory by year.				
2013 Study	5.00%	5.00%	5.00%	5.00%
2015 Study	22.62%	4.96%	0.82%	16.00%
kWh Savings Rates 2014-2026 -- % per Household				
Assumes constant savings rates.				
2013 Study	1.80%	1.80%	n/a	1.50%
2015 Study	1.08%	1.40%	n/a	2.60%
Therm Savings Rates 2014-2026 -- % per Household				
Assumes constant savings rates.				
2013 Study	1.30%	n/a	1.30%	0.90%
2015 Study	0.61%	n/a	1.30%	2.00%
Behavior vs. Equipment				
2013 Study	67.00%	67.00%	67.00%	67.00%
2015 Study	100%	100%	100%	100%

Source: Navigant team analysis, 2015

3.8 Low Income Programs

The Navigant team reviewed the low income sector forecast and model inputs with staff from the CPUC and the IOUs determined additional edits relative to the 2013 study were necessary to align with recent data. The two key inputs reviewed and updated for the low income sector were 1) unit energy savings (savings per participant) and 2) forecasted number of participants.

The average savings per household as reported in the Energy Savings Assistance (ESA) Annual Reports provides the most accurate and transparent approach to defining unit energy savings (UES) for the low income segment. The team analyzed these reports focusing on reported savings from 2011 through 2014. Table 3-16 provides the final UES values used in the 2015 model and compares the value to that used in the 2013 study. The final values used in the 2015 study are the average of reported savings per participant from 2011 to 2014. SCE KWh savings increased significantly while PG&E and SDG&E decreased. All estimates for demand savings per participant decreased relative to the 2013 study. Gas savings per participant decreased for PG&E and SDG&E while increasing for SCG.

Table 3-16: 2015 Potential Model UES Input Assumptions – Average Savings per Treated Household

Utility	2013 Model	2015 Model
KWh/Participant		
PG&E	391	349
SCE	286	378
SDG&E	397	333
SCG	-	-
KW/Participant		
PG&E	0.24	0.08
SCE	0.29	0.14
SDG&E	0.23	0.03
SCG	-	-
Therms/Participant		
PG&E	20	15
SCE	-	-
SDG&E	21	17
SCG	20	27

Source: Navigant team analysis of ESA Annual Reports

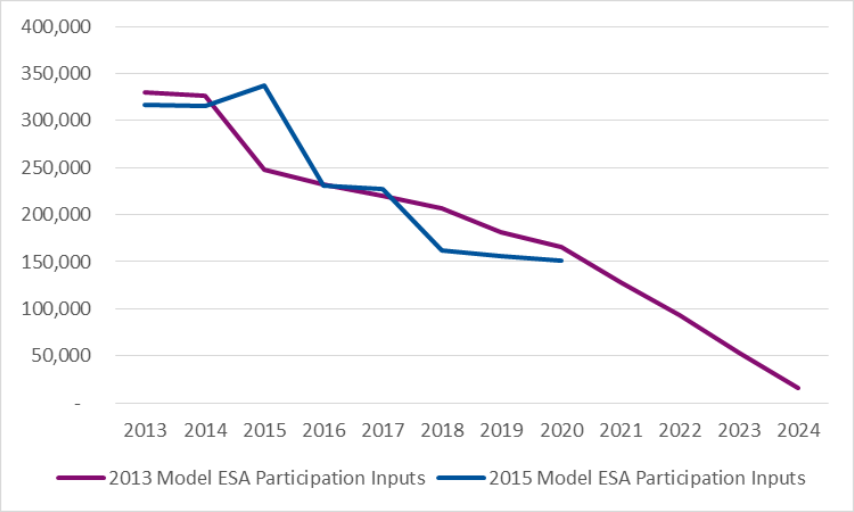
The Navigant team also updated the model's low income program participation forecasts to align more closely with IOU participations forecasts and with current CPUC policy stating that all eligible and willing ESA program candidates would be served by 2020. Table 3-17 provides the recommended participations forecasts for 2015 through 2020, while Figure 3-6 provides a comparison of the final 2015 model participation forecasts with forecasts used the and 2013 potential models. The final 2015 forecasts does not extend beyond 2020 because CPUC policy beyond that date is currently uncertain. The forecasts for participation in the 2016 to 2020 period are relatively consistent though lower than the 2013 study assumptions.

Table 3-17: Low Income Program Participation and Forecast by Utility[62]

Year	Forecast of Total Homes Treated				
	Total	PG&E	SCE	SDG&E	SCG
2015	337,645	119,940	87,389	20,316	110,000
2016	231,316	47,000	54,000	20,316	110,000
2017	227,316	43,000	54,000	20,316	110,000
2018	162,316	38,000	54,000	20,316	50,000
2019	155,816	31,500	54,000	20,316	50,000
2020	150,876	26,560	54,000	20,316	50,000

Source: Navigant team analysis of ESA Annual Reports

Figure 3-6: Comparison of ESA Participation Forecasts



Source: Navigant team analysis of ESA Annual Reports

3.9 Energy Efficiency Financing

The CPUC has recognized financing as an energy efficiency resource program[63]. In the 2013 Study, Navigant developed a new approach to estimate the savings impact from financing; the approach considers financing as a mechanism influencing customer choices by reducing market barriers such as hassle factor, liquidity constraint, and high up front cost[64].

[62] 2015 – 2020 participation forecasts are net of any retreatment or add-back assumptions
[63] CPUC Decision 12-05-2015, May 8, 2012 and Decision Approving 2013-14 Energy Efficiency Programs and Budgets, October 9, 2012
[64] Gillingham, Newell, and Palmer. (2009). "Energy Efficiency Economics and Policy." *Resources for the Future*, 2009. Available at: http://www.rff.org/documents/RFF-DP-09-13.pdf

The 2015 Study follows the same methodology and analytical approach as the 2013 Study. We leveraged the CPUC led Statewide Finance Baseline Residential study[65] and California-specific business credit score data to update residential and commercial sector market characteristics in the 2015 Study. The key areas of data updates include:

» **Eligible population**: Navigant identified residential and non-residential population eligibility as a key area of data update for Stage 1. Navigant conducted additional research on California specific residential and commercial customer credit score distribution. The CPUC led Statewide Finance Baseline Residential study obtained over 11,000 consumer credit data points from Experian. Consistent with the California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA) financing pilot program customer credit score minimum requirement, Navigant assumes residential customers with FICO score above 580 are eligible for financing. Similarly, Navigant collected 10,000 business credit score data points from Experian and assumed that businesses with low to medium credit risks are eligible for financing.

» **Interest rates**: The California Statewide Finance Baseline Residential Study includes a mystery borrower analysis, the study collected over 400 interest rate quotes from California banks and credit unions. Navigant updated the market interest rate assumption in the PG model accordingly.

» **Implied Discount Rate reduction**: Based on the preliminary findings from the Statewide Finance Baseline Residential study, the percent of residential customers citing upfront cost as a market barrier is higher than Navigant's previous estimation. Navigant has made adjustments to the implied discount rate reduction for the single family and multi-family sectors.

Table 3-18 summarizes the data updates for Stage 1.

Table 3-18: Summary of Financing Model Data Update

Input	2013 Study Value	2015 Study Value	2015 Study Source
Single Family Sector Interest Rate	9%	8%	Mystery Borrower Analysis, PY2013-2014 California Statewide Finance Baseline Residential Study under Work Order ED_O_FIN3
Single Family Eligible Population	63%	98%	Experian Consumer Credit Data, access date: Nov 19, 2014
Commercial Eligible Population	20%	77%	Experian Business Credit Data, access date: Mar 2, 2015
Single Family Sector Implied Discount Rate Reduction*	11%	14%	Residential Baseline Survey, PY2013-2014 California Statewide Finance Baseline Residential Study under Work Order ED_O_FIN3
Multi-Family Implied Discount Rate Reduction	13%	20%	Residential Baseline Survey, PY2013-2014 California Statewide Finance Baseline Residential Study under Work Order ED_O_FIN3

[65] Work performed under Work Order ED_O_FIN3

As shown in Table 3-18, the eligible population for single family sector and commercial sector increased significantly based on the primary credit data. In addition, the implied discount rate reduction for the single family sector and the multi-family sector increased, implying higher savings estimated from financing in Stage 1. Navigant left other financing model assumptions intact; the 2013 Study report captures details on other modeling assumptions.

4. Results

4.1 Statewide Potential

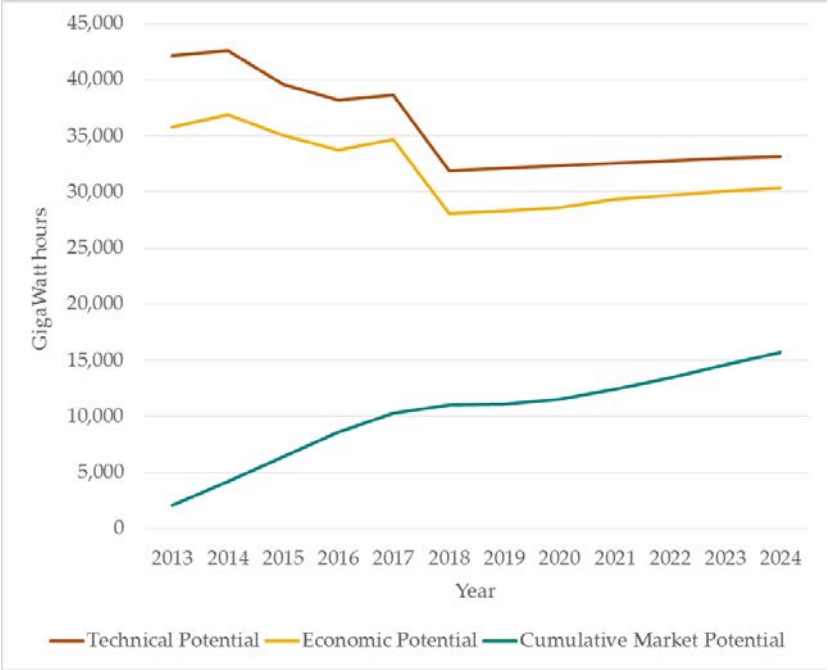
4.1.1 Technical, Economic and Cumulative Market Potential

Figure 4-1 through Figure 4-6 illustrate the statewide technical economic and cumulative market potential from IOU equipment rebates for electric (GWh), demand (MW) and gas (MMTherms) as well as savings as a percent of sales.[66] Theses graphs do not show IOU claimable savings from C&S advocacy programs or behavior programs nor do they include the effects of energy efficiency financing. The figures represent the remaining potential starting in 2013 (i.e. the effects of previous installations of high efficiency equipment prior to 2013 are accounted).

Figure 4-1 shows a technical potential of approximately 38,000 GWh in 2016 and an economic potential of approximately 33,700 GWh. Cumulative market potential grows at a relatively constant rate from 2013 to 2017 when its trajectory slows. This change in trajectory is due to the effects of new lighting C&S that come into effect in 2018 and decrease the IOU claimable savings. Technical and economic potential also decrease in 2018 due to changes in lighting C&S. Figure 4-2 shows statewide technical and economic electric potential as a percent of sales start at approximately 21% and 18% respectively in 2016 and drop to below 16% by 2024. Cumulative market potential grows to approximately 8% of sales by 2024. Figure 4-3 and Figure 4-4 show similar trends in demand potential.

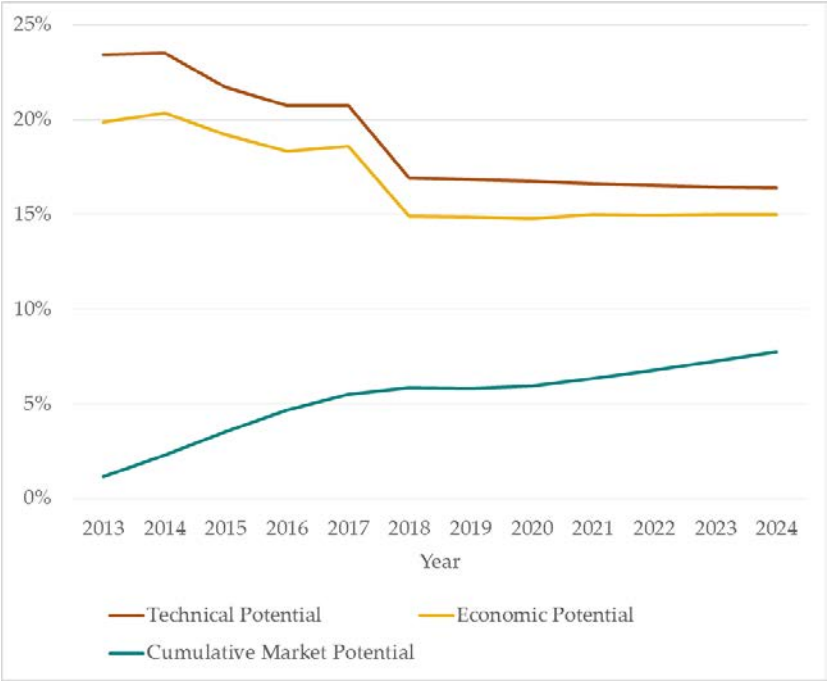
[66] Savings as a percent of sales reflects the value calculated when dividing energy efficiency potential in any given year by the forecasted energy consumption for that year. Forecasted energy consumption is sourced from the CEC.

Figure 4-1: Statewide Electric Technical, Economic and Cumulative Market Potential



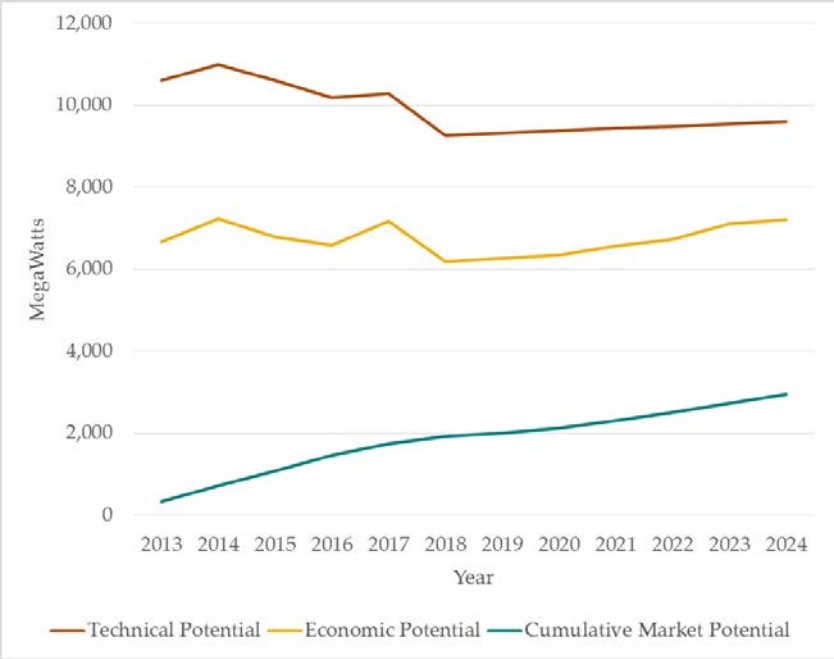
Source: June 2015 PG Model

Figure 4-2: Statewide Electric Potential as a Percent of Sales



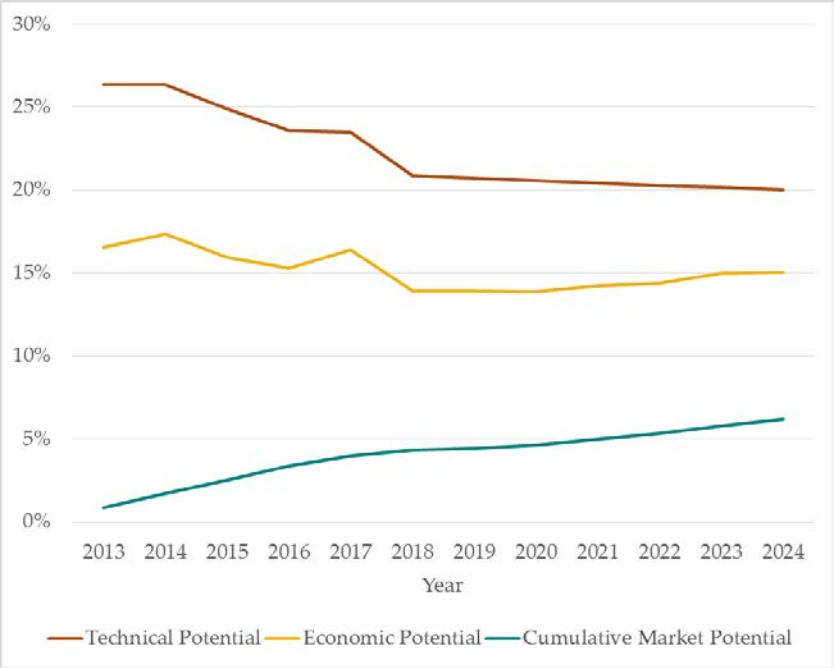
Source: June 2015 PG Model

Figure 4-3: Statewide Peak Demand Technical, Economic and Cumulative Market Potential



Source: June 2015 PG Model

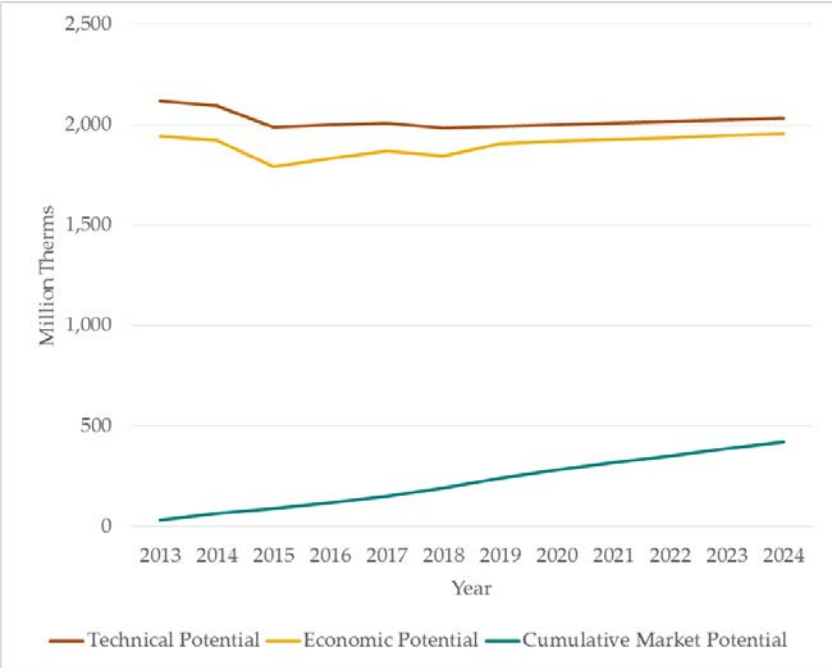
Figure 4-4: Statewide Peak Demand Potential as a Percent of Sales



Source: June 2015 PG Model

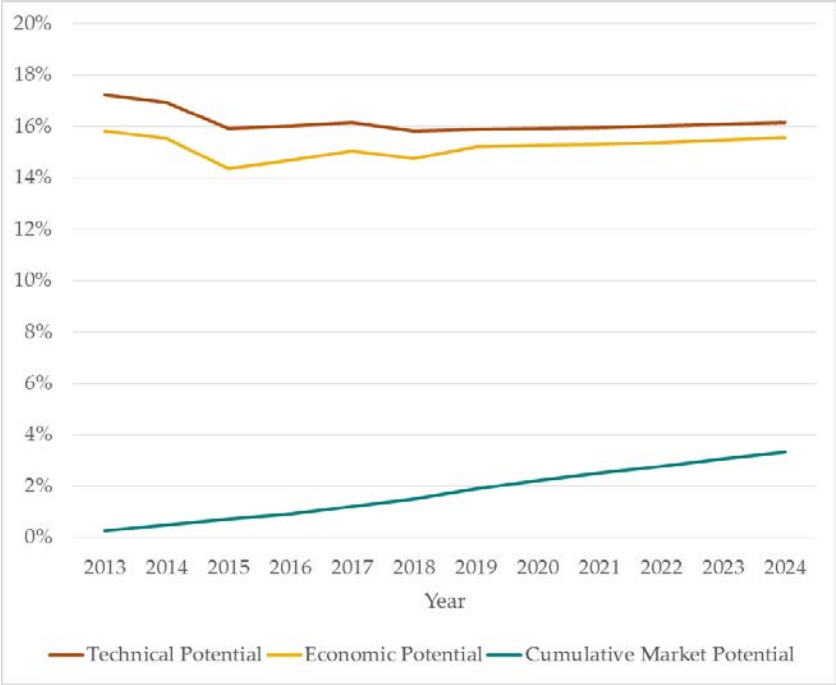
Figure 4-5 shows a technical potential of approximately 2,000 MMTherms in 2016 and an economic potential of approximately 1,800 MMTherms. Cumulative market potential grows at a relatively constant rate throughout the study period. Figure 4-6 shows statewide technical and economic gas potential as a percent of sales start at approximately 16% and 14.5% respectively in 2016 and stay relatively consistent through 2024. Cumulative market potential grows to approximately 3.3% of sales by 2024.

Figure 4-5: Statewide Natural Gas Technical, Economic and Cumulative Market Potential



Source: June 2015 PG Model

Figure 4-6: Statewide Natural Gas Potential as a Percent of Sales



Source: June 2015 PG Model

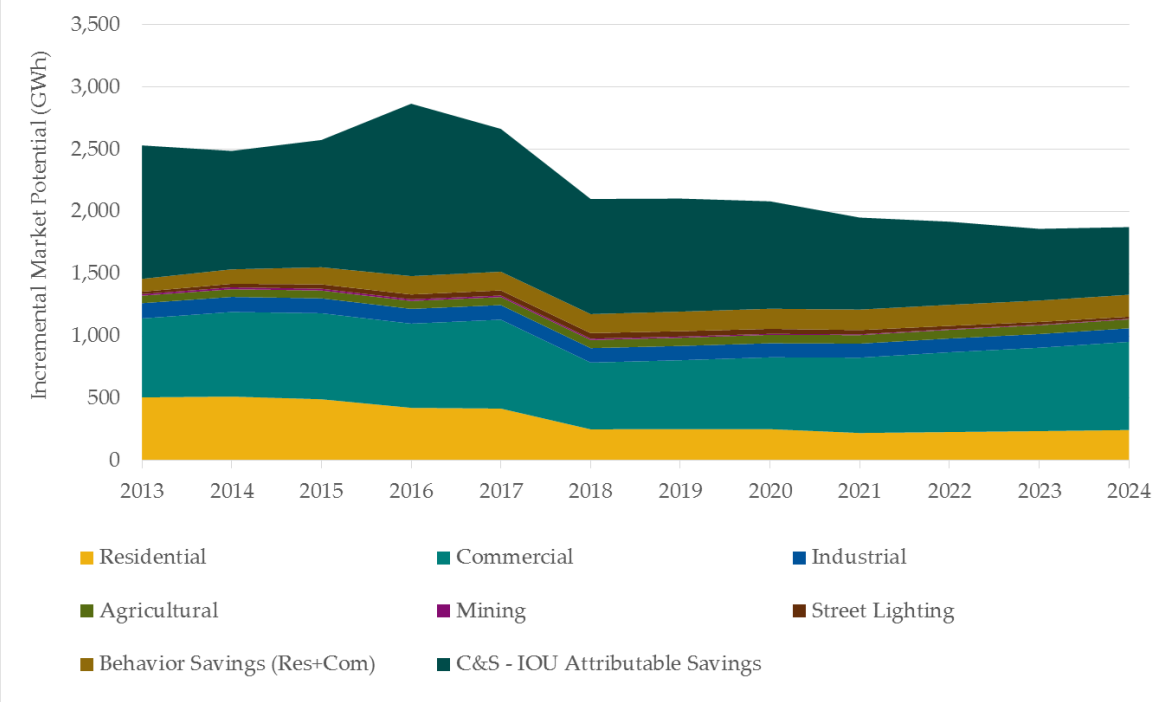
4.1.2 Incremental Market Potential

Figure 4-7 through Figure 4-9 illustrate the statewide incremental market potential from IOU programs for electric (GWh), demand (MW) and gas (MMTherms) respectively. Theses graphs include IOU claimable savings from C&S advocacy programs and behavior programs but they do not include the effects of energy efficiency financing.

Figure 4-7 shows a large portion of IOU potential comes from IOU attributable C&S savings. Residential and Commercial rebated equipment has historically contributed a significant amount of savings to IOU programs and will continue to do so through 2017. In 2018, changes in lighting C&S act to reduce IOU claimable savings. The AIMS sectors remain a small portion of future potential. IOU behavior programs provide more electric savings than the agriculture, mining and streetlighting sectors combined.

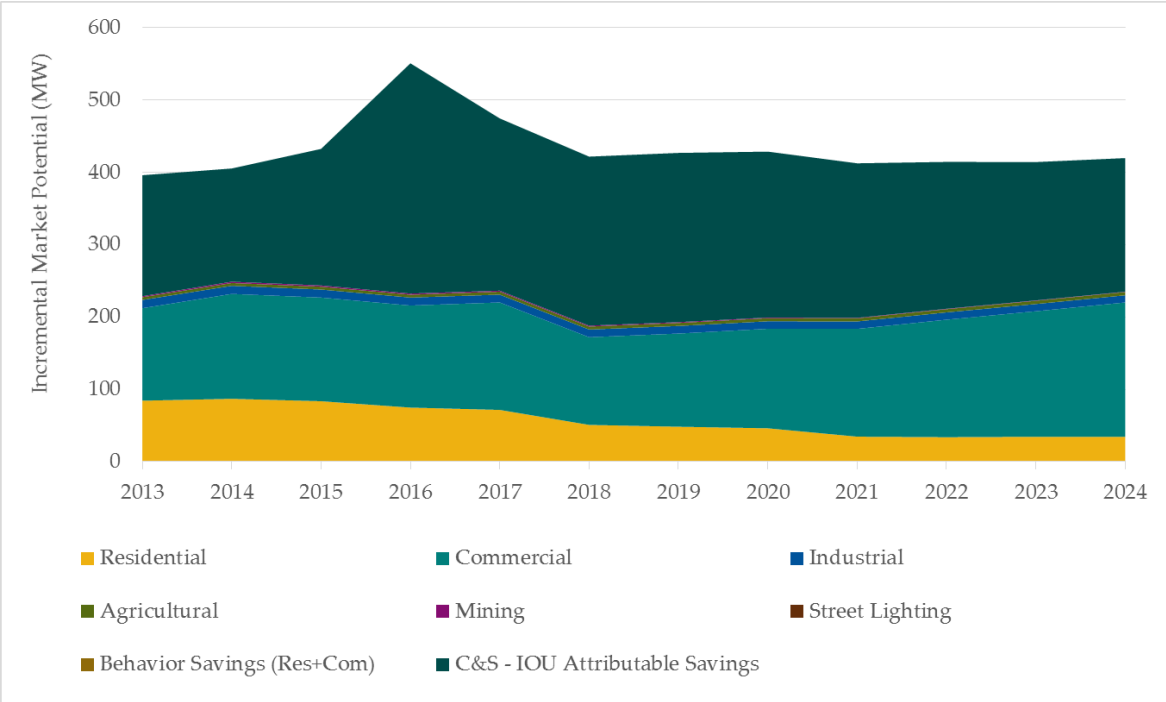
Figure 4-8 shows similar trends for peak demand savings with a few noted differences: behavior programs and street lighting measures do not have any quantified IOU claimable savings potential. Figure 4-8 also shows a spike in expected demand savings in 2016 from C&S. This spike is due to expected 2016 Title 20 HVAC standards regarding air filter labeling.

Figure 4-7: Statewide Incremental Electric Potential



Source: June 2015 PG Model

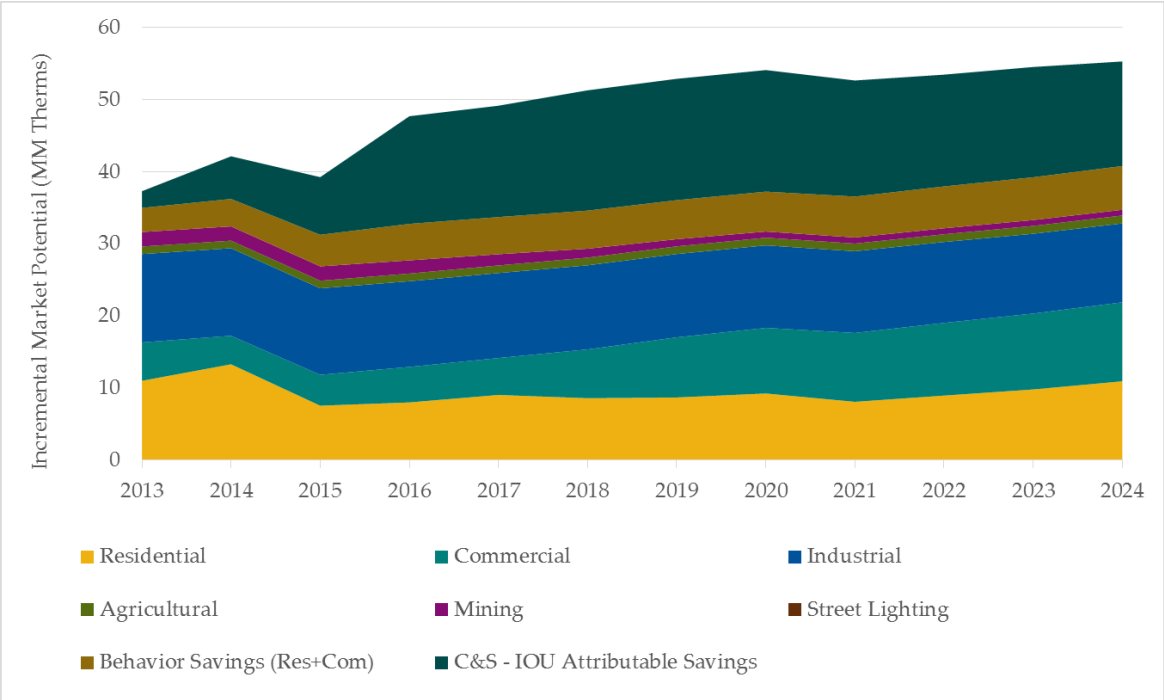
Figure 4-8: Statewide Incremental Demand Potential



Source: June 2015 PG Model

Figure 4-9 shows larger contributions by the Industrial and Mining sectors towards total gas savings potential. Residential and Commercial savings are expected to grow in 2016 and beyond. C&S savings will continue to play a role in IOU program potential but is not as significant of a contributor when compared to electric savings. Like electric potential, IOU behavior programs provide more gas savings than the agriculture, mining and streetlighting sectors combined.

Figure 4-9: Statewide Incremental Natural Gas Potential



Source: June 2015 PG Model

4.1.3 Incremental Market Potential as a Percent of Energy Sales

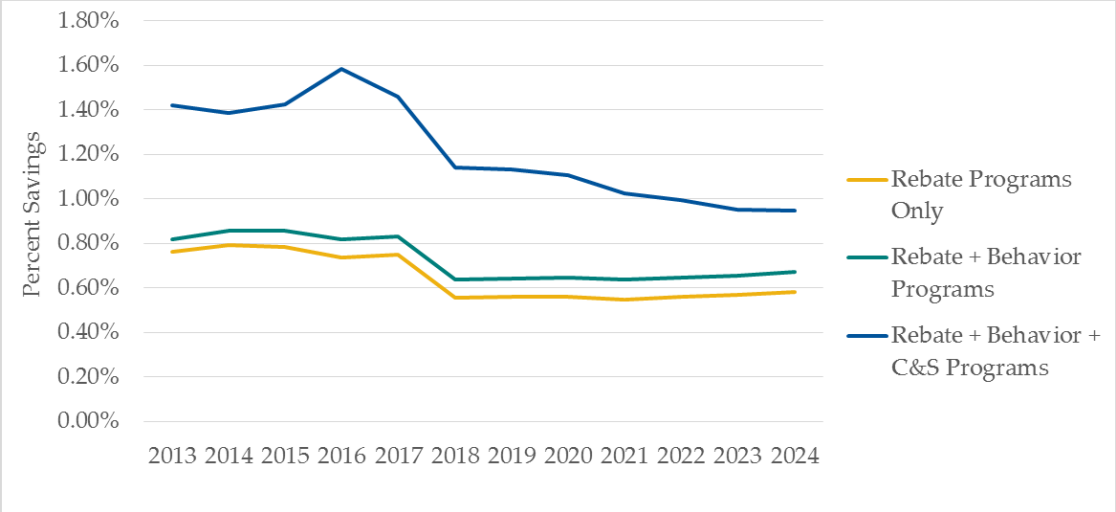
The proposed Assembly Bill 1330 would create an Energy Efficiency Resource Standard (EERS) in California; a statewide target for electric and natural gas efficiency savings. AB 1330, as currently written, would set the following targets:

- Incremental electric savings achieved of no less than 1.5% in 2020 and 2% in 2025
- Incremental natural gas savings achieved of no less than 0.75% in 2020 and 1% in 2025
- Percent savings shall be determined based upon the average retail sales of electricity and natural gas of the immediately preceding three years

Given these possible targets, the study calculated the percent savings by dividing incremental market potential by retail energy sales forecast from the CEC. Retail sales were converted to a three-year historic rolling average per the language of AB 1330.

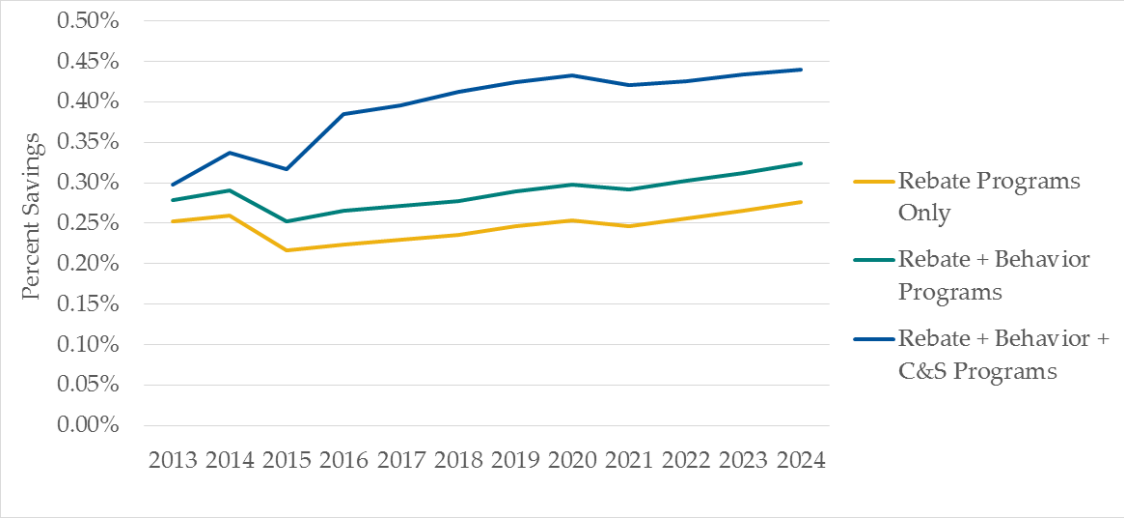
Figure 4-10 illustrates the percent savings in each year considering three sources of savings (rebate programs, behavior programs and IOU C&S programs). It is unclear at this time which sources of savings can and should be counted towards AB 1330 targets. When considering only IOU rebate programs, savings in 2016 amounts to 0.74% of sales. Adding the savings from behavior programs increases the value to 0.82%. The total savings from rebate programs, behavior programs and C&S in 2016 results in 1.58% savings. Savings as a percent of retail sales declines over time. A similar graph for gas savings can be found in Figure 4-11. In all analyzed situations, gas savings is less than 0.5% of CEC forecasted gas sales.

Figure 4-10: Statewide IOU Electric Savings as a Percent of Annual Sales



Source: June 2015 PG Results Viewer

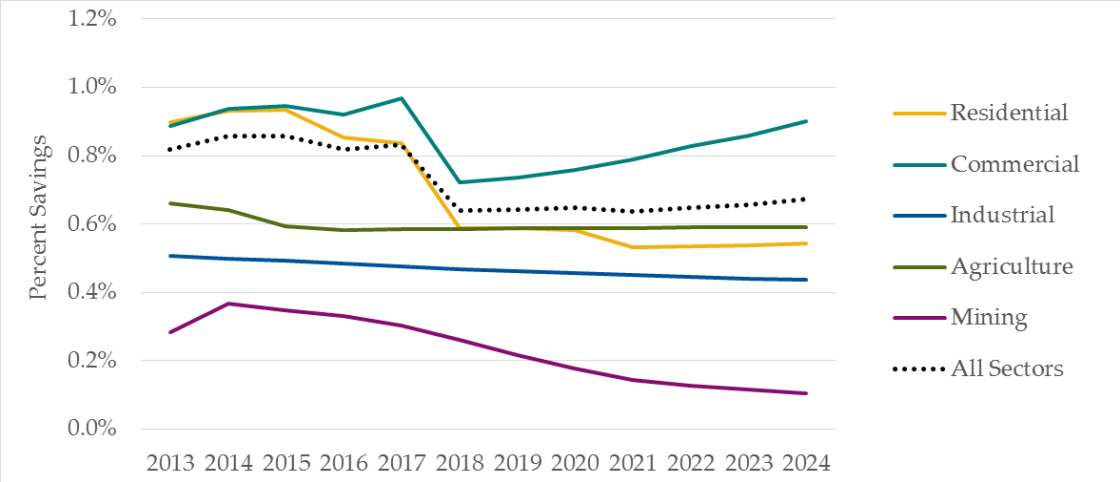
Figure 4-11: Statewide IOU Natural Gas Savings as a Percent of Annual Sales



Source: June 2015 PG Results Viewer

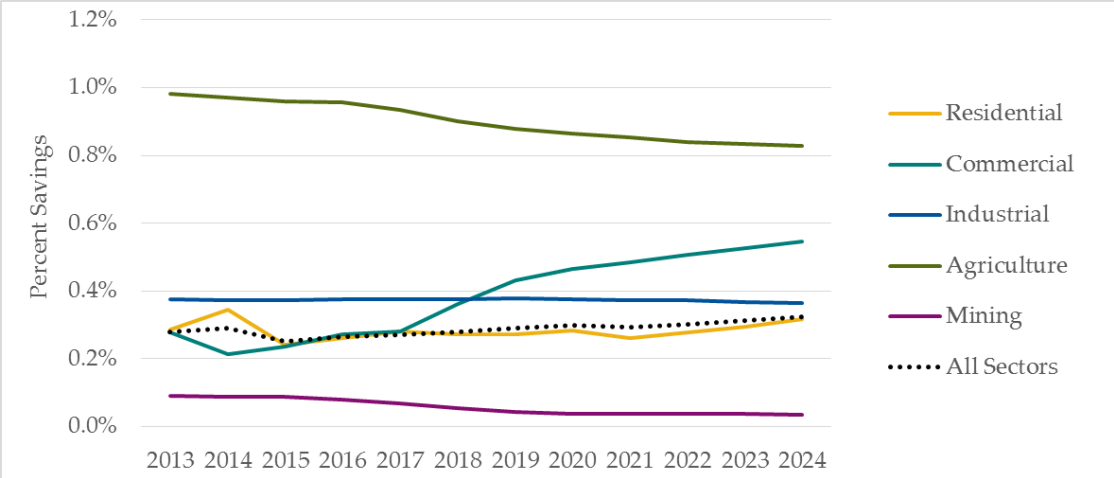
Figure 4-12 dives deeper into rebate program and behavior program savings for each sector. The graphs exclude savings from C&S. In 2016, Commercial program savings amount to 0.92% of Commercial electric sales, Residential programs result in 0.85% savings and while Industrial programs amount to 0.48% savings. The overall impact of all sectors is shown as the dotted line labeled "All Sectors". Figure 4-13 shows a similar graphic for gas savings.

Figure 4-12: Sector Level IOU Electric Program Savings as a Percent of Annual Sales



Note: Streetlighting not shown for scale. Streetlighting averages above 2% for the entire study period.
Source: June 2015 PG Results Viewer

Figure 4-13: Sector Level IOU Gas Program Savings as a Percent of Annual Sales



Source: June 2015 PG Results Viewer

4.2 Market Potential by IOU Territory

The following tables (Table 4-1 through Table 4-4) detail the annual incremental market potential for each IOU from 2016 through 2024. The potential is disaggregated by rebate programs (including behavior programs) as well as net C&S (IOU claimable) savings. Savings values for PG&E and SDG&E

include interactive effects (the impact of electric energy efficiency on gas savings) while savings for SCE and SCG exclude these interactive effects. IOU rebate program potential shown in the tables below are gross incremental annual savings while the IOU claimable C&S savings are net IOU attributable annual savings. Savings values for SDG&E further reflect an adjustment to whole building savings to be consistent with CPUC Decision 14-10-046 (further discussion can be found in section 1.4).

Table 4-1: PG&E Market Potential

	GWh			MW			MMTherms		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total
2016	624.5	611.3	1,235.9	85.0	140.6	225.6	12.9	5.5	18.4
2017	637.4	506.5	1,143.9	87.4	105.2	192.6	12.9	5.7	18.6
2018	507.4	408.3	915.7	68.9	103.2	172.1	14.8	6.1	20.9
2019	510.9	401.0	911.9	69.6	103.3	173.0	14.9	6.2	21.1
2020	519.1	380.9	900.0	71.4	101.3	172.7	15.5	6.2	21.7
2021	523.9	326.2	850.1	74.4	94.3	168.8	15.9	5.9	21.8
2022	541.2	294.7	835.9	80.3	89.7	170.0	16.7	5.7	22.4
2023	558.2	254.1	812.3	86.3	84.4	170.7	17.5	5.6	23.2
2024	581.3	239.8	821.1	91.7	81.5	173.3	18.6	5.3	23.9

**Includes behavior programs, excludes effects of financing.*
Source: June 2015 PG Model

Table 4-2: SCE Market Potential

	GWh			MW			MMTherms		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total
2016	673.8	630.5	1,304.4	122.3	145.0	267.3	0.0	0.0	0.0
2017	693.5	522.4	1,215.9	123.0	108.5	231.4	0.0	0.0	0.0
2018	527.7	421.1	948.8	99.4	106.4	205.8	0.0	0.0	0.0
2019	541.8	413.6	955.3	103.1	106.6	209.7	0.0	0.0	0.0
2020	553.0	392.9	945.9	106.9	104.5	211.4	0.0	0.0	0.0
2021	542.4	336.5	878.9	103.3	97.3	200.6	0.0	0.0	0.0
2022	558.8	304.0	862.7	108.6	92.5	201.1	0.0	0.0	0.0
2023	573.2	262.1	835.4	113.2	87.1	200.3	0.0	0.0	0.0
2024	592.8	247.3	840.2	118.8	84.1	202.9	0.0	0.0	0.0

**Includes behavior programs, excludes effects of financing.*
Source: June 2015 PG Model

Table 4-3: SCG Market Potential

	GWh			MW			MMTherms		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S**	Total
2016	0.0	0.0	0.0	0.0	0.0	0.0	17.3	11.7	29.1
2017	0.0	0.0	0.0	0.0	0.0	0.0	18.1	12.2	30.3
2018	0.0	0.0	0.0	0.0	0.0	0.0	16.6	12.7	29.4
2019	0.0	0.0	0.0	0.0	0.0	0.0	18.0	12.6	30.6
2020	0.0	0.0	0.0	0.0	0.0	0.0	18.4	12.2	30.6
2021	0.0	0.0	0.0	0.0	0.0	0.0	17.7	10.9	28.6
2022	0.0	0.0	0.0	0.0	0.0	0.0	18.2	10.3	28.5
2023	0.0	0.0	0.0	0.0	0.0	0.0	18.6	9.6	28.2
2024	0.0	0.0	0.0	0.0	0.0	0.0	19.0	9.1	28.1

**Includes behavior programs, excludes effects of financing.*
***Excludes interactive effects*
Source: June 2015 PG Model

Table 4-4: SDG&E Market Potential

	GWh			MW			MMTherms		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total
2016	181.0	143.1	324.1	24.5	32.9	57.4	2.6	0.6	3.2
2017	185.0	118.6	303.5	25.7	24.6	50.3	2.7	0.6	3.3
2018	140.8	95.6	236.4	19.6	24.1	43.7	3.2	0.7	3.9
2019	143.7	93.8	237.6	20.1	24.2	44.2	3.2	0.7	3.9
2020	147.3	89.2	236.4	20.9	23.7	44.6	3.3	0.7	4.0
2021	146.6	76.4	223.0	21.1	22.1	43.2	3.0	0.7	3.7
2022	151.3	69.0	220.3	22.5	21.0	43.4	3.1	0.6	3.7
2023	154.4	59.5	213.9	23.4	19.8	43.2	3.2	0.6	3.8
2024	158.1	56.1	214.2	24.5	19.1	43.6	3.2	0.6	3.8

**Includes behavior programs, excludes effects of financing, and includes adjustment to whole building savings to be consistent with CPUC Decision 14-10-046.*
Source: June 2015 PG Model

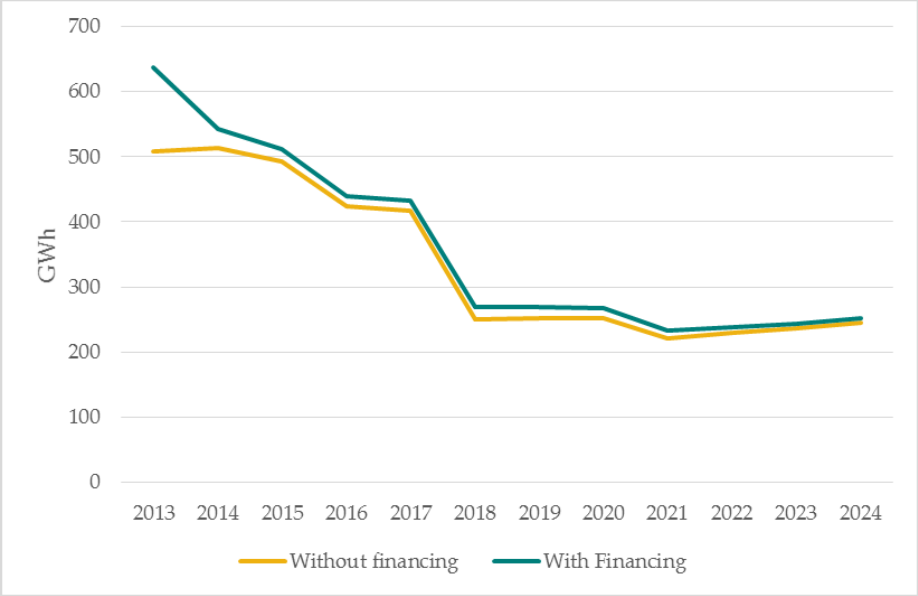
4.3 Effects of Financing on Potential

The introduction of financing reduces market barriers to energy efficiency technology adoption. To estimate the influence of financing, the PG model calculates savings potential by sector for two scenarios:

with financing and without financing. The difference between the two scenarios represents the incremental savings estimate due to energy efficiency financing.

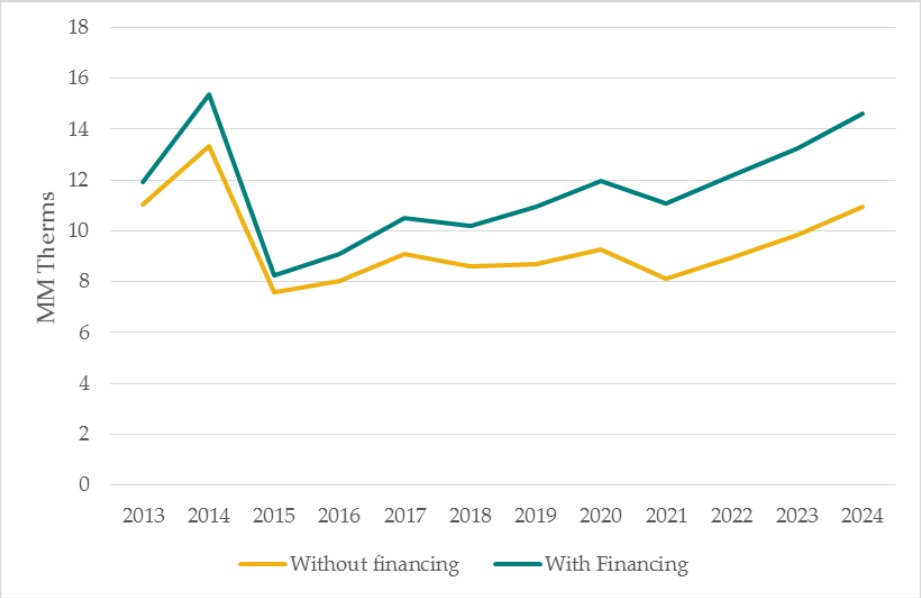
Financing increases residential sector incremental electric savings by an average of 4.5 percent (Figure 4-14) while increasing gas savings by 20.8 percent (Figure 4-15) over the 2016 -2024 time frame. The sum of all additional first year savings due to financing from 2016-2024 amounts to 117 GWh and 22 MMTherms in the residential sector. In 2016, financing adds 16.3 GWh and 1.05 MMTherms to the residential incremental savings. The impact due to financing in 2016 is equivalent to an additional 3.7% incremental first year electric savings and 11.6% incremental first year gas savings in the residential sector.

Figure 4-14: Residential Incremental Electric Savings Potential due to Financing (GWh)



Source: June 2015 PG Model

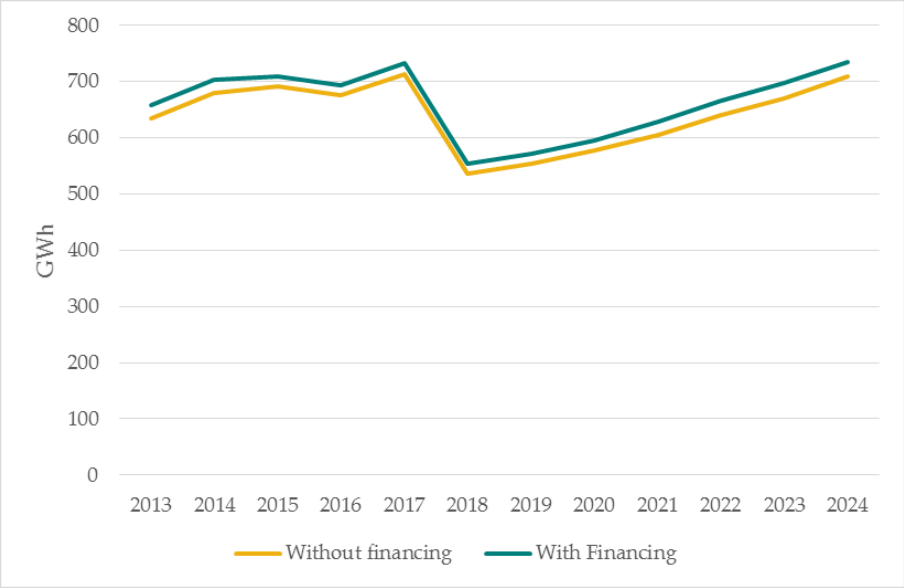
Figure 4-15: Residential Incremental Gas Savings due to Financing (MM Therms)



Source: June 2015 PG Model

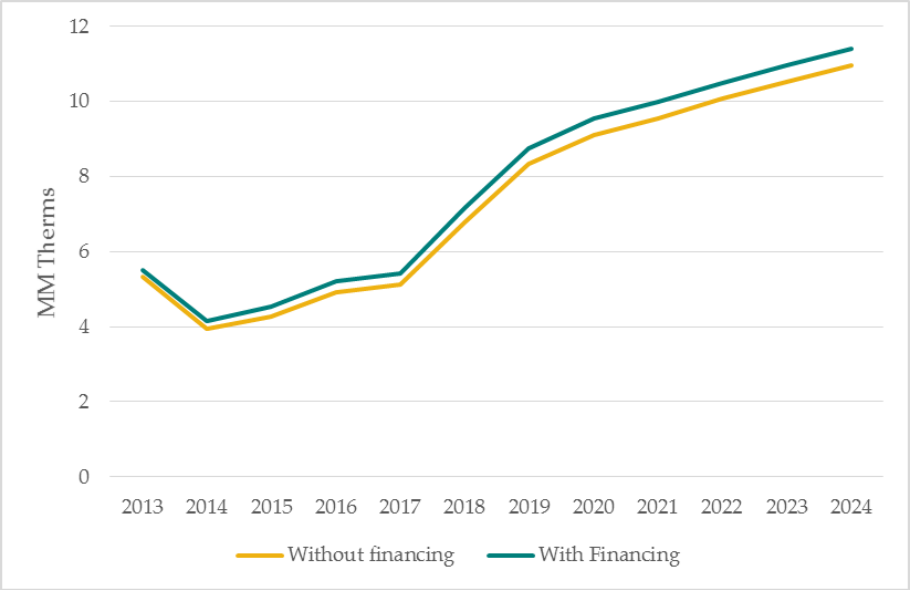
The impact of financing on the commercial sector increases electric savings by 3.3 percent (Figure 4-16) and gas savings by 4.7 percent (Figure 4-17) on average from 2016 to 2024. This translates to 193 GWh and 3.6 MM Therms of total first year electric and gas savings in the commercial sector from 2016-2024. In 2016 financing in the commercial sector can increase savings by 17.6 GWh (2.5 percent increase) and 0.3 MMTherms (5.6 percent increase).

Figure 4-16: Commercial Incremental Electric Savings due to Financing (GWh)



Source: June 2015 PG Model

Figure 4-17: Commercial Incremental Gas Savings due to Financing (MM Therms)



Source: June 2015 PG Model

Two key considerations are bounding the potential of financing in the commercial sector:

1. Population eligibility and
2. The reduction in implied discount rate assumptions.

Financing is slightly less available to commercial customers than residential customers. In the context of California energy efficiency financing landscape, the IOU energy efficiency financing pilot programs are designed to make financing accessible to the majority of residential customers. The minimum program requirement of a 580 FICO score potentially qualifies 98 percent of the residential customers. Compare to the residential sector, 77 percent of businesses have low or medium credit risk representing the eligible population for financing.

Based on Navigant's market research, residential sector customers have a much higher implied discount rate than commercial customers. Financing has a more significant reduction to residential customer implied discount rate than commercial customer implied discount rate.

4.4 Detailed Stage 1 Results

Along with the model file and the summary results shown above, the team developed a downloadable excel tool, the 2015 PG Results Viewer, which provides access to all detailed mid-case results from the model. The Results Viewer provides stakeholders the ability to manipulate and visualize model outputs from the high-level statewide standpoint all the way to the granular measure level. The Results Viewer is

structured with multiple tabs to view summary results as well as detailed model outputs, as seen in Table 4-5. The results viewer can be found on the CPUC's website.[67]

Table 4-5: 2015 PG Results Viewer Tabs

Summary Outputs	Detailed Output Viewing	
Data Key	CEC Sales Data	Incremental Codes and Standards
Technical, Economic and Market Potential	Incremental Market Potential	Cumulative Codes and Standards
IOU Potential	Technical Potential	Behavior
Use Category Dashboard	Economic Potential	Incremental Market Potential Financing
Percent Savings Dashboard	Cumulative Market Potential	Cumulative Market Potential Financing
C&S and Behavior Dashboard		
Financing Dashboard		

Following is a brief description of each of the Summary Outputs tabs:

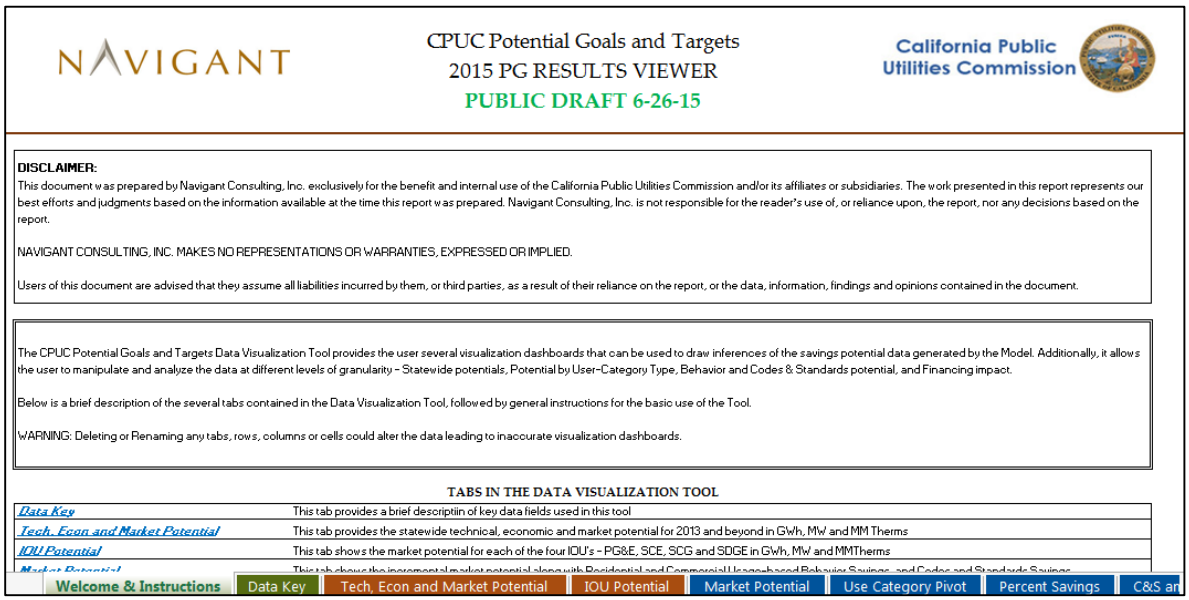
- Technical, Economic and Market Potential: This tab provides the statewide technical, economic and market potential for 2013 and beyond. The user can further filter and view results by IOU.
- IOU Potential: This tab shows the market potential for each of the four IOU's.
- Use Category Dashboard: This tab provides the user the ability to visualize the Incremental Market Potential results by End Use Categories. It also allows the user to manipulate the model outputs based on their needs through filters such as Service Territory, Building Type, Sector etc.
- Percent Savings Dashboard: This tab shows the incremental market potential as a percent of total energy sales.
- C&S and Behavior Dashboard: This tab shows the Codes and Standards, and Behavior potential for all four IOU's. It also allows the user to manipulate the model outputs based on their needs through filters such as Service Territory, Savings Type and Sector.
- Financing Dashboard: This tab shows the effects of financing on incremental market potential for Residential and Commercial sectors

On the other hand, the Detailed Output Viewing tabs contain all the raw model outputs, as well as the raw CEC Sales Data. The raw model outputs is the source data for all the dashboard visualizations provided, and additionally gives the user the ability to perform custom analysis based on their needs. Figure 4-18 through Figure 4-21 will show some snapshots of the tool.

[67] http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Energy+Efficiency+Goals+and+Potential+Studies.htm

Figure 4-18 is a snapshot of the Results Viewer Main Page that provides a high level summary of the tool, a brief description of each tab and some general instructions.

Figure 4-18: Results Viewer Main Page



NAVIGANT

CPUC Potential Goals and Targets
2015 PG RESULTS VIEWER
PUBLIC DRAFT 6-26-15

California Public Utilities Commission

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The CPUC Potential Goals and Targets Data Visualization Tool provides the user several visualization dashboards that can be used to draw inferences of the savings potential data generated by the Model. Additionally, it allows the user to manipulate and analyze the data at different levels of granularity – Statewide potentials, Potential by User-Category Type, Behavior and Codes & Standards potential, and Financing impact.

Below is a brief description of the several tabs contained in the Data Visualization Tool, followed by general instructions for the basic use of the Tool.

WARNING: Deleting or Renaming any tabs, rows, columns or cells could alter the data leading to inaccurate visualization dashboards.

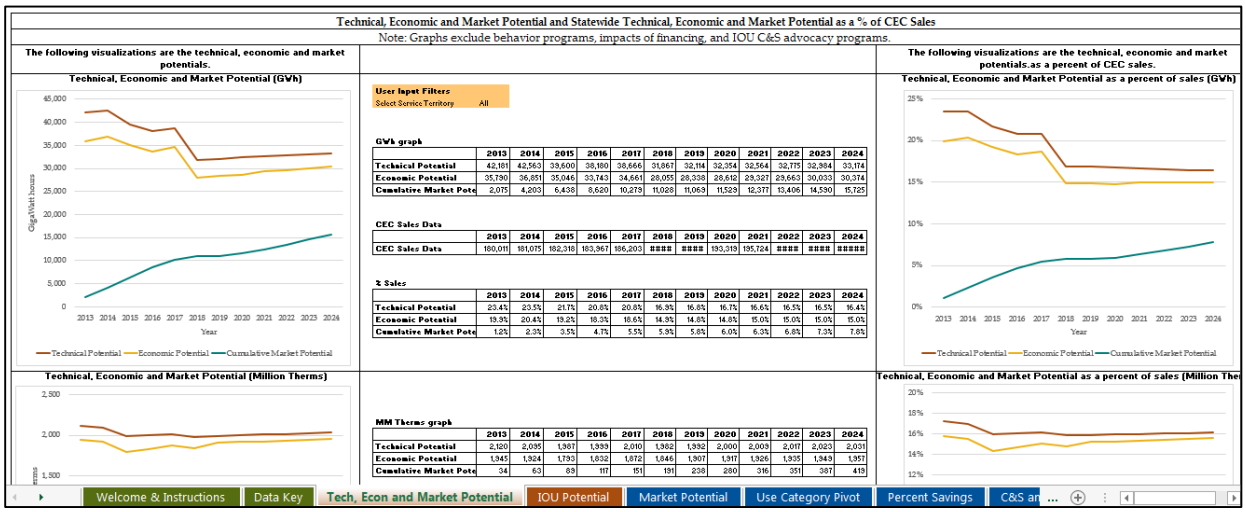
TABS IN THE DATA VISUALIZATION TOOL

Data Key	This tab provides a brief descriptiin of key data fields used in this tool
Tech, Econ and Market Potential	This tab provides the statewide technical, economic and market potential for 2013 and beyond in GWh, MW and MM Therms
IOU Potential	This tab shows the market potential for each of the four IOU's – PG&E, SCE, SCG and SDGE in GWh, MW and MMTherms

Welcome & Instructions | Data Key | Tech, Econ and Market Potential | IOU Potential | Market Potential | Use Category Pivot | Percent Savings | C&S ar

As discussed previously, the Results Viewer provides various Summary Outputs tabs, one of which is highlighted in Figure 4-19. The layout of the results page has graphics on either side of the summary model outputs, to provide the user the ability to visually see the information, as well as seeing the model outputs that is represented in the graphs.

Figure 4-19: Tech, Econ and Market Potential Page



Technical, Economic and Market Potential and Statewide Technical, Economic and Market Potential as a % of CEC Sales

Note: Graphs exclude behavior programs, impacts of financing, and IOU C&S advocacy programs.

The following visualizations are the technical, economic and market potentials.

Technical, Economic and Market Potential (GWh)

User Input Filters
Select Service Territory All

GWh graph

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Technical Potential	42,161	42,563	39,600	38,180	38,666	31,867	32,114	32,354	32,564	32,775	32,984	33,174
Economic Potential	35,790	36,851	35,046	33,743	34,661	28,055	28,338	28,612	29,327	29,663	30,033	30,374
Cumulative Market Pote	2,075	4,203	6,438	8,620	10,279	11,028	11,069	11,529	12,377	13,406	14,530	15,725

CEC Sales Data

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
CEC Sales Data	180,011	181,075	182,318	183,367	186,203	####	####	193,319	195,724	####	####	#####

% Sales

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Technical Potential	23.4%	23.5%	21.7%	20.8%	20.8%	16.9%	16.8%	16.7%	16.6%	16.5%	16.5%	16.4%
Economic Potential	19.9%	20.4%	19.2%	18.3%	18.6%	14.9%	14.8%	14.8%	15.0%	15.0%	15.0%	15.0%
Cumulative Market Pote	1.2%	2.3%	3.5%	4.7%	5.5%	5.9%	5.8%	6.0%	6.3%	6.8%	7.3%	7.8%

The following visualizations are the technical, economic and market potentials.as a percent of CEC sales.

Technical, Economic and Market Potential as a percent of sales (GWh)

Technical, Economic and Market Potential (Million Therms)

MM Therms graph

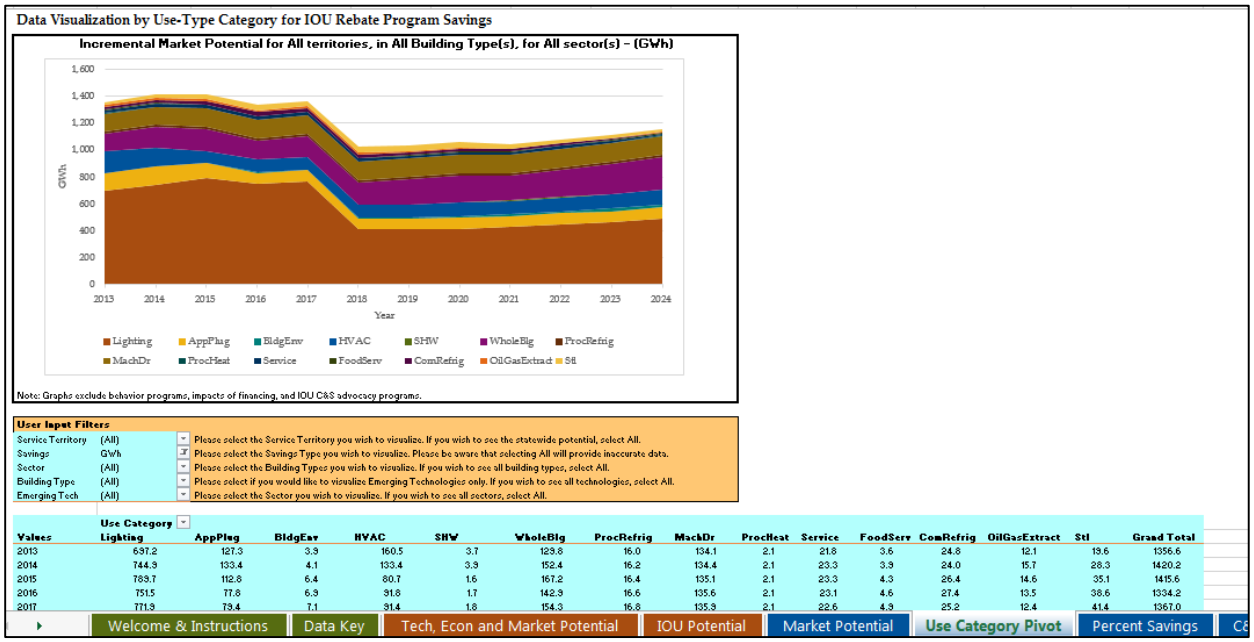
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Technical Potential	2,120	2,095	1,987	1,939	2,010	1,962	1,932	2,000	2,009	2,017	2,023	2,031
Economic Potential	1,945	1,924	1,793	1,832	1,872	1,846	1,807	1,917	1,926	1,935	1,943	1,951
Cumulative Market Pote	34	63	89	117	151	191	238	280	316	351	387	419

Technical, Economic and Market Potential as a percent of sales (Million The

Welcome & Instructions | Data Key | Tech, Econ and Market Potential | IOU Potential | Market Potential | Use Category Pivot | Percent Savings | C&S ar

Figure 4-20 is a snapshot of the Use-Category Dashboard that gives the user over 300 different views of the results based on user defined selections of several key parameters (IOU, savings type, sector, building type, inclusion of ETs). The page layout is designed to be as simple as possible with the graphic at the top, the user-customizable filters below, followed by a table of the model outputs being plotted. The table (like the graph) is auto-updated based on the user selections.

Figure 4-20: Use-Category Dashboard Page



Lastly, Figure 4-21 provides a snapshot of the detailed output format that is provided in the Results Viewer. The figure illustrates the incremental market potential. This table contains energy savings data for each measure in each IOU, building type, use category, measure type (emerging vs. conventional), sector, and year. The data resides in a format that is database-friendly and can be exported to other programs for additional user analysis.

Figure 4-21: Incremental Market Potential Page

Service Territory	Savings	Sector	Building Type	Use Category	Emerging Tech	Measure	2013	2014	2015	2016	2017	2018	2019	2020	2021	202
PG&E	GWh	Residential	Res - Multi Family	AppPlug	Yes	AppPlug - Clothes Washer (Electric) - Emerging	0.04	0.05	0.04	0.05	0.06	0.06	0.07	0.08	0.10	0.1
PG&E	GWh	Residential	Res - Multi Family	AppPlug	Yes	AppPlug - Clothes Washer (Gas) - Emerging	-0.01	-0.02	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.0
PG&E	GWh	Residential	Res - Multi Family	AppPlug	Yes	AppPlug - Dishwasher (Electric) - Emerging	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
PG&E	GWh	Residential	Res - Multi Family	AppPlug	Yes	AppPlug - HP Clothes Dryer - Emerging	0.00	0.00	0.00	0.00	0.06	0.13	0.21	0.31	0.41	0.5
PG&E	GWh	Residential	Res - Multi Family	AppPlug	Yes	AppPlug - Smart Strip Home Office - Emerging	0.23	0.24	0.27	0.29	0.31	0.32	0.32	0.32	0.31	0.3
PG&E	GWh	Residential	Res - Multi Family	AppPlug	Yes	AppPlug - Smart Strip Home Theater - Emerging	0.24	0.25	0.28	0.30	0.32	0.33	0.33	0.33	0.32	0.3
PG&E	GWh	Residential	Res - Multi Family	AppPlug	No	AppPlug - Clothes Washer (Electric)	0.26	0.28	0.15	0.15	0.15	0.10	0.10	0.10	0.10	0.0
PG&E	GWh	Residential	Res - Multi Family	AppPlug	No	AppPlug - Clothes Washer (Gas)	-0.38	-0.39	-0.20	-0.20	-0.20	-0.14	-0.14	-0.14	-0.14	-0.1
PG&E	GWh	Residential	Res - Multi Family	AppPlug	No	AppPlug - Computer Monitor	0.14	0.14	0.14	0.13	0.13	0.13	0.12	0.13	0.13	0.1
PG&E	GWh	Residential	Res - Multi Family	AppPlug	No	AppPlug - Desktop Computer (Res - ES Plus)	0.00	0.00	0.13	0.18	0.24	0.29	0.35	0.40	0.46	0.5
PG&E	GWh	Residential	Res - Multi Family	AppPlug	No	AppPlug - Desktop Computer (Res - ES)	0.00	0.00	0.00	0.00	0.26	0.30	0.34	0.38	0.43	0.4
PG&E	GWh	Residential	Res - Multi Family	AppPlug	No	AppPlug - Dishwasher (Electric)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
PG&E	GWh	Residential	Res - Multi Family	AppPlug	No	AppPlug - Recycle Refrigerator	0.75	0.75	0.87	0.98	1.09	1.17	1.21	1.22	1.17	1.0
PG&E	GWh	Residential	Res - Multi Family	AppPlug	No	AppPlug - Self-Contained Refrigerator	0.21	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
PG&E	GWh	Residential	Res - Multi Family	BldgEnv	No	BldgEnv - Attic Batt Insulation	0.17	0.16	0.15	0.14	0.13	0.11	0.09	0.08	0.06	0.0
PG&E	GWh	Residential	Res - Multi Family	BldgEnv	No	BldgEnv - Wall Spray On Insulation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
PG&E	GWh	Residential	Res - Multi Family	BldgEnv	No	BldgEnv - Window Film	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
PG&E	GWh	Residential	Res - Multi Family	HVAC	No	HVAC - SEER Rated Split System AC (SEER 15)	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.0
PG&E	GWh	Residential	Res - Multi Family	Lighting	Yes	Lighting - LED Lamp (Basic High - Indoor) - Emerging	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.03	0.06	0.1
PG&E	GWh	Residential	Res - Multi Family	Lighting	Yes	Lighting - LED Lamp (Basic High - Outdoor) - Emerging	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02
PG&E	GWh	Residential	Res - Multi Family	Lighting	Yes	Lighting - LED Lamp (Basic Low - Indoor) - Emerging	0.01	0.02	0.05	0.09	0.15	0.04	0.07	0.11	0.16	0.2
PG&E	GWh	Residential	Res - Multi Family	Lighting	Yes	Lighting - LED Lamp (Basic Low - Outdoor) - Emerging	0.00	0.00	0.01	0.02	0.02	0.01	0.01	0.02	0.02	0.0
PG&E	GWh	Residential	Res - Multi Family	Lighting	Yes	Lighting - LED Lamp (Reflector - Indoor) - Emerging	0.00	0.02	0.03	0.06	0.10	0.14	0.17	0.20	0.23	0.2
PG&E	GWh	Residential	Res - Multi Family	Lighting	Yes	Lighting - LED Lamp (Reflector - Outdoor) - Emerging	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.0
PG&E	GWh	Residential	Res - Multi Family	Lighting	Yes	Lighting - LED Lamp (Specialty - Indoor) - Emerging	0.02	0.02	0.07	0.13	0.21	0.28	0.32	0.36	0.45	0.5
PG&E	GWh	Residential	Res - Multi Family	Lighting	Yes	Lighting - LED Lamp (Specialty - Outdoor) - Emerging	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.0
PG&E	GWh	Residential	Res - Multi Family	Lighting	Yes	Lighting - LED Plug-In Indoor Fixture - Emerging	0.08	0.15	0.15	0.15	0.15	0.01	0.01	0.01	0.01	0.0
PG&E	GWh	Residential	Res - Multi Family	Lighting	Yes	Lighting - LED Plug-In Outdoor Fixture - Emerging	0.01	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.0
PG&E	GWh	Residential	Res - Multi Family	Lighting	No	Lighting - Compact Fluorescent Fixture (Indoor)	0.05	0.11	0.11	0.11	0.11	0.00	0.00	0.00	0.00	0.0
PG&E	GWh	Residential	Res - Multi Family	Lighting	No	Lighting - Compact Fluorescent Fixture (Outdoor)	0.04	0.08	0.07	0.07	0.07	0.00	0.00	0.00	0.00	0.0
PG&E	GWh	Residential	Res - Multi Family	Lighting	No	Lighting - Compact Fluorescent Lamp (Basic High - Indoor)	2.41	2.06	1.76	1.53	1.35	0.00	0.00	0.00	0.00	0.0
PG&E	GWh	Residential	Res - Multi Family	Lighting	No	Lighting - Compact Fluorescent Lamp (Basic High - Outdoor)	0.32	0.21	0.19	0.18	0.17	0.00	0.00	0.00	0.00	0.0
PG&E	GWh	Residential	Res - Multi Family	Lighting	No	Lighting - Compact Fluorescent Lamp (Basic Low - Indoor)	4.79	4.26	3.99	3.60	3.17	0.00	0.00	0.00	0.00	0.0
PG&E	GWh	Residential	Res - Multi Family	Lighting	No	Lighting - Compact Fluorescent Lamp (Basic Low - Outdoor)	0.66	0.52	0.51	0.47	0.42	0.00	0.00	0.00	0.00	0.0
PG&E	GWh	Residential	Res - Multi Family	Lighting	No	Lighting - Compact Fluorescent Lamp (Reflector - Indoor)	0.41	0.58	0.68	0.77	0.83	0.86	0.84	0.81	0.72	0.6
PG&E	GWh	Residential	Res - Multi Family	Lighting	No	Lighting - Compact Fluorescent Lamp (Reflector - Outdoor)	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.0

... CEC Sales Data | Incremental Market Potential | Technical Potential | Economic Potential | Cumulative Market Potential | Incremental Codes and Standards | Cumulativ ...

A revised version of the Tool will be developed and submitted along with Stage 2 deliverables, based on stakeholder feedback and updated model outputs, including the low and high cases scenarios.

4.5 Comparison of 2015 Study to 2013 Study Results

Significant data updates have been made in Stage 1 that cause results to depart from those previously stated in the 2013 Study. A comparison of statewide (all IOUS combined) savings found in Table 4-6 through Table 4-7.

Relative to the 2013 study, overall potential from electric rebate programs decreased slightly between 2016 and 2018 while potential from C&S increased during the same period. Thus total electric potential from 2016 to 2018 increased. Rebate program electric potential after 2018 (after major changes in lighting standards take effect) decrease relative to the 2013 study.

Relative to the 2013 study, overall potential from gas rebate programs decreased on the order of 20% from 2016 through 2024. However, during this same period potential from C&S increased significantly relative to the 2013 study. The net effect of both changes is an overall minimal change to the total potential over the 2016-2024 period though a 9% increase is observed in 2016 and 2017.

The key drivers behind the differences in the results of the two studies are listed below.

- The 2015 study uses more up-to date historic market data for the purposes of model calibration. The 2015 study uses evaluated program results from 2010-12 that was not available in the 2013 study as well as better data about the saturation of equipment from saturation surveys (CLASS and CSS).
- Residential and commercial measures assumptions about unit energy savings were sourced from the DEER2015 Update and 10-12 EM&V studies. Some additional adjustments to CFLs,

refrigerator recycling, and commercial lighting based on DEER2016 and the Ex Ante Uncertain Measures update.

» The 2015 study used updated measure cost data to characterize residential and commercial measures. The 2013 study in some case relied upon cost data from as early as 2008. HVAC and appliance measures saw the largest changes in cost given this data refresh.

» The CEC proved updated building stock and energy consumption forecasts.

» The updated CPUC evaluation of IOU C&S programs (2010-12 EM&V study) shows more savings than previous evaluation results (2006-08 EM&V study)

» Additional data about IOU behavior programs has generally increased behavior program savings

» Better data on LEDs was obtained. LED assumptions are more conservative in both price and efficacy in the 2015 study relative to the 2013 study. This results in a lower LED potential in the 2015 compared to the 2013 study. In the 2013, much of the increase in potential after 2018 came from LEDs. The post-2018 LED potential is more conservative given data updates.

Table 4-6: 2015 Stage 1 vs. 2013 Study Results: Electric Potential (GWh)

	2013 Study			2015 Stage 1			Difference		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total
2016	1,637	937	2,574	1,482	1,385	2,867	-9%	48%	11%
2017	1,600	734	2,334	1,517	1,147	2,665	-5%	56%	14%
2018	1,227	664	1,891	1,177	925	2,102	-4%	39%	11%
2019	1,335	644	1,979	1,196	908	2,105	-10%	41%	6%
2020	1,463	613	2,076	1,219	863	2,082	-17%	41%	0%
2021	1,589	517	2,106	1,213	739	1,952	-24%	43%	-7%
2022	1,720	458	2,178	1,251	668	1,919	-27%	46%	-12%
2023	1,829	366	2,195	1,286	576	1,862	-30%	57%	-15%
2024	1,932	337	2,269	1,332	543	1,875	-31%	61%	-17%

**Includes behavior programs, excludes effects of financing.*
Source: June 2015 PG Model, and 2013 Study

Table 4-7: 2015 Stage 1 vs. 2013 Study Results: Demand Potential (MW)

	2013 Study			2015 Stage 1			Difference		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total
2016	266	192	458	232	319	551	-13%	66%	20%
2017	268	127	395	236	238	475	-12%	88%	20%
2018	218	123	341	188	234	422	-14%	90%	24%
2019	238	122	360	193	234	427	-19%	92%	19%
2020	262	119	381	199	230	429	-24%	93%	13%
2021	285	109	394	199	214	413	-30%	96%	5%
2022	311	103	414	211	203	415	-32%	97%	0%
2023	335	94	429	223	191	414	-33%	103%	-3%
2024	358	90	448	235	185	420	-34%	105%	-6%

**Includes behavior programs, excludes effects of financing.*
Source: June 2015 PG Model, and 2013 Study

Table 4-8: 2015 Stage 1 vs. 2013 Study Results: Natural Gas Potential (MMTherms)

	2013 Study			2015 Stage 1			Difference		
Year	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total	Rebate Programs*	Net C&S	Total
2016	39.2	7.3	46.5	32.8	17.9	50.6	-16%	145%	9%
2017	39.0	9.1	48.1	33.7	18.5	52.2	-13%	103%	9%
2018	43.5	10.5	54.0	34.6	19.6	54.2	-20%	87%	0%
2019	45.1	11.2	56.3	36.1	19.5	55.6	-20%	74%	-1%
2020	47.1	11.3	58.4	37.3	19.1	56.3	-21%	69%	-4%
2021	48.9	10.2	59.1	36.6	17.5	54.1	-25%	71%	-9%
2022	50.8	10.0	60.8	38.0	16.6	54.6	-25%	66%	-10%
2023	52.4	9.9	62.3	39.3	15.9	55.2	-25%	61%	-11%
2024	54.1	9.7	63.8	40.8	15.0	55.9	-25%	55%	-12%

**Includes behavior programs, excludes effects of financing.*
Source: June 2015 PG Model, and 2013 Study

Appendix A. Calibration

A.1 Overview

Forecasting is the inherently uncertain process of estimating future outcomes by applying a model to historic and current observations. As with all forecasts, the PG model results cannot be empirically validated a priori, as there is no future basis against which one can compare simulated versus actual results. Despite that all future estimates are untestable at the time they are made, forecasts can still warrant confidence when historic observations can be shown to reliably correspond with generally accepted theory and models.

Calibration provides both the forecaster and stakeholders with a degree of confidence that simulated results are reasonable and reliable. Calibration is intended to achieve three main purposes:

- Ground the model in actual market conditions and ensure the model reproduces historic program achievements;
- Ensure a realistic starting point from which future projects are made; and
- Account for varying levels of market barriers across different types of technologies and end uses.

The PG model is calibrated by reviewing portfolio data from 2006 up through 2012 to assess how the market has reacted to program offerings in the past. The Navigant team used ex-post EM&V data from 2006-2012 as the calibration data and also compared results to the 2013-2014 compliance filing data.

The calibration data are used to inform the appropriate values for the customer willingness and awareness parameters that drive measure adoption during the model time horizon. These parameters are then considered to account for the range of factors—technological, economic, market, and program factors— that contribute to historic program achievements. This includes consumers' awareness of programs and their willingness to participate in them.

This calibration method (a) tracks what measures have been installed or planned for installation over an historic six-year period and (b) forecasts how remaining stocks of equipment will be upgraded, including the influence of various factors such as new codes and standards, emerging technologies, or new delivery mechanisms. The calibration approach is not applied to emerging technologies, as there is insufficient historical basis to adjust future adoption for these technologies.

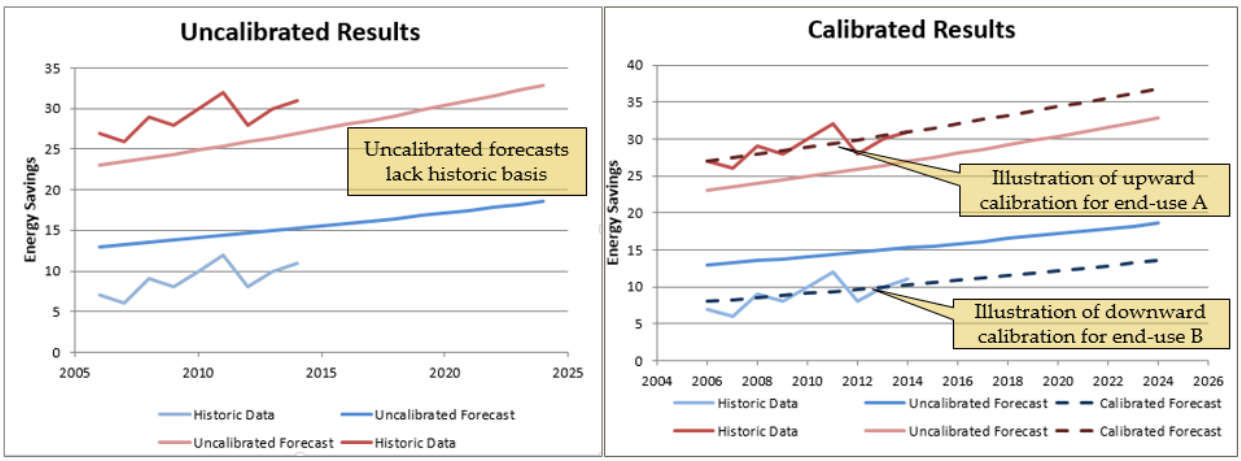
A.2 Necessity of Calibration

Calibration refers to the standard process of adjusting model parameters such that model results align with observed data. In evaluative statistical models, calibration is called *regression*, and goodness of fit is typically the main focus since the models are usually simple. In situations of complex dynamics and non-linearity (as in this study), model sophistication and adequacy can become the main focus. But grounding the model in observation remains equally necessary. The ability of a forecast to reasonably simulate observed data affords credibility and confidence to forecast estimates.

Although there are data supporting all underlying parameters in the PG model, much of the data are at an aggregate level that can be inadequate to forecast differences across the various classes of technologies and end uses. The customer willingness-to-adopt factor is a good example of this effect. Customers may exhibit certain average purchase tendencies in adopting measures based on their financial characteristics. However there may be features of certain end use technologies that cause customer behavior to vary from the average. Residential building envelope is an end use where adoption of measures like insulation is consistently lower than would be predicted compared with other end uses. Residential lighting adoption, on the other hand, performs better than the average predicted customer purchase tendencies, even after adjusting for differences in financial attractiveness. We often think of these differences as the influence of non-financial product attributes or of market barriers.

Figure A-1 below illustrates the concept of calibration. The chart on the left shows how certain end uses may over predict (blue) or under predict (red) adoption compared to observations of program participation. By adjusting the customer willingness factors, as illustrated in the right chart below, the modeled results in past years become aligned with reported historical program achievements.

Figure A-1: The Concept of Calibrating



Note that model parameters and results may be increased *or* decreased depending on the end use. We do not "calibrate down" on aggregate, but rather just "calibrate" the end uses both up and down as appropriate based on the data, as shown in the chart on the right above.

Calibration is not an optional exercise in modeling. One might suggest that the average customer data should be sufficient to make a reliable aggregated forecast. However there are two important non-linearities that compel us toward a more granular parameterization:

» Program portfolios are not evenly composed across end-uses. This leads to an uneven weighting issue whereby average customer willingness may not lead to the correct calculation of total savings.

» The dynamics in the model regarding the timing of adoption can become incompatible with the remaining potential indicated by program achievements. For example, if the forecast results were not calibrated for CFL lighting in the residential sector, the saturation may remain inaccurately low in early years and indicate a larger remaining potential in future years. Thus calibrating a willingness parameter upward may increase its potential in the early years but decrease its potential in later years. This implies that in the absence of IOU program intervention, residential CFLs would have historically had much lower adoption. Calibration therefore allows us to capture these program influences to more accurately reflect remaining potential.

This discussion is intended to highlight the necessity of calibration and the effective irrelevance of uncalibrated parameters. It may be tempting to "relax" the calibrated parameters back toward the average to measure the effect of what could be possible. But the uncalibrated results can be difficult to interpret and almost certainly would not produce feasible results for certain end uses. Thus they provide no basis for a reasonable forecast. Instead, we treat the calibrated results as the most basic set of interpretable results from which alternate scenarios are developed. Changes to calibrated parameters are not returned to the uncalibrated averages, but are rather explicitly developed based on the feasibility of values that parameters might take over time and how quickly the change might occur. This is discussed more in the last section of this brief.

A.3 Interpreting Calibration

Calibration can constrain market potential for certain end uses when aligning model results with past IOU energy efficiency portfolio accomplishments. Although calibration provides a reasonable historic basis for estimating future market potential, past program achievements may not capture the potential due to structural changes in future programs or changes in consumer values. Calibration can be viewed as holding constant certain factors that might otherwise change future program potential, such as:

» Consumer values and attitudes toward energy efficient measures;
» Market barriers associated with different end uses;
» Program efficacy in delivering measures; and
» Program spending constraints and priorities.

Changing values and shifting program characteristics would likely cause deviations from market potential estimates calibrated to past program achievements.

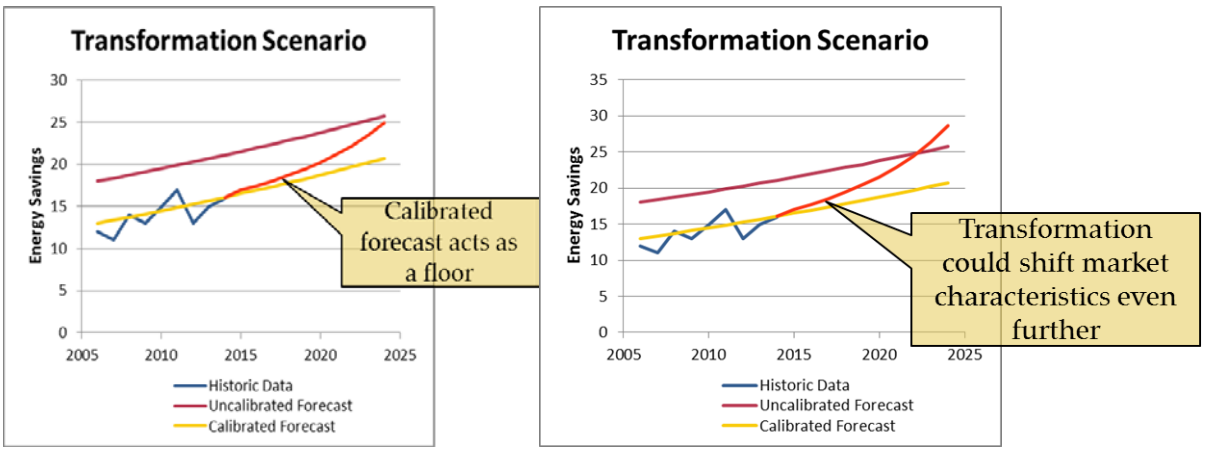
Does calibrating to historic data constrain the future forecast? In a strictly numeric sense, yes. If a certain end use is calibrated downward or upward, then future adoption and its timing are affected. However this should not be interpreted as "calibration constrains the level of adoption that we think is possible." Rather calibration provides a more accurate estimate of the current state of customer willingness, market barriers, program characteristics and remaining adoption potential. One forecast scenario might assume that the underlying conditions remain the same—a sort of business as usual scenario. We might develop another scenario such that it represents a transforming market based on agreed-upon end state parameter values appropriate for the end use market. For insulation that may mean a slight

improvement, for water heating a greater improvement, and for lighting perhaps little change is warranted if fewer market barriers exist today.

One interpretation is that the calibration process creates a floor for the remaining potential. Market barriers, customer attitudes, and program efficacy generally move in the direction of improvement. The extent to which a market or program can improve should not be compared to the uncalibrated results, but rather to the vision for what is reasonably possible for the paramters describing each end use. This may require little change, some change, or greater change in parameter values for different end-uses. But improvements to parameter values are based on their own merits and feasibility, and are independent of the uncalibrated paramter values and results.

Figure A-2 below shows two illustrative end uses where there is a calibrated base scenario (yellow) and alternative high scenarios (red) that are independent of the uncalibrated numbers (dark red). The chart on the left below shows a high forecast that may increase but still not meet the uncalibrated forecast, while the chart on the right shows a high forecast that exceeds the adoption of the uncalibrated forecast. The relation to the uncalibrated forecast is effectively arbitrary.

Figure A-2: Illustrative Transformative Scenarios



A.4 Implementing Calibration

Calibration examines three types of parameters to best align results with past program achievements:

- *Willingness parameters*
  - Primary target of calibration,
  - *Implied Discount Rate* – the iDR is adjusted when perceived market barriers are higher or lower than typical measures, or when factors other than financial characteristics may play a larger role in purchase decisions,
  - *Sensitivity* – the consumer sensitivity to the differences in financial attractiveness is adjusted when markets are considered mature and customer primary focus is measure financial attractiveness.

- » *Awareness parameters*
  - Sometimes used, but only after willingness,
  - Results are generally insensitive to awareness factors when measures are replace on burnout (ROB) with a measure life greater than 5 years because stock turnover dominates the timing,
  - *Word of mouth and marketing factors* - For retrofit and short-lived measures awareness can be adjusted to better fit the timing of market growth.
- » *Initial awareness*
  - Less influential, but frequently used to align the curvature of the adoption with 2013 market saturation data.
  - Used to align the curvature of adoption timing with the estimated willingness and starting saturations.

Parameters are adjusted to fit historic observations during the calibration period. Then the parameters are applied to the forecast period, which begins in the year of most recent density data vintage. Calibrating parameters up and down can have different effects in a dynamic model depending on the initial saturation (i.e., density) data. For example, calibrating up can increase both historic and future adoption if the initial saturation is low. If initial saturation is high, then calibrating up can increase past adoption in the model, leaving less for future years.

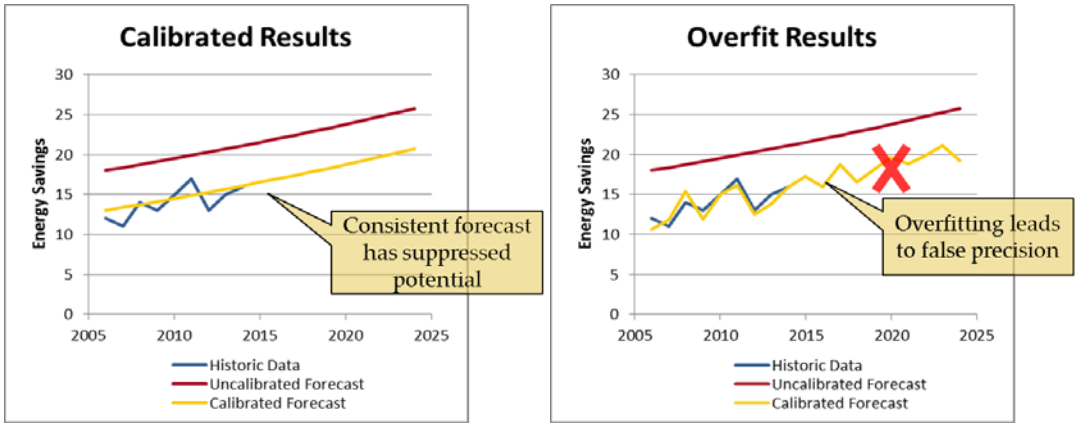
Once the consumer preference parameters are calibrated, the model forecast begins in 2013 by applying known market saturation data of that same vintage. Forecasts indicate the saturation of measures over time under the expected IOU future program influences.

A.5 Granularity of Calibration

The calibration process is undertaken at the sector and end use level for program activity in years 2006 to 2012.[68] The calibration accordingly accounts for the *cumulative* effect of market and program activity during these years. In our experience, this level is sufficient to capture the major differences in customer attitudes at the sector and end use level and to produce stable, reliable results over the forecast period. Overfitting the data (as illustrated in Figure A-3) can produce erratic model behavior that is beyond the precision of the forecast and the data that we use.

[68] Evaluation ex-post gross data were used for 2006-2012 from the CA Standard Program Tracking Database

Figure A-3: Proper and Improper Calibration



The data used for calibration are the ex post, gross evaluated program data. These data have units of energy savings such as MWh and Therms saved. By adjusting consumer preference parameters we can align the adoption and savings forecast over the calibration period with the actual evaluation data. This alignment is used by adjusting the consumer parameters for each sector, utility, and end use. The model is not calibrated at the building type or measure level for three reasons:

- The gain in precision of the results from calibrating at a lower level is expected to be negligible owing to the precision of the data sources for non-calibrated model inputs (e.g., density, building stocks, and calibration data).
- Calibrating at the lowest level of the model may give an appearance of rigor. But it is unlikely that customer preferences are represented by such sophisticated and highly dimensional reasoning. In other words, a highly granular model of consumer preferences would be at odds with the relative simplicity of the reasoning that consumers apply when making a purchase decision.
- Optimizing the non-linear model at the measure and building type level is a computationally intractable task that would require division into many batches—an enormously work- and time-intensive task due to the complexity of the model. It is not clear that such a path would lead to more accurate results and indeed might take away valuable resources from completing other aspects of the study scope.

The end use/sector/multiyear level of calibration was chosen because:

- The model variance is mostly explained at the sector and end use level making this level adequate to account for the most influential non-linear effects,
- The precision of lower level calibration results is not significantly improved beyond the chosen level,
- It is unlikely that in deciding to adopt a measure, consumers show very different purchase behavior toward similar technologies,
- Individual year calibration data are too noisy and inconsistent to fit and may lead to unreliable predictions.
- The chosen level of calibration strikes the right balance of analytical benefit versus cost.

Calibration of the PG model is performed at the back end of the modeling process in that input willingness and awareness parameters are iteratively (and manually) adjusted in the back end of the model until alignment is reached with ex post, gross evaluated data program data over the calibration period. The manual nature of this iterative task results in a lengthy process that requires repeatedly running the model, one sector and IOU at a time, to calibrate at the end-use level.

A.6 Scenario Analyses

This section offers an auxiliary discussion about scenario analyses not directly related to the process of calibration but brought up by stakeholders in relation to discussions about calibration.

Explicit Scenarios

Calibrated parameters provide the starting point for interpretable quantitative results. Scenarios are developed as explicit modifications to key variables the calibrated forecast such that the results can be easily interpreted. Multiple key variables can be changed in the calibrated forecast to produce results under different scenarios. These key variables fall under two categories:

1. Exogenous variables (events and outcomes that cannot be influenced) and
2. Endogenous variables (events and outcomes that can be influenced)

Disentanglement of Parameter Uncertainty from Policy and Program Levers in Scenarios

One factor that has obfuscated the interpretation of scenarios in the 2013 study is the combination of exogenous parameter uncertainty (e.g., retail rates, building stocks, technology curves, etc.) with the endogenous variables that may be influenced by policy and program implementation (e.g., measure inclusion criteria, codes and standards, variable incentive levels, or market transformation activities). This conflation of exogenous and controllable parameters within the scenarios made them difficult to interpret. Separation of exogenous parameter uncertainty from parameters that may be influenced or controlled will help disambiguate the meaning of the scenarios.

Navigant believes it is important to consider the effects of exogenous parameter estimates as a statement about the range of uncertainty stemming from several important factors that are beyond stakeholder's control--an effective uncertainty band. Then other parameters that represent the influence of policy and program decisions might be used to estimate credible increases in adoption, beyond the base calibrated results that might be achieved.

Maximum Achievable Potential

In previous discussions, some stakeholders have expressed a desire to use estimates of economic potential to convey the upper bound of what is possible. Although economic potential has a financial basis, it does not have a market basis. In particular, economic potential has no consideration of customer preferences nor does it account for the turnover of stock and the time scale of diffusion for different classes of technologies. For instance, future potential for ROB and long-lived measures generally are constrained by stock turnover rates which is not captured within economic potential. This leaves a

disconnect and a gap between economic potential and the upper bound of what could maximally be achieved with market-based program activities under idealized market conditions. Furthermore, the *maximum achievable potential (MAP)* is not a result that would likely be achieved under current conditions, but rather provides a maximum benchmark against which future market and program potential can be interpreted. The idea of MAP is one that would not penalize future potential based on current conditions, but rather show that programs will include strategies that might remove barriers over time which could lead to higher market adoption rates. In essence, such a scenario would illustrate future shifts in programmatic priorities and consumer attitudes that would increase future savings. Navigant will develop details for the MAP scenario as part of Stage 2 work.

A.7 Detailed Electric Calibration Inputs

Table A-1: PG&E Electric Detailed Calibration Inputs by Sector, End-Use, and Year (GWh)

Sector End-Use	2006	2007	2008	2009	2010	2011	2012	2006-2012 Total
Residential	206.86	504.21	722.23	434.65	683.82	527.95	454.80	3,534.52
AppPlug	36.98	72.15	82.92	48.71	98.58	83.59	57.38	480.32
BldgEnv	0.46	1.02	1.26	1.10	3.66	3.21	2.95	13.66
HVAC	2.43	3.95	4.35	3.50	7.69	3.95	4.45	30.31
Lighting	166.80	426.30	630.77	379.50	571.94	435.16	387.09	2,997.57
NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SHW	0.15	0.43	0.22	0.09	0.23	0.39	0.07	1.59
WholeBlg	0.04	0.35	2.71	1.75	1.73	1.65	2.85	11.08
Commercial	154.43	438.66	852.94	580.03	391.68	367.34	389.16	3,174.24
AppPlug	1.38	5.75	32.57	24.11	21.04	23.78	18.26	126.89
BldgEnv	2.49	4.61	6.05	2.20	1.70	1.58	1.38	20.00
ComRefrig	20.16	62.67	99.40	69.57	64.27	64.32	53.43	433.82
FoodServ	0.28	6.84	3.96	3.59	3.42	1.79	0.88	20.76
HVAC	17.20	57.54	138.37	105.52	86.83	80.46	79.22	565.15
Lighting	110.71	289.30	524.43	360.55	171.56	182.40	224.61	1,863.56
NA	1.54	11.91	47.43	12.80	5.49	3.45	2.01	84.63
ProcHeat	0.00	0.00	0.15	0.04	0.11	1.01	2.75	4.06
ProcRefrig	0.00	0.00	0.00	0.00	21.34	8.50	6.32	36.16
Service	0.00	0.00	0.00	1.63	15.81	0.00	0.00	17.44
SHW	0.68	0.04	0.58	0.03	0.11	0.04	0.29	1.77
Res/Com Total	361.29	942.87	1,575.17	1,014.67	1075.49	895.29	843.96	6,708.76

Source: Navigant analysis of CPUC Standard Program Tracking Database. 2014 (includes HVAC Interactive Effects)

Table A-2: SCE Electric Detailed Calibration Inputs by Sector, End-Use, and Year (GWh)

Sector End-Use	2006	2007	2008	2009	2010	2011	2012	2006-2012 Total
Residential	271.56	529.85	549.91	465.04	843.33	727.05	742.00	4,128.74
AppPlug	81.91	80.36	110.37	85.69	96.87	73.01	39.20	567.41
BldgEnv	0.01	0.21	0.41	2.04	1.40	0.78	0.06	4.91
HVAC	2.19	6.02	6.86	4.34	3.79	2.35	4.31	29.86
Lighting	184.23	434.59	386.58	366.20	722.98	641.98	668.97	3,405.53
Service	3.19	8.46	44.43	6.62	17.67	7.84	28.73	116.94
SHW	0.03	0.20	0.34	0.14	0.61	0.82	0.17	2.32
WholeBlg	0.00	0.00	0.93	0.00	0.00	0.29	0.56	1.77
Commercial	189.77	439.21	523.16	441.39	424.67	424.77	382.07	2,825.04
AppPlug	0.97	1.83	13.49	16.21	17.87	10.33	14.05	74.74
BldgEnv	1.18	1.72	2.25	0.84	4.37	7.71	3.04	21.11
CompAir	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.30
ComRefrig	14.49	16.57	30.34	18.77	39.45	58.97	36.55	215.13
FoodServ	0.15	10.64	1.42	3.98	2.23	1.90	1.66	21.98
HVAC	17.37	49.12	107.46	63.25	57.18	62.14	68.35	424.87
Lighting	135.48	309.60	337.20	292.93	268.28	263.22	231.44	1,838.14
NA	0.01	2.56	5.59	10.66	17.70	8.18	8.16	52.86
ProcHeat	0.00	0.21	0.23	0.00	0.00	0.00	0.15	0.59
ProcRefrig	0.00	0.00	0.00	0.00	0.60	1.12	3.51	5.23
Service	0.17	8.39	17.05	2.08	1.83	1.06	5.19	35.79
SHW	0.10	0.04	0.00	0.00	0.00	0.00	0.00	0.14
WholeBlg	19.86	38.54	8.14	32.66	15.15	10.15	9.68	134.18
Res/Com Total	461.33	969.06	1,073.07	906.44	1,268.00	1,151.82	1,124.07	6,953.79

Source: Navigant analysis of CPUC Standard Program Tracking Database. 2014 (includes HVAC Interactive Effects)

Table A-3: SDG&E Electric Detailed Calibration Inputs by Sector, End-Use, and Year (GWh)

Sector End-Use	2006	2007	2008	2009	2010	2011	2012	2006-2012 Total
Residential	55.38	177.31	120.23	142.49	136.62	189.18	243.31	1,064.52
AppPlug	8.69	18.88	16.74	17.40	14.22	9.21	7.29	92.42
BldgEnv	0.10	0.18	0.25	0.24	0.16	0.14	0.18	1.26
HVAC	0.10	1.46	1.58	3.87	1.26	2.29	1.49	12.05
Lighting	46.47	156.77	97.68	106.50	119.40	176.94	233.92	937.67
NA	0.00	0.00	0.00	0.00	0.00	0.36	0.20	0.55
SHW	0.01	0.03	3.98	10.15	0.01	0.01	0.10	14.29
WholeBlg	0.00	0.00	0.00	4.32	1.58	0.24	0.13	6.27
Commercial	72.80	135.75	188.65	294.72	87.11	82.27	131.21	992.50
AppPlug	0.56	1.42	5.88	6.05	4.96	0.47	7.41	26.76
BldgEnv	0.14	1.02	0.61	0.52	0.89	0.20	0.27	3.64
ComRefrig	4.00	5.27	8.21	9.64	11.42	10.97	12.25	61.76
FoodServ	0.03	3.22	0.18	2.07	0.23	0.99	0.84	7.55
HVAC	6.85	45.45	45.10	46.07	23.59	26.18	36.51	229.76
Lighting	54.60	72.14	121.82	183.73	38.80	34.93	57.11	563.13
NA	0.92	4.09	5.63	30.08	5.45	7.66	10.67	64.50
ProcHeat	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04
Service	0.00	0.78	0.29	4.00	1.61	0.80	6.04	13.52
SHW	0.00	0.08	0.88	1.77	0.09	0.02	0.11	2.93
WholeBlg	5.70	2.28	0.07	10.79	0.07	0.00	0.00	18.90
Res/Com Total	128.18	313.06	308.88	437.20	223.73	271.45	374.52	2,057.02

Source: Navigant analysis of CPUC Standard Program Tracking Database. 2014 (includes HVAC Interactive Effects)

A.8 Detailed Gas Calibration Inputs

Table A-4: PG&E Gas Detailed Calibration Inputs by Sector, End-Use, and Year (MM Therms)

Sector End-Use	2006	2007	2008	2009	2010	2011	2012	2006-2012 Total
Residential	-2.81	-7.45	-9.60	-5.67	-8.45	-6.44	-5.87	-46.30
AppPlug	-0.52	-0.93	-0.58	0.44	0.27	0.20	0.18	-0.94
BldgEnv	0.27	0.41	0.52	0.36	1.12	1.04	0.92	4.64
HVAC	0.45	0.68	1.04	0.72	1.04	0.59	0.38	4.89
Lighting	-3.20	-8.12	-11.57	-8.18	-12.41	-9.75	-8.72	-61.95
NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SHW	0.18	0.48	0.61	0.66	1.14	1.16	0.73	4.95
WholeBlg	0.00	0.04	0.39	0.34	0.39	0.32	0.64	2.11
Commercial	1.68	6.95	17.35	5.06	4.12	5.59	4.30	45.06
AppPlug	0.03	0.07	0.16	0.13	0.00	-0.01	0.02	0.40
BldgEnv	0.00	0.01	0.02	0.01	0.65	0.28	0.24	1.20
ComRefrig	0.13	0.41	0.02	0.02	0.01	0.02	0.22	0.82
FoodServ	0.08	0.15	0.45	0.22	0.11	0.19	0.30	1.50
HVAC	1.70	7.36	15.52	6.25	1.44	1.91	2.99	37.18
Lighting	-0.80	-1.96	-3.20	-3.44	-1.26	-1.16	-1.63	-13.45
NA	0.03	0.02	1.42	0.14	0.69	2.59	0.40	5.30
ProcHeat	0.19	0.62	1.89	0.98	1.05	0.57	0.76	6.06
ProcRefrig	0.00	0.00	0.00	0.00	0.07	0.02	0.01	0.10
Service	0.00	0.00	0.00	0.00	0.87	0.00	0.00	0.87
SHW	0.32	0.29	1.06	0.75	0.50	1.18	0.98	5.08
Res/Com Total	-1.13	-0.50	7.74	-0.61	-4.33	-0.86	-1.57	-1.24

Source: Navigant analysis of CPUC Standard Program Tracking Database. 2014 (includes HVAC Interactive Effects)

Table A-5: SCG Gas Detailed Calibration Inputs by Sector, End-Use, and Year (MM Therms)

Sector End-Use	2006	2007	2008	2009	2010	2011	2012	2006-2012 Total
Residential	1.19	1.67	2.36	4.12	8.52	8.43	7.48	33.79
AppPlug	0.17	0.34	0.48	0.41	0.99	0.77	1.72	4.88
BldgEnv	0.19	0.38	0.35	0.26	0.34	0.33	0.36	2.22
HVAC	0.05	0.16	0.08	0.10	0.73	0.84	0.77	2.73
NA	0.00	0.00	0.00	0.12	0.25	1.32	1.18	2.87
SHW	0.79	0.79	1.44	3.13	6.12	5.14	3.24	20.66
WholeBlg	0.00	0.00	0.00	0.10	0.09	0.04	0.20	0.43
Commercial	6.22	13.69	28.71	20.09	4.86	9.87	15.08	98.52
AppPlug	0.00	0.00	0.47	0.69	0.34	0.23	0.00	1.75
BldgEnv	0.58	0.50	0.46	0.21	0.13	0.03	0.01	1.93
FoodServ	0.05	0.18	0.33	0.54	0.33	0.23	0.29	1.96
HVAC	3.64	8.51	14.38	14.67	0.77	0.58	3.16	45.71
NA	1.53	1.96	9.95	1.09	1.57	1.64	5.18	22.91
ProcHeat	0.25	0.85	0.92	0.33	0.57	1.80	5.02	9.74
ProcRefrig	0.00	0.00	0.00	0.00	0.07	0.01	0.03	0.11
SHW	0.16	1.69	2.20	0.76	0.54	0.59	0.43	6.38
WholeBlg	0.01	0.00	0.00	1.78	0.52	4.75	0.96	8.03
Res/Com Total	7.41	15.36	31.07	24.21	13.38	18.31	22.56	132.31

Source: Navigant analysis of CPUC Standard Program Tracking Database. 2014

Table A-6: SDG&E Gas Detailed Calibration Inputs by Sector, End-Use, and Year (MM Therms)

Sector End-Use	2006	2007	2008	2009	2010	2011	2012	2006-2012 Total
Residential	-0.46	-1.55	0.40	2.12	0.59	-0.40	-2.22	-1.52
AppPlug	-0.12	-0.08	0.82	0.16	0.00	0.20	0.09	1.07
BldgEnv	0.03	0.06	0.07	0.07	0.05	0.05	0.06	0.39
HVAC	0.01	0.05	0.06	0.13	0.17	0.18	0.13	0.74
Lighting	-0.59	-2.03	-1.16	-1.11	-1.45	-2.19	-2.94	-11.47
NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SHW	0.20	0.45	0.61	2.86	1.71	1.31	0.42	7.57
WholeBlg	0.00	0.00	0.00	0.01	0.11	0.04	0.02	0.18
Commercial	1.11	0.84	1.34	3.61	0.85	1.68	4.49	13.91
AppPlug	0.03	0.06	0.05	0.00	-0.06	0.01	0.00	0.09
BldgEnv	0.00	0.00	0.01	0.00	0.09	0.08	0.00	0.18
ComRefrig	0.03	0.03	0.05	0.07	0.04	0.05	0.09	0.37
FoodServ	0.02	0.05	0.05	0.05	0.05	0.09	0.08	0.38
HVAC	0.17	0.56	0.76	1.91	0.31	0.10	1.41	5.22
Lighting	-0.12	-0.17	-0.25	-0.32	-0.04	-0.05	-0.11	-1.06
NA	0.03	0.11	0.17	0.52	0.19	0.93	2.52	4.48
ProcHeat	0.84	0.01	0.00	0.16	0.09	0.22	0.21	1.51
ProcRefrig	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Service	0.00	0.00	0.00	0.00	0.04	0.00	0.11	0.15
SHW	0.02	0.19	0.49	1.18	0.14	0.25	0.19	2.47
WholeBlg	0.10	-0.01	0.00	0.03	0.00	0.00	0.00	0.13
Res/Com Total	0.65	-0.71	1.75	5.73	1.44	1.28	2.27	12.39

Source: Navigant analysis of CPUC Standard Program Tracking Database. 2014 (includes HVAC Interactive Effects)

Appendix B. Emerging Technologies

The Stage 1 update for Emerging Technologies (ETs) maintained the same measure list as the 2013 Study and focused on only updating the inputs to the 2015 PG Model where the Navigant team had better information or data availability.

ETs are defined as meeting one or more of the following criteria:

- Not widely available in today's market but expected to be available in the next 1-3 years;
- Widely available but representing less than 5% of the existing market share; and/or
- Costs and/or performance are expected to improve in the future.

B.1 Overview of Updates

ETs were only examined for the Residential and Commercial sectors. These sectors are modeled using individual measures for specific applications.

The Navigant team relied on data from various sources to update each ET:

- The Navigant team extrapolated or used directly cost and performance data from DEER where possible. In some cases, some ETs had already been characterized in the DEER database since the 2013 Study. For such cases, the Navigant team continued to call these measures ETs to be consistent with the last study (e.g. 0.98 AFUE Gas Furnace).
- IOU workpapers and other case studies provided additional cost and performance data.
- 2010 – 2012 EM&V studies[69] such as "Work Order 017 Ex Ante Measure Cost Study "provided more California-specific data.
- In absence of any California-specific verified data, the Navigant team leveraged data from national studies published by the U.S. Department of Energy (DOE) and the Pacific Northwest National Lab (PNNL) and adjusted to California specific values based on regulatory and market conditions.
- DOE standards and rulemaking review ensured the maximum technically feasible energy efficiency level for many measures and end uses remained same.
- Energy Star's qualified products list and shipment data provided market saturation data.

While the measure categories remained same, their definitions were updated in some cases to reflect the market conditions more closely where we had better data.

[69] *2010-2012 WO017 Ex Ante Measure Cost Study.*
2010-2012 WO013 Residential Lighting Process Evaluation and Market Characterization.
2010-2012 WO028 California Upstream and Residential Lighting Impact Evaluation.

- LEDs were redefined based on CFL definitions update. LED definitions are linked to CFL definitions, which were updated based on 2010 – 2012 EM&V studies.
- Residential Water heaters were updated from 0.77 Energy Factor (EF) to 0.82 EF due to the addition of 0.82 EF water heater measure to DEER. If a measure with same or higher efficiency than the corresponding ET efficiency was included in DEER since the 2013 Study, Navigant set the minimum efficiency of the ET to match the highest efficiency description in DEER for applicable measures.
- Self-Contained Refrigerator measure was redefined to be 15% less than energy code due to redefinition of Energy Star products.
- Dishwasher measure was redefined to be EF>1.0 compared to previous round, based on code and competing conventional energy efficient measure update.
- Commercial Refrigeration Fiber Optic LED lighting measure was eliminated. Strong LED efficacy and cost improvements have led to LEDs becoming a dominant lighting technology and moving towards large market penetration in commercial refrigeration market. This resulted in nearly no future potential for this particular ET measure, as such, the Navigant team abandoned the measure from Stage 1.

Some ETs (along with some conventional technologies) are expected to decrease in cost over time. The Navigant team developed four cost reduction profiles that could apply to various ETs (and non-ETs) in the 2013 Study (see 2013 Study Appendix A). These cost reduction vectors were qualitatively assigned to each ET based on various market drivers that could drive the cost down. Navigant revised these cost reduction assignments based on the further market intelligence developed for the ET measures since the 2013 study (see Table B-1).

B.2 Updates for LEDs

The Navigant team also updated data on the cost reduction and performance improvement profiles for LED technologies. LED costs have declined rapidly in recent years (a 50% reduction in market average price from 2011 to 2015) and are expected to continue to decrease in the foreseeable future. Meanwhile, LED efficacy has been increasing and is expected to increase over 40% from 2015 to 2024. This efficacy change will continue to decrease the wattage requirements of LEDs in the future. The PG Model reflects both of these trends.

LED efficacies were updated to reflect market average products and LED efficacies have dropped compared to the 2013 Study. Previous data[70] used in the 2013 Study represented the "best performers" in the market which was based on U.S. DOE technology targets and did not represent the majority of products in the market. New data[71] in Stage 1 represents the average performance and cost which are based on historical data for LEDs. Stage 1 also uses efficacy and cost data specific to LED applications (i.e. General Service and Directional), which allowed Navigant to map the efficacy data to each LED measure more precisely. The mapping of each LED measure to its definition and application can be found in Table B-2.

LED costs were also updated to market average products based on the most recent DOE pricing study[72] conducted by PNNL. This study is purely based on bulk purchasing that DOE has done for verification of LED lighting product performance through its CALiPER and Gateway programs. As such, the analysis is not based on catalog pricing and is based on actual LED purchases at volume pricing. The Navigant team determined that this should be a good proxy and would not be inflated pricing.

Then, these LED efficacies and prices were further adjusted to represent LEDs that meet the California Energy Commission's Voluntary Quality LED Lamp Specification[73]. The specifications are based on enhancements to the ENERGY STAR standard with a particular focus on improvements to the color temperature, consistency, and color rendering (with requirements for Color Rendering Index (CRI) greater than or equal to 90). The specification applies to screw-base and bi-pin A-lamp, flame-tip, globe, and spotlight lamps. After December 11, 2013, compliance with the specification for LED lamps became mandatory for IOU incentive program eligibility (this followed a one-year "transition period" that began when the specification came into effect on December 11, 2012).

Navigant leveraged a web-scraped database[74] of pricing and specifications for over 15,000 LED lighting products time-stamped between 2008 and 2014 for developing CRI adjustment factors. Major data sources include Home Depot, Lowes, Target, Walmart, Grainger, BestBuy, CALiPER, Gateway, GSA

[70] Navigant. *Energy Savings Potential of Solid-State Lighting in General Illumination Applications.* Prepared for the U.S. Department of Energy, January 2012.
[71] Navigant. *Energy Savings Forecast of Solid-State Lighting in General Illumination Applications.* Prepared for the U.S. Department of Energy, August 2014.
[72] Pacific Northwest National Laboratory. *Solid-State Lighting Pricing and Efficacy Trend Analysis for Utility Program Planning.* Prepared for the U.S. Department of Energy, October 2013.
[73] http://www.energy.ca.gov/2012publications/CEC-400-2012-016/CEC-400-2012-016-SF.pdf
[74] Navigant Web-Scrape LED Product Database

Advantage, Platt, ACE Hardware, Amazon.com, and 1000bulbs.com. This extensive resource of data enables the development of LED price estimates for a variety of product categories ranging from LED lamps (A-line, Globe, decorative, BR, PAR, R, MR, etc.) to luminaires (downlights, track fixtures, surface mounted/recessed troffers, panels, high/low bay, etc.) to outdoor fixtures. The database also holds a variety of information on each product entry including wattage, lumen output, CCT, CRI, voltage, dimmability, Energy Star qualified, and number of product reviews.

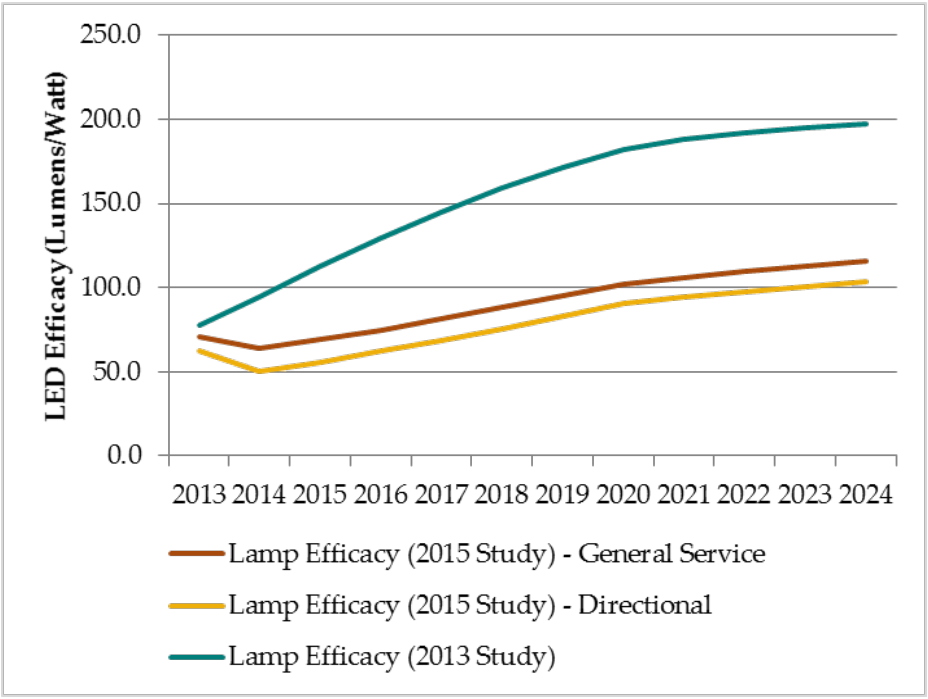
From this dataset the Navigant team analyzed how variations in LED performance affect LED efficacy and selling price. This ability enabled the team to evaluate the efficacy and the price premium associated with LEDs that meet the California Energy Commission's Voluntary Quality LED Lamp Specification.

Although the CPUC Ex Ante Measure Cost Study examined some LED technologies, the information contained in the report was collected in 2013 and is already obsolete because of the rapid evolution of the LED market

The current database includes location specific data for California and these data were analyzed to determine average efficacy and price in 2014 for CRI greater than or equal to 90, compared to CRI less than 90. From this comparison, the Navigant team then developed estimates for the average percentage change in efficacy and price associated with products that offer CRI greater than or equal to 90 for each LED measure.

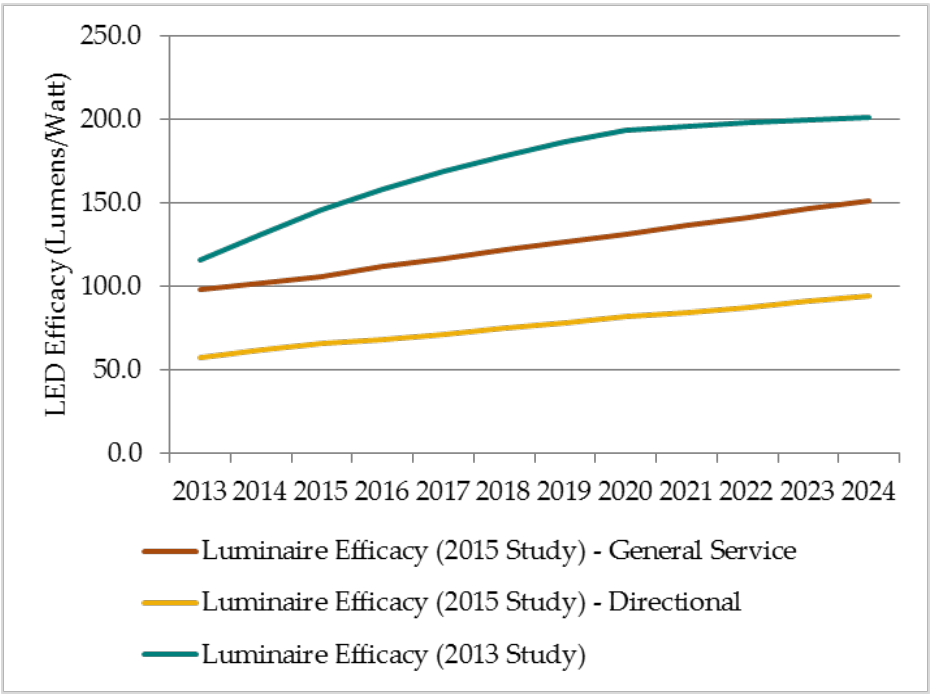
On average efficacies were adjusted by 16-19% and prices were adjusted by 10-12% starting in 2014 with the percentage adjustment decreasing over time to almost 0% by 2020. The Navigant team assumed the average CRI for LEDs in the California market will catch up with the Voluntary Quality LED Lamp Specification over time. As such, in couple years there will be no premium associated with LED products that meet the CRI requirement compared to the DOE study LED efficacies and prices for market average products. Figure B-1 and Figure B-2 illustrate the difference in LED efficacies used in both studies from 2013 to 2024. The small drop in the LED lamp efficacies from 2013 to 2014 shown in Figure B-1 is due to the Voluntary Quality LED Lamp Specification going into effect in 2014. Figure B-3 and Figure B-4 illustrate the difference in LED prices used in both studies from 2013 to 2024. Additional details on which LED measure are General Service and which are Directional can be found in Table B-2.

Figure B-1: LED Technology Improvements (Lamps)



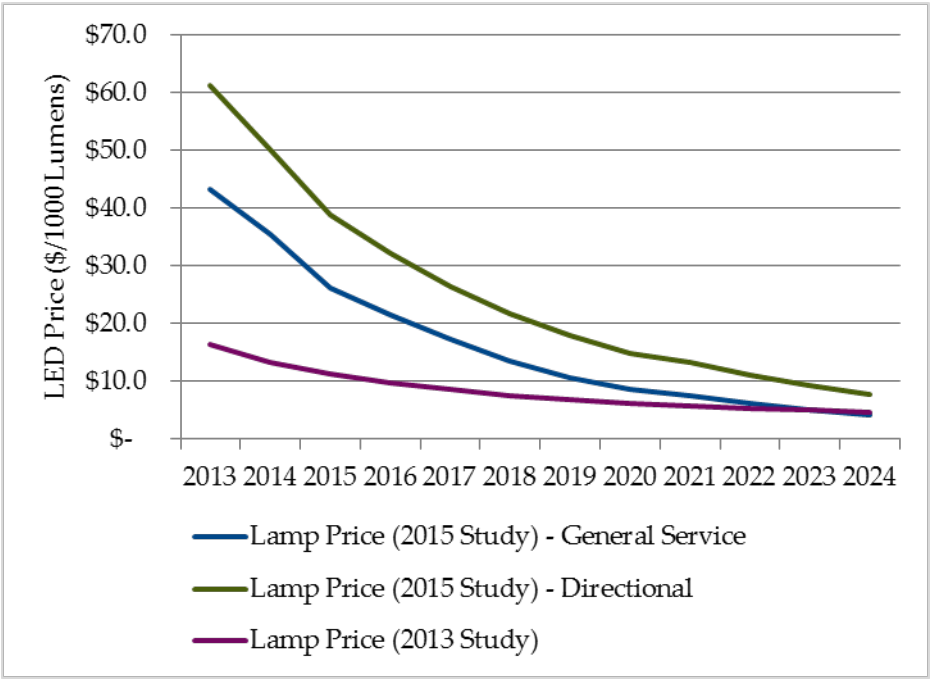
Source: Navigant team analysis 2015.

Figure B-2: LED Technology Improvements (Luminaires)



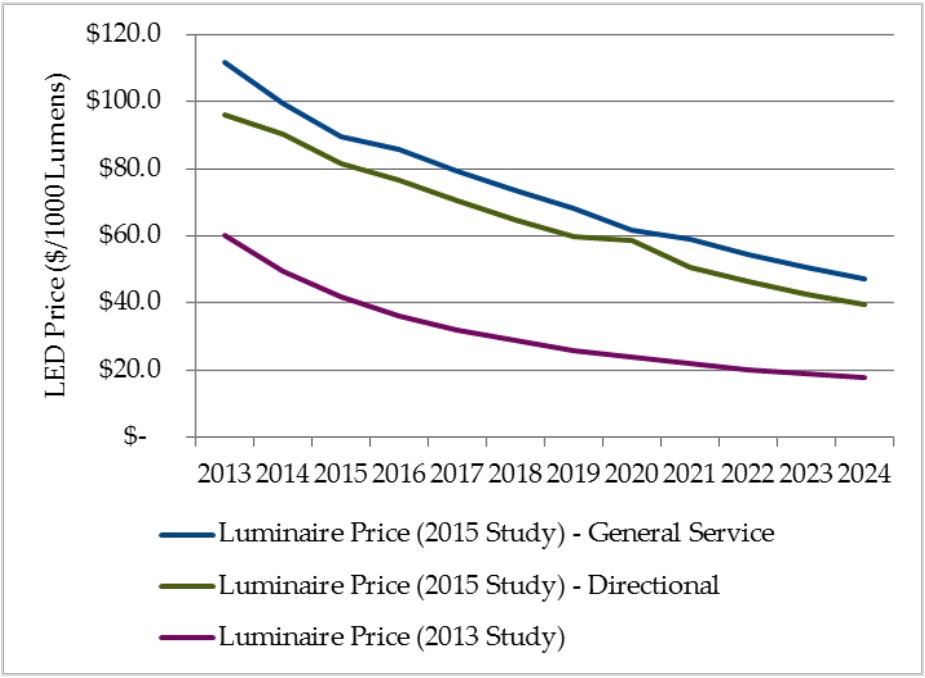
Source: Navigant team analysis 2015.

Figure B-3: LED Cost Reduction Profiles (Lamps)



Source: Navigant team analysis 2015.

Figure B-4: LED Cost Reduction Profiles (Luminaires)



Source: Navigant team analysis 2015.

B.3 Emerging Technology Risk Factor

In the 2013 Study, the Navigant team assigned a risk factor to each ET to account for the inherent uncertainty in the ability for ETs to produce reliable future savings. Actual future adoption of ETs will vary depending on technology. Some ETs may gain large customer acceptance, capture significant market shares, and generate large savings, while others may falter achieving no market share and no savings. It is impossible to pre-determine which ETs will succeed and which will fail. The ET risk factor acts to de-rate the market adoption of each individual ET. The result is a total ET savings value that is representative of what can be expected of the group of ETs. In Stage 1, the Navigant team revised the risk factors based on the same qualitative metrics that were used previously which included market risk, technical risk, and data source risk. The framework for assigning the risk factor is shown in the 2013 Study.

Navigant's logic for revising the risk factors was based on the success of the measure meeting one or more of the following criteria since the 2013 Study:

- Has overcome some of the market barriers identified previously;
- Has established strong distribution channels;
- Has resolved remaining technology issues; and
- Has produced evaluated energy savings that are equal to current (unevaluated) savings claims.

B.4 Emerging Technology Key Descriptors

Table B-1 lists the emerging technologies included in this study along with their descriptions, market introduction year, applicability, and risk factor and technology improvement parameters.

Table B-2 maps LED technologies to their measure description, LED type, and proxy LED market technology.

Table B-1: Measure Level Details of ETs Included in the 2015 Potentials and Goals Study

Sector	Fuel Type	Efficiency Measure	Base Case Description	Measure Market Introduction Year	Technology Applicability	Risk Factor	Cost Reduction Profile	Efficient Consumption Reduction Profile
RES	Electric	Clothes Washer All Sizes, Electric DHW, Electric or Gas Dryer - Average MEF = 2.87, Average Capacity = 2.93 Gallons	Clothes Washer All Sizes, Electric DHW, Electric or Gas Dryer - Average MEF = 0.78, Average Capacity = 2.93 Gallons	2012	100%	20%	Low	None
RES	Gas	Clothes Washer All Sizes, Gas DHW, Electric or Gas Dryer - Average MEF = 2.87, Average Capacity = 2.93 Gallons	Clothes Washer All Sizes, Gas DHW, Electric or Gas Dryer - Average MEF = 0.78, Average Capacity = 2.93 Gallons	2012	100%	20%	Low	None
RES	Electric	Energy Star® Dish Washer - Standard Size w/Electric Water Heater - 160 Cycles per Year - EF = 1.0	Dish Washer - Standard Size w/Electric Water Heater - 160 Cycles per Year - Average EF = 0.45	2012	100%	30%	Low	None
RES	Gas	Energy Star® Dish Washer - Standard Size w/Electric Water Heater - 160 Cycles per Year - EF = 1.0	Dish Washer - Standard Size w/Gas Water Heater - 160 Cycles per Year - Average EF = 0.45	2012	100%	30%	Low	None
RES	Electric	Heat Pump Electric Clothes Dryer	Average Market Baseline Clothes Dryer	2016	100%	50%	Medium	None
RES	Electric	Emerging Tech Refrigerator - 15% less energy than code	Code Refrigerator	2012	60%	35%	Low	None
RES	Electric	Home office - Smart Strip with one control outlet, four controlled outlets, and two constant outlets	Power Strip	2008	100%	25%	Medium	None
RES	Electric	Home theater - Smart Strip with one control outlet, four controlled outlets, and two constant outlets	Power Strip	2008	100%	25%	Medium	None
COM	Electric	Advanced Rooftop Unit AC, EER 12, COP 3.52, Advanced Economizer and Controls	Package EER Rated dxAC - Average EER = 9.68	2014	100%	45%	Medium	None
COM	Electric	Energy Recovery Ventilation system for commercial HVAC	No Energy Recovery Ventilation system	2009	12%	50%	Medium	None

Sector	Fuel Type	Efficiency Measure	Base Case Description	Measure Market Introduction Year	Technology Applicability	Risk Factor	Cost Reduction Profile	Efficient Consumption Reduction Profile
RES	Gas	Furnace Upgrade to Efficient Furnace - Average AFUE = 98	Base Case Furnace - Average AFUE = 76.8, Average HIR = 1.25	2015	100%	10%	Low	None
RES	Electric	22 SEER Split-System Air Conditioner	Residential SEER-rated split Air Conditioners, 18-65 kBTU/h; pre-2001: SEER = 10 (EER = 8.52), one-speed fan; post-2001: SEER = 13 (EER = 11.08), one-speed fan; 2014: SEER = 14 (EER = 11.82), one-speed fan	2015	100%	20%	Medium	None
RES	Electric	Split SEER-Rated Heat Pump - Average SEER = 21	Res SEER-Rated Splt HP, 7.1-3.01 kBTU/h; pre-2001: SEER = 10 (HSPF = 7.1), one-speed fan; post-2001: SEER = 13 (HSPF = 8.2), one-speed fan; 2014: SEER = 14 (HSPF = 8.2), one-speed fan	2015	100%	20%	Medium	None
COM	Electric	LED fixture: 33W, 3500 lumens	LF fixture: T8, 48inch, 32W lamp (2), Total fixture Watts = 59; Ballast specs: Instant Start, Electronic, NLO, 2 per lamp; Lamp specs: 3175 lumens, CRI=70, rated hours = 20000	2011	100%	20%	LED Luminaire - General Service	LED Luminaire - General Service
COM	Electric	LED interior lamp: 24W, 1700 lumens	Indoor Incandescent Lamp (Screw-In >= 25W) - Average Lamp Watts = 131.89W, Average Lamp CFL Ratio = 0.357	2011	100%	25%	LED Lamp - Directional	LED Lamp - Directional
RES	Electric	LED Screw-In Indoor Lamp: 16.5W, 1300 lumens	Incandescent, Screw-In Indoor 81.5W	2011	100%	25%	LED Lamp - Directional	LED Lamp - Directional
RES	Electric	LED Screw-In Outdoor Lamp: 16.5W, 1200 lumens	Incandescent Screw-In Outdoor, 87W	2011	100%	25%	LED Lamp - Directional	LED Lamp - Directional
COM	Electric	LED interior lamp: 11W, 900 lumens	Indoor Incandescent Lamp (Screw-In < 25W) - Average Lamp Watts = 58.13W, Average Lamp CFL Ratio = 0.357	2011	100%	20%	LED Lamp - General Service	LED Lamp - General Service

Sector	Fuel Type	Efficiency Measure	Base Case Description	Measure Market Introduction Year	Technology Applicability	Risk Factor	Cost Reduction Profile	Efficient Consumption Reduction Profile
RES	Electric	LED Screw-In Indoor Lamp: 8W, 675 lumens	Incandescent Screw-In Indoor, 46W	2011	100%	20%	LED Lamp - General Service	LED Lamp - General Service
RES	Electric	LED Screw-In Outdoor Lamp: 9W, 700 lumens	Incandescent Screw-In Outdoor, 57W	2011	100%	20%	LED Lamp - General Service	LED Lamp - General Service
RES	Electric	LED Screw-In Indoor Reflector Lamp: 12W, 850 lumens	Incandescent Screw-In Indoor, 71.5W	2011	100%	20%	LED Lamp - Directional	LED Lamp - Directional
RES	Electric	LED Screw-In Outdoor Reflector Lamp: 14W, 1000 lumens	Incandescent Screw-In Outdoor, 76W	2011	100%	20%	LED Lamp - Directional	LED Lamp - Directional
RES	Electric	LED Screw-In Indoor Specialty Lamp: 10W, 780 lumens	Incandescent Screw-In Indoor, 42W	2011	100%	20%	LED Lamp - General Service	LED Lamp - General Service
RES	Electric	LED Screw-In Outdoor Specialty Lamp: 11W, 870 lumens	Incandescent Screw-In Outdoor, 38W	2011	100%	20%	LED Lamp - General Service	LED Lamp - General Service
COM	Electric	LED interior fixture: 14W, 900 lumens	Incandescent interior fixture 98.8W	2011	100%	20%	LED Luminaire - Directional	LED Luminaire - Directional
RES	Electric	LED Indoor Fixture: 10W, 650 lumens	Incandescent Indoor Fixture, 79W	2011	100%	20%	LED Luminaire - Directional	LED Luminaire - Directional
RES	Electric	LED Outdoor Fixture: 10W, 700 lumens	Incandescent Outdoor Fixture, 114W	2011	100%	20%	LED Luminaire - Directional	LED Luminaire - Directional
COM	Gas	Condensing Small Gas Storage Water Heater with low Nox burner - Average Size = 51 Gal, Average EF = 0.77	Multiple base efficiency levels used, example: Small Gas Storage Water Heater - Average Size = 51 Gal; Average EF = 0.57; Average Recov Eff = 0.76	2015	80%	50%	Low	None

Sector	Fuel Type	Efficiency Measure	Base Case Description	Measure Market Introduction Year	Technology Applicability	Risk Factor	Cost Reduction Profile	Efficient Consumption Reduction Profile
RES	Gas	Small Gas Storage Water Heater - Average Size = 51 Gal, Average EF = 0.82	Small Gas Storage Water Heater - Average Size = 51 Gal; Average EF = 0.561; Average Recov Eff = 0.76	2015	100%	25%	Low	None
COM	Gas	Condensing Large Gas Storage Water Heater - Average Et = 0.99	Multiple base efficiency levels used, example: Large Gas Storage Water Heater; Et = 0.80; Stdby Loss = 0.56%/hr	2012	100%	30%	Low	None

Table B-2: LED Mapping

LED Mapping					
NEW Measure Name	Sector	Efficiency Measure	LED Type	LED Mapping	Market Proxy
Lighting - LED Lamp (Basic High - Indoor) - Emerging	Com	LED interior lamp: 24W, 1700 lumens	Lamp	Directional	LED R, BR, PAR Lamp
Lighting - LED Lamp (Basic Low - Indoor) - Emerging	Com	LED interior lamp: 11W, 900 lumens	Lamp	General Service	LED A-type Lamp
Lighting - LED Fixture (Replacing T8) - Emerging	Com	LED fixture: 33W, 3500 lumens	Luminaire	General Service Linear Fix.	LED Troffer Fixture
Lighting - LED Plug-In Indoor Fixture - Emerging	Com	LED interior fixture: 14W, 900 lumens	Luminaire	Directional	LED Downlight + Track
Lighting - LED Lamp (Basic High - Indoor) - Emerging	Res	LED Screw-In Indoor Lamp: 16.5W, 1300 lumens	Lamp	Directional	LED R, BR, PAR Lamp
Lighting - LED Lamp (Basic Low - Indoor) - Emerging	Res	LED Screw-In Indoor Lamp: 8W, 675 lumens	Lamp	General Service	LED A-type Lamp
Lighting - LED Lamp (Basic High - Outdoor) - Emerging	Res	LED Screw-In Outdoor Lamp: 16.5W, 1200 lumens	Lamp	Directional	LED R, BR, PAR Lamp
Lighting - LED Lamp (Basic Low - Outdoor) - Emerging	Res	LED Screw-In Outdoor Lamp: 9W, 700 lumens	Lamp	General Service	LED A-type Lamp

Lighting - LED Plug-In Indoor Fixture - Emerging	Res	LED Indoor Fixture: 10W, 650 lumens	Luminaire	Directional	LED Downlight + Track
Lighting - LED Plug-In Outdoor Fixture - Emerging	Res	LED Outdoor Fixture: 10W, 700 lumens	Luminaire	Directional	LED Downlight + Track
Lighting - LED Lamp (Reflector - Indoor) - Emerging	Res	LED Screw-In Indoor Reflector Lamp: 12W, 850 lumens	Lamp	Directional	LED R, BR, PAR Lamp
Lighting - LED Lamp (Reflector - Outdoor) - Emerging	Res	LED Screw-In Outdoor Reflector Lamp: 14W, 1000 lumens	Lamp	Directional	LED R, BR, PAR Lamp
Lighting - LED Lamp (Specialty - Indoor) - Emerging	Res	LED Screw-In Indoor Specialty Lamp: 10W, 780 lumens	Lamp	General Service	LED MR16
Lighting - LED Lamp (Specialty - Outdoor) - Emerging	Res	LED Screw-In Outdoor Specialty Lamp: 11W, 870 lumens	Lamp	General Service	LED Other

Appendix C. AIMS Sectors

C.1 Industrial

The Navigant team considered the full range of inputs for the Industrial sector to determine where new data sources exist and where existing data sources received significant updates since the 2013 Study. The following sections provide details on those update activities.

Industry Standard Practices

The Stage 1 update effort for the Industrial sector incorporated ISPs issued by the CPUC (approved for Study consideration) into the existing structure. Navigant engaged the CPUC Ex Ante Team to understand the studies for consideration. Initially, Navigant began by identifying all studies related to or partially related to ISP study efforts (i.e., risk assessment studies completed by the IOUs). Table C-1 shows the various sources initially identified by Navigant.

Mapping Industry Standard Practices

For the ISP studies deemed eligible for consideration, Navigant mapped these into the inputs structure initially developed in the 2013 Study. That is, each of the 11 ISP studies were viewed against the 273 assessment recommendation codes (ARCs) that define the measures that inform the Industrial sector potential. See the IAC database manual for additional detail[75] and the 2013 Study Appendix for details on how Navigant initially used these inputs.

Navigant's engineering team vetted each ISP study from the list of eleven (see Table C-2) to identify the associated equipment, measure activities under review, and the related Industrial subsectors where the ISP consideration pertained.

- First the team reviewed the list of 273 ARCs to estimate if the particular study would interact with a given IAC assessment recommendation. The ARC descriptions of measures are somewhat limited, but the Navigant team leveraged the ARC hierarchy scheme to confirm if an ISP study was relatable. For example, ARC 2.2622 includes the following hierarchal descriptions:
    - 2.2: Thermal systems
    - 2.26: Cooling
    - 2.262: Chillers and refrigeration
    - 2.2622: Replace existing chiller with high efficiency model
- These ISP studies often only identify a subsector or industrial area by qualitative descriptions (e.g., "automotive, medical, or packaging manufacturers"). However, Navigant related these ISP studies to subsectors, as defined by the 2013 Study, which rely on North American Industry Classification System (NAICS) codes. The team typically assigned each ISP by three digit NAICS

[75] Industrial Assessment Center. The IAC database manual. Last accessed April 2015. http://iac.rutgers.edu/manual_database.php.

(e.g., NAICS 325 for Chemical manufacturers).

- Next, for those ISP studies that Navigant linked to a subsector and ARC within the Study scope the team reviewed the studies to understand the ISP claims. That is, Navigant reviewed conclusions to understand if an ISP position existed or if one was not found through the study. Navigant further reviewed study findings for specific conditions or scenarios where ISPs do or do not exist. For example, a study might conclude that ISP exists only for new construction or only for facilities in certain regions. For these instances, Navigant estimated the impact on a given subsector as whole. A new construction ISP would generally be estimated to have negligible impact on a subsector and therefore excluded from consideration for the updates.

Navigant's full review of the ISPs found that they generally fell into one of five categories:

1. ISP established by the given study and incorporated into Industrial inputs (2 studies).
2. A study related to the Industrial sector inputs, but the study did not conclude an ISP existed. Therefore, the team did not incorporate any ISP de-ratings into Industrial inputs (1 study).
3. ISP study relates to another sector; the Mining (oil and gas extraction) sector for these instances (4 studies).
4. ISP study relates to a sector outside of the AIMS PG Study scope; e.g., wastewater treatment or parking garage ventilation fans (2 studies).
5. ISP study is highly specific and there are no relatable ARCs (2 studies); Navigant concludes that the ISPs' impact on potential is negligible given the high specificity.

Through the mapping exercise, Navigant related three studies to three ARCs from the list of 11 ISP studies initially identified for the Industrial sector and approved for consideration by the CPUC. Table C-1 shows the results of the mapping exercise and these studies can be found on the CPUC's ISP website.[76]

[76] Ibid, CPUC ISP list.

Table C-1: Industry Standard Practice Studies Initially Identified for 2015 Potential and Goals Study – Stage 1

Study Category	Source	Author/Authority	Number Initially Identified	Number Used
Finalized ISP Studies (Industrial sector)	Energy Division Ex Ante Team	CPUC/Itron, CPUC/PG&E, PG&E, SCE, SCG, SDG&E	11	3
Non-Final or Pending ISP Studies (Industrial or Commercial sectors)	Energy Division Ex Ante Team	CPUC/SCG, PG&E, SCE, SDG&E	9	0
Other Finalized ISP Studies (Commercial sector)	Energy Division Ex Ante Team	CPUC, SCE	1*	0
Risk Assessment Studies	SCE/ASWB Engineering	SCE/ASWB Engineering	34 (excluding 6 studies identified and accounted for by Ex Ante Team)	0
Total			55	3

Source: Navigant team analysis of various ISP and risk assessment studies (2015)
**Navigant initially identified only one study that related to the Commercial sector when in fact it was found later in the update effort that one of the 11 Industrial ISP studies also related to the Commercial sector.*

With CPUC guidance, Navigant screened the list to include only those finalized ISP studies (Industrial sector) that had been developed through the Energy Division Ex Ante Team and deemed viable by the CPUC for use in the 2015 update. That is, the 11 studies shown in the first row of Table C-1. For example, Navigant explored a range of studies and risk assessment reports, and these were ultimately excluded from this specific effort. CPUC considered these risk assessment studies as lower rigor efforts that support rebate eligibility decisions that are not applicable for this Potential Study. CPUC posted completed studies online for reference.[77] Table C-2 shows the studies within the initial scope of consideration.

The Stage 2 effort will continue the discussion with the CPUC and stakeholders to determine how the ISP study process can be refined to better support the needs of potential forecasting, and to assess how to best use lower rigor risk assessments and other market data.

[77] Navigant reviewed a total of 11 studies deemed eligible for consideration by the CPUC. Nine of those studies are posted online. ISP positions are stated for the remaining two and Navigant reviewed those, but formal reports have not yet been prepared and posted online yet. Ibid, CPUC. ISP List.

Table C-2: Industry Standard Practice Studies Mapping Exercise

Study Title	ISP Mapped to Industrial Sector?	Considerations (or reasons for exclusion)
Oil Pipeline Pump Motor VFDs	No	Accounted for in Mining sector.
CO Demand Control Ventilation for Enclosed Parking Structures - VFD Airflow Modulation	No	Commercial related, parking structures that are not specifically targeted by the Industrial sector.
Industry Standard Practice for Outdoor Steam Pipe Insulation for Oil-fields in California	No	Accounted for in Mining sector.
Cement Industry Standard Practice to Add a Percentage of Limestone During Grinding	No	Not included. ISP is extremely specific and the measure inputs do not account for this specific application/measure. Estimating the application of this ISP would result in negligible impacts on Industrial potential.
Juice Tank Insulation	Yes, but no ISP concluded	IAC ARC: *Use economic thickness of insulation for low temperatures.*
Injection Molding Machine Industry Standard Practice Study	Yes	IAC ARC: *Replace hydraulic/pneumatic equipment with electric equipment.*
Industry Standard Practice Assessment For Artificial Lift Pump Control Technologies	No	Accounted for in Mining sector.
Almond Drying Exhaust Air Recirculation Summary*	Yes	IAC ARC: *Utilize outside air instead of conditioned air for drying.*
Oilfield WW Pump Controls Summary_v1_Sanitized*	No	Accounted for in Mining sector.
Wastewater Treatment Plant Pumps VFD - v1	No	Wastewater facility related, not specifically targeted by the Industrial sector.
Low-Rigor ISP Study on Thermal Oxidizers in Plastic Bag Industry	No	Not included. ISP is extremely specific and the measure inputs do not account for this specific application/measure. Estimating the application of this ISP would result in negligible impacts on Industrial potential.

Source: Navigant team analysis of CPUC approved ISP studies (2015)
**Final report drafts of these studies are currently not available on the CPUC website.*

Applying New ISPs to Model Structure

Navigant updated the inputs developed with the 2013 Study structure to incorporate these new ISPs, namely, the studies related to injection molding and almond drying exhaust air recirculation (while the third study on juice tank insulation is excluded because no ISP was found from that study effort). Specifically, Navigant updated the de-rating factors estimated in the 2013 Study for the associated ARCs: 2.4324 and 2.2711. The de-rating factors from the 2013 Study apply to the entire industry whereas these ISP findings apply to the ARCs only for a given portion of Industrial subsectors. Therefore in order to make these recent ISP findings relatable, Navigant conducted the following steps:

- **Measure Equipment Densities:** Navigant reviewed ARCs against subsectors to estimate measure equipment densities. Measure equipment densities are an estimate of the measure densities, or saturations, and are the product of two parameters.
  - **Measure applicability (or total technology density):** As an example for the almond drying exhaust air recirculation ISP study: Navigant estimated that the identified ARC, ARC 2.2711, relates only to six of the 15 established subsectors.
  - **Baseline density:** The Navigant team of expert engineers estimated the saturation of baseline equipment (or the portion of equipment that could be converted to efficient equipment). This is, about 50 percent of the related equipment are at the baseline efficiency level for the given example.
  - **Combining the two parameters:** In terms of energy consumption for the example, Navigant's analysis estimated that ARC 2.2711 relates to only approximately 18 percent of the consumption associated with process cooling and refrigeration end-uses. This is the measure equipment density associated with the ARC.
- **ISP Multiplier:** Continuing the example for ARC 2.2711 and the exhaust air ISP, Navigant's analysis found that the ISP study only relates to the Food subsector (NAICS 311 and 312). Therefore, ARC 2.2711 should only be de-rated for the Food subsector. When considering each subsector's energy consumption, this exercise results in an Industrial sector ISP multiplier of 83 percent for this ARC.
- **Updated De-rate Factor:** The measure equipment density and ISP multiplier are then combined to estimate the new de-rate factor. From the previous example: 18 percent multiplied by 83 percent to arrive at a 15 percent de-rate factor. That is, 15 percent of the original savings reported within the IAC database are applicable to the California market. This value is uploaded into the Industrial inputs and replaces the de-rate factor established during the 2013 Study for ARC 2.2711.

Table C-3 shows the results of this exercise. The list only contains three ISP studies and related ARCs and only two de-rating factor updates. However, Navigant applied the review process to the full list of ISP studies and ARCs to confirm applicability. Further, this analysis approach developed during this 2015 Study can be redeployed for future potential study efforts and after the issue of new ISP studies if the current model framework remains.

Table C-3: Results of the Derating Factor Update Exercise

Study Title	IAC ARC	Application?	Applicable Subsectors (NAICS)	Measure Equipment Density	ISP Multiplier	De-rating Factor
Juice Tank Insulation	2.2516: Use economic thickness of insulation for low temperatures.	Not ISP (only ISP for new construction); not applied to ARC	Food (311, 312)	N/A, not ISP and no updates applied (relying on 2013 de-rating value)		
Injection Molding Machine Industry Standard Practice Study	2.4324: Replace hydraulic/pneumatic equipment with electric equipment.	Applied to ARC	Electronics (334, 335) Chemicals (325) Plastics (326) Transportation Eq. (336) Other (339)	0.500	0.536	0.268
Almond Drying Exhaust Air Recirculation Summary	2.2711: Utilize outside air instead of conditioned air for drying.	Applied to ARC	Food (311, 312)	0.184	0.828	0.152

Source: Navigant team analysis (2015)

Vetting and Density Review Exercise

As mentioned in the previous exercise, the Navigant team, including engineers from ASWB Engineering, reviewed the list of 273 ARCs to vet their applicability to the California market. This vetting exercise reviewed ARCs in terms of measure equipment densities. Navigant conducted this analysis task in response to stakeholder comments and concerns raised about the IAC database being a national level database and not for California specific data. Navigant conducted quantitative reviews for similar comments received during the 2013 Study, and those details can be found in the 2013 Study Appendix G and Appendix T. This current effort built on that 2013 Study work and augment findings with additional expertise from team members familiar with the California Industrial sector and IOU program activities and eligibility requirements.

Navigant's review identified instances where certain ARCs were not fully applicable to California (e.g., cold climate IAC ARCs not applicable in California's milder climate, etc.) or where California or Federal regulations make certain ARCs ineligible (e.g., OSHA requirements for hot surface insulation). Also, the team reviewed ARCs in consideration of California energy efficiency program requirements to identify instances were ARCs are not eligible due to programmatic constraints such as restrictions on maintenance improvements and combined heat and power (CHP) measures.

The results of this exercise confirmed the de-rating factors established for the list of 273 ARCs during the 2013 Study effort.

Preserving 2013 Study De-rating Factors

Finally, after confirming the validity of the 2013 de-rating inputs Navigant updated the values with the recent findings from the ISP review and mapping exercise. Of the 273 ARCs that inform the Industrial potential model Navigant only updates two values as shown in Table C-4 while the remainder were left unchanged from the 2013 study.

Table C-4: Updated De-rating Factors

ARC Description	ARC	2013 De-rating Factor	2015 De-rating Factor
Replace hydraulic / pneumatic equipment with electric equipment	2.4324	0.670	0.268
Utilize outside air instead of conditioned air for drying	2.2711	0.667	0.152

Source: Navigant team analysis (2015)

Other Data Reviews and Updates

Navigant reviewed the other data sources that inform the Industrial inputs to determine where updates to information were warranted. The following subsections provider further details.

Industrial Assessment Center Database

The 2013 Study relied on IAC database records from 2004 to 2012; 2012 is the most recent year with available data. For Stage 1 the Navigant team reviewed the IAC database updates and found additional recommendations made at facilities and recorded in the database for years 2013 and 2014. For those two additional years the IAC added approximately 9,000 measures. Navigant conducted a sensitivity analysis to understand the change in average savings per ARC resulting from the addition of the new data. Table C-5 provides the details of those findings.

Average electric and gas savings per measure (per ARC), as a percent of facility consumption, only changed by 0.03 percent and 0.16 percent, respectively. Therefore, Navigant concluded that the overall changes in the IAC database are negligible, and the team excluded these additional measures and preserved the IAC database inputs used for the 2013 Study.

Table C-5: IAC Database Analysis of Updates

ARC Description	Electric ARCs	Gas ARCs
Additional ARCs (recommendations made in 2013 and 2014)	6,294	2,636
Average savings per ARC from 2004 to 2012 dataset (% of facility consumption)	2.73%	6.41%
Average savings per ARC from 2004 to 2015 dataset (% of facility consumption)	2.70%	6.25%

Source: Navigant team analysis (2015)

Subsector Consumption Data: Quarterly Fuel and Energy Report (QFER)
Navigant obtained updated QFER data (new data for years 2012 and 2013) from the CEC to support the Stage 1 updates.[78] These data specify energy consumption by NAICS and Navigant uses these date to estimate subsector distributions. Navigant notes that QFER updates were only available for electric consumption data, and gas consumption data were not available at the time of the update. Also, Navigant did not anticipate significant changes or shifts in NAICS subsector distributions of energy consumption in the Industrial sector. Therefore, Stage 1 relies on the distributions developed for the 2013 Study.

Subsector Forecasts Data: Integrated Energy Policy Report
Navigant also obtained updated IEPR forecasts from the CEC.[79] Similar to the QFER data, only electric forecasts for energy consumption (kWh) and retail rates ($/kWh) were available at the time of the study. Therefore, the team updated electric forecasts for Stage 1, but the gas forecasts remain unchanged from the 2013 Study.

The IEPR Industrial electric consumption forecasts reduced from the 2013 Study and this reflects a correction to account for Publicly Owned Utilities (POUs) that reside within the larger IOU planning areas. For the planning areas in their entirety (i.e., without considering the reduction resulting from excluding POUs), IEPR estimates a decrease in consumption for PG&E and SDG&E, and an increase for SCE.

Table C-6: IAC Database Analysis of Updates

IOUs	As a percent of the 2013 Forecast Value (average for years 2015 to 2024)	
	Excluding POUs	Excluding POUs
PG&E	76.6%	76.3%
SCE	87.9%	93.9%
SDG&E	100%	92.9%

Source: Navigant team analysis (2015)

The CEC also updated retail rate forecasts to show a slight increase for all IOUs except for SDG&E, and Navigant incorporated these into the model.

[78] CEC. Quarterly Fuel and Energy Report. Last accessed April 2015. http://energyalmanac.ca.gov/electricity/web_qfer/
[79] Ibid, IEPR.

Table C-7: IEPR Electric Retail Rate ($/kWh) Forecast Updates and Comparison

IOUs	Average Retail Rate for years 2015 to 2024	
	Excluding POUs	Excluding POUs
PG&E	$0.111	$0.124
SCE	$0.098	$0.115
SDG&E	$0.156	$0.135

Source: Navigant team analysis (2015)

Other California Data

As part of the Stage 1 update vetting activities Navigant performed similar activities carried out during the 2013 Study. These activities included a comparative metrics vetting of the initial model outputs against IOU compliance filing data.[80] In addition to obtaining feedback directly from stakeholders such as the IOU representatives, comparing results to IOU planning generally helps the Navigant team understand if program activities and ISP constraints are appropriately reflected in the model.

C.2 Agriculture

Similar to the Industrial sector, the Navigant team considered the full range of inputs and sources for the Agriculture sector to determine where new data sources exist and where existing data sources received significant updates since the 2013 Study. The Agriculture sector relies on IAC, QFER, IEPR data, DEER, and the Commercial sector Study effort inform the Agriculture sector.

Industry Standard Practices

Navigant reviewed the ISPs explored for the Industrial sector and found that no new CPUC vetted and approved ISPs exist for the Agriculture sector. The Agriculture sector relies on a similar approach as the Industrial sector in that inputs are informed by supply curves that are adjusted with de-rating factors to account for ISPs, program eligibility considerations, and other constraints that prevent programs from claiming savings. While Navigant's review found no new Agriculture-specific ISPs to incorporate into the inputs, the de-rating factors for Stage 1 change from the factors established through the 2013 Study stakeholder process. These factors are developed from a comparison of Industrial incremental market potential model runs where both de-rating factors are included and excluded. Table C-8 shows a comparison of those model runs from Stage 1 and the resulting de-rate factors that are applied to the Agriculture sector inputs. Additional details on the previous factors and on this analysis approach can be found in the 2013 Study Appendix H and Appendix T.

[80] DEER. IOU Compliance Filings. Last accessed March 2015. ftp://ftp.deeresources.com/E3CostEffectivenessCalculators

Table C-8: Derating Factors Applied to the Agriculture Sector Inputs

Fuel	Equipment Measures	O&M Measures
Electric	11.8%	26.0%
Gas	32.8%	39.9%

Source: Navigant team analysis (2015)

Other Data Reviews and Updates

Navigant reviewed the other data sources that inform the Agriculture inputs to determine where updates to information were warranted. These reviews occurred simultaneous to the same reviews conducted for the Industrial sector, and Navigant made similar conclusions with the noted differences in analysis findings. The following subsections provide details on those updates.

Industrial Assessment Center Database

Similar to the review for the Industrial sector, Navigant conducted a sensitivity analysis and concluded that the overall changes in the IAC database are negligible. Therefore, Navigant excluded additional IAC measures and preserved the IAC database inputs used for the 2013 Study.

Subsector Consumption Data: Quarterly Fuel and Energy Report (QFER) and Drought Conditions

Navigant received updated electric consumption data for the Agriculture sector. Updates for gas consumption were not available. Navigant did not anticipate significant changes or shifts in NAICS subsector distributions of energy consumption in the Agriculture sector. However, Navigant identify significant year-over-year changes in sector-wide consumption. Through further investigation, Navigant correlated increased energy consumption with drought condition years.[81] Therefore, instead of relying on the most recent single year of data, Navigant instead developed a drought-adjusted annual average in order to represent typical energy consumption. The potential model relies on typical energy consumption since savings are derived directly as a percent of energy consumption. Basing the model inputs on 2013 data would erroneously imply increased energy efficiency potential during drought conditions. Navigant reviewed QFER historical trends to develop the adjustment factor. Figure C-1 and Table C-9 show the historical data and the drought factor developed from that data.

[81] California Drought Data. USDA. California Drought 2014: Farms. Last accessed March 2015 http://ers.usda.gov/topics/in-the-news/california-drought-2014-farm-and-food-impacts/california-drought-2014-farms.aspx

Figure C-1: Agriculture Sector Historical Consumption[82]

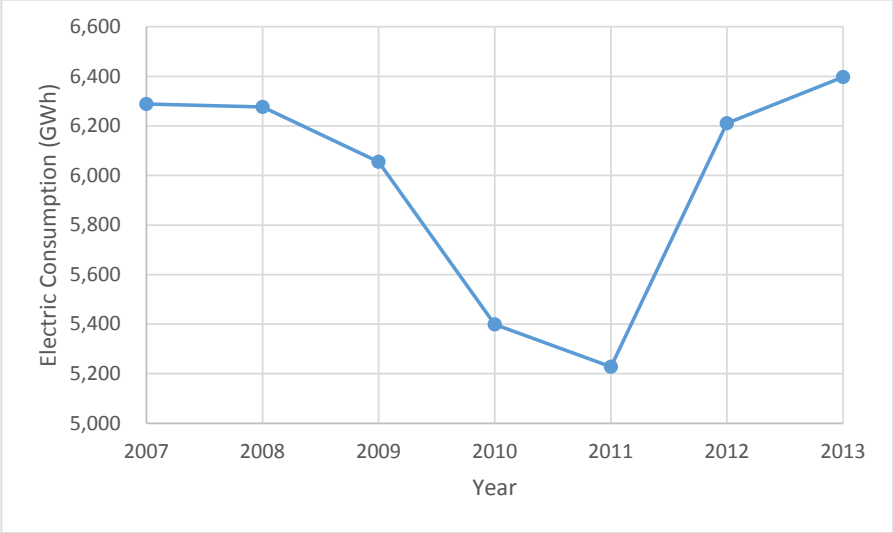


Table C-9: Agriculture Drought Factor[83]

Year	Agriculture Sector Consumption (GWh)	Drought Year?
2007	6,288	Yes
2008	6,277	Yes
2009	6,055	Yes
2010	5,399	No
2011	5,228	No
2012	6,211	Yes
2013	6,397	Yes
Average: 2007-2009 and 2012-13	6,245	Yes
Average: 2010-2011	5,314	No
Drought Factor	0.85	

Source: Navigant team analysis (2015)

Navigant developed drought factors in a similar manner as described in Table C-9 for the individual subsectors/end-uses examined for the Agriculture sector. Ultimately, the drought factors presented in Table C-10 inform the 2015 Potential Study and are applied to the most recent IEPR forecast data that reflects increased energy consumption due to drought conditions. That is, the drought factor reflects the ratio of non-drought conditions to drought conditions (i.e., the average of non-drought QFER year divided by the average of drought QFER years).

[82] Ibid, QFER data.
[83] Ibid, QFER data.

Table C-10: Agriculture Subsector Drought Factors, Electric Consumption[84]

Subsector	Drought Factor	Comments on the Impacts of Drought Conditions[85]
Dairy	90.9%	Increased cooling loads required for livestock and liquid storage.
Irrigated Agriculture	75.0%	Increased pumping energy required to lift water from lower water tables.
Greenhouses and Nurseries	97.8%	Negligible impact; slight cooling load increases expected.
Vineyards and Wineries	77.0%	Increased cooling loads required for liquid storage.
Concentrated Animal Feeding Operations	89.6%	Increased cooling loads required for livestock.
Refrigerated Warehouses	99.5%	Negligible impact; slight cooling load increases expected.
Post-Harvest Processing	94.8%	Minor impact; slight cooling load increases expected for indoor facilities.

Source: Navigant team analysis (2015)

Subsector Forecast Data: Integrated Energy Policy Report

Navigant obtained updated IEPR forecasts.[86] Similar to the Industrial sector, only electric forecasts for energy consumption (kWh) and retail rates ($/kWh) were available at the time of the study. Also, Industrial and Agriculture retail rates are the same (see Table C-7 for changes). The team updated electric forecasts for Stage 1, but the gas forecasts remain unchanged from the 2013 Study.

As previously discussed for the development of the drought factor, Navigant initially reviewed the IEPR electric consumption forecasts for the IOUs and identified a significant increase in the forecast between the 2013 Study inputs and the most recent IEPR release. This increase aligns with the difference seen in QFER data for drought and non-drought years.

[84] Ibid, QFER data.
[85] Based on Navigant's engineering judgment that is also informed by recent MASI Study activities.
[86] Ibid, IEPR data.

Table C-11: Agriculture Subsector Drought Factors, Electric Consumption[87]

Subsector	Drought Factor
2006	100%
2007	100%
2008	100%
2009	101%
2010	98%
2011	87%
2012	106%
2013	114%
2014	115%
2015	116%
2016	117%
2017	117%
2018	118%
2019	119%
2020	120%
2021	121%
2022	122%
2023	123%
2024	125%
2015 to 2024 Average	120%

Source: Navigant team analysis (2015)

Navigant also reduced the IEPR Agriculture electric consumption forecasts to remove POU energy consumption that reside within the larger IOU planning areas. Table C-12 shows the consumption forecasts that reflect the adjustment for drought conditions and exclusion of POUs.

Table C-12: Agriculture IEPR Electric Consumption (kWh) Forecast Updates

IOUs	As a percent of the 2013 Forecast Value (average for years 2015 to 2024)	
	Excluding POUs	Excluding POUs
PG&E	86.1%	91.0%
SCE	62.4%	60.4%
SDG&E	100%	92.9%

Source: Navigant team analysis (2015)

[87] Ibid, IEPR data.

DEER Data

Navigant relied on the same data from the 2013 Study when characterizing gas measures for greenhouses. These data augment the IAC database for the Agriculture sector inputs and include DEER and other analyses developed from secondary sources such as USDA Virtual Grower. DEER serves as the majority source for these measures and Navigant reviewed DEER and found no updated information. Therefore those specific inputs from the 2013 Study remain unchanged.

Commercial MICS

Similar to the DEER data, Navigant also supplemented the Agriculture inputs with sources other than IAC data for HVAC and water heating measures found in winery and vineyard operations. These are sourced from the Potential Study's Commercial sector inputs that include measure details on water heaters and building shell insulation. Navigant did not find any new sources or data to update these commercial measures, and therefore, these inputs for the Agriculture sector remain unchanged from the 2013 Study.

Other California Data

As part of the Stage 1 update vetting activities Navigant performed similar activities carried out during the 2013 Study. These activities included a comparative metrics vetting of the initial model outputs against IOU compliance filing data.[88] Similar to the Industrial sector reviews, comparing results to IOU planning helps the Navigant team understand if program activities and constraints (ISP, programmatic, regulatory, etc.) are appropriately reflected in the model.

C.3 Mining

Similar to the other AIMS sectors, Navigant considered the range of inputs and sources for the Mining sector to determine where new data sources exists and where existing data sources received significant updates since the 2013 Study. Unlike the Industrial and Agriculture sectors, the Mining sector relies on an approach more similar to the Residential and Commercial sectors. Inputs are developed from the bottom up and define specific measures instead of more broadly defined end-uses. Navigant determined that there are no significant updates for certain measure-specific parameters such as baseline and measure level efficiencies or equipment costs. However, Navigant reviewed the range of sources to both vet the 2013 Study inputs as well as identify any new or updated sources to consider that apply to the market more generally such as sector level consumption data.

Industry Standard Practices

Following the analysis of the Industrial sector ISPs, Navigant identified ISPs issued and approved by the CPUC that apply to the Mining sector (and more specifically the oil and gas extraction subsector). During the 2013 Study, Navigant also engaged the CPUC Energy Division (ED) Ex Ante Team for

[88] Ibid, DEER. IOU Compliance Filings.

guidance on how ISPs affect energy efficiency potential within the sector. The ISP studies identified through this recent effort are reflected in the input previously provided by the Ex Ante Team. Table C-13 shows the ISPs related to the Mining sector and how they influence the Potential Study inputs.

Table C-13: Industry Standard Practice Studies Relating to Mining Sector[89]

Study Title	Incorporated into Inputs?	Considerations (or reasons for exclusion)
Oil Pipeline Pump Motor VFDs	No	Midstream surface transport pumps are currently excluded from the Study scope (however, savings from pumps retrofitted with VFDs are de-rated to reflect ISP- see other studies)
Industry Standard Practice for Outdoor Steam Pipe Insulation for Oil-fields in California	Yes	Savings from improvements to steam boiler operations de-rated to reflect ISP
Industry Standard Practice Assessment For Artificial Lift Pump Control Technologies	Yes	Savings from pump-off controller (POC) and VFD installations de-rated to reflect ISP
Oilfield WW Pump Controls Summary_v1_Sanitized*	Yes	Savings from VFD installations de-rated to reflect ISP (new construction in addition to retrofits)

Source: Navigant team analysis (2015)
**Final report drafts of these studies are currently not available on the CPUC website.*

Major and Minor Market Segmentations

Within the oil and gas extraction subsector, ISP considerations are typically a function of organizational size. "Majors" are often subject to more conservative ISP considerations and only "minors" are typically eligible for certain energy efficiency measures. During the 2013 Study Navigant received guidance from the Ex Ante Team that approximately 80 percent of California oil production originated from major producers. This estimate informed the 2013 Study inputs and final Mining sector de-ratings. Navigant confirmed this market bifurcation as part of Stage 1 update by identifying the guidance published by SCE in September 2013 that also sourced guidance from ED. Table C-14 summarizes that guidance. Ultimately, the major-minor market distribution developed for the 2013 Study remains unchanged for Stage 1. Navigant's initial estimate is informed by a review of the 30 largest producers within the state, and the team does not anticipate any significant shifts for that market characteristic in the past two years.

[89] Ibid, CPUC ISP list.

Table C-14: Mining (Oil and Gas Extraction) Major and Minor Market Share Distributions[90]

Designation	Guidance	Market Distribution	Initial ED/CPUC Guidance (2013 Study)	2013 Study Market Distribution; Used for 2015 Study**
Major	Producing more than 2.5% of CA total oil production for 2012*	77%	About 80%	83%
Minor	Producing less than 2.5% of CA total oil production for 2012*	23%	About 20%	17%

Source: Navigant team analysis (2015)
**Approximately 198 MM barrels produced in 2012.*
***This distribution developed through a review of the 30 largest producers within the state.*

Other Data Reviews and Updates

Navigant reviewed the other data sources that inform the Mining inputs to determine where updates to information were warranted. The following subsections provide details on those updates.

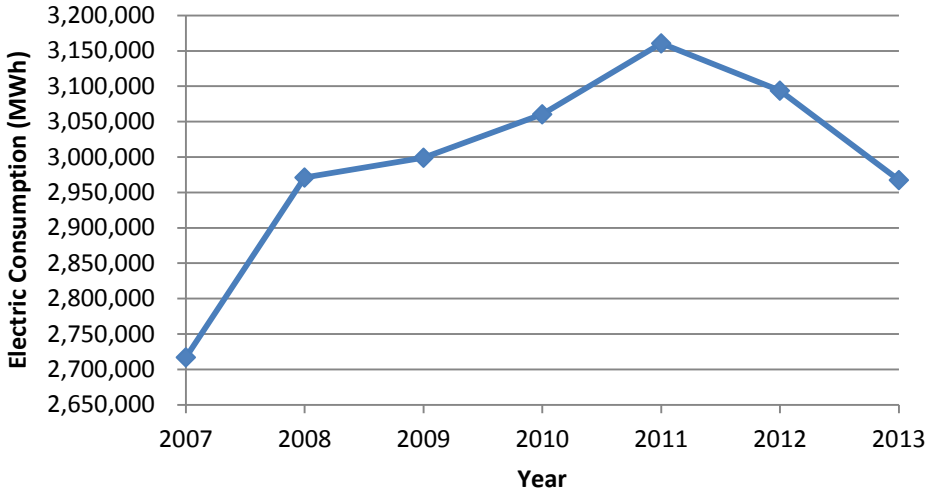
Subsector Consumption Data: Quarterly Fuel and Energy Report (QFER)

Navigant obtained updated QFER data from the CEC to support the Stage 1 updates.[91] For the Mining sector inputs, Navigant relies on the total QFER data to vet the sector-wide roll up of consumption developed as part of the bottoms-up analysis approach. Specifically, Navigant uses the QFER data to vet the equipment stock estimates.

Navigant notes that QFER updates were only available for electric consumption data, and gas consumption data were not available at the time of the update. Consumption for the oil and gas extraction subsector (NAICS 211 and 213) has fallen from 2011 to 2013, but increased overall by 9 percent from 2007 to 2013. Year-over-year changes in consumption reflect production levels that are driven by many factors including economic and regulatory ones. Due to the relatively small changes in sector-wide consumption in recent years Navigant's vetting of QFER data ultimately concluded that no changes to the equipment stocks are warranted.

[90] Oil Industry Major and Minor Company Guidance. Last accessed: April 2015. http://www.caasupport.com/2013/09/oil-industry-major-minor-company-guidance/
[91] Ibid, QFER.

Figure C-2: Oil and Gas Extractor Subsector Electric Consumption (MWh)[92]



Energy Consumption Data Management System

The Mining sector is also informed by the Energy Consumption Data Management System (ECDMS) maintained by the CEC. Navigant uses this data to inform the distribution of sector activity among the IOUs. Similar to the QFER data update, Navigant did not anticipate a significant change in distributions. However, Navigant did apply Stage 1 findings shown in Table C-15 to the inputs. Table C-15 shows ECDMS data for the Mining sector that, in addition to oil and gas extraction, includes mineral mining and construction energy consumption that are currently outside of the scope of the Potential Study. For example, Navigant estimates that the consumption shown in Table C-15 for SDG&E relates only to mineral mining and/or construction.

Table C-15: Mining Sector IOU Consumption Distributions[93]

IOU	Electric Consumption Share (% of IOUs)		Gas Consumption Share (% of IOUs)	
	2013 Study	2015 Study	2013 Study	2015 Study
PG&E	46.5%	48.6%	9.1%	7.1%
SCE/SCG	48.8%	47.4%	90.5%	91.5%
SDG&E	4.7%	4.0%	0.4%	1.4%

Source: Navigant team analysis (2015)

California Department of Conservation Data

Navigant relies on oil and gas extraction statistics published by the California Department of Conservation for a significant portion of the Mining sector inputs. During the 2013 Study Navigant

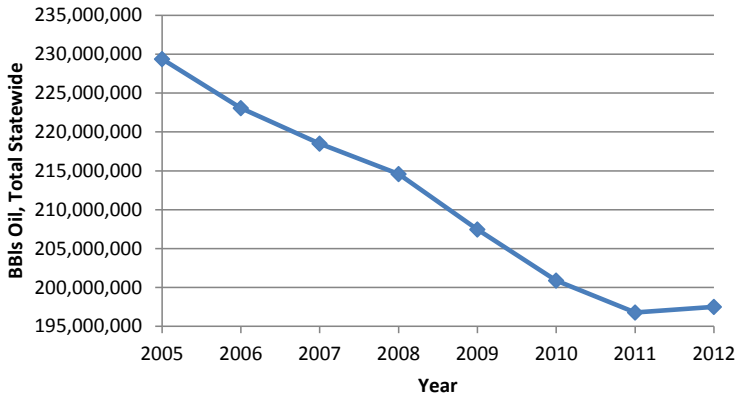
[92] Ibid, QFER data.
[93] CEC. California Energy Consumption Database. Last accessed: April 2015. http://ecdms.energy.ca.gov/

referenced the 2009 Annual Report of the State Oil and Gas Supervisor[94] that included granular details on oil well counts, oil production levels, water production levels, injection (water, steam, other), and several other statistics for specific geographies and individual organizations/operators. Stage 1 referred to the Department of Conservation data again and also identified a 2012 study[95] update as the most recent source. Unfortunately, the most recent publications do not offer the same level of details as the 2009 study. However, Navigant leveraged this new information where it could within the updates, and this included updates to statewide oil production and well counts.

In addition to informing several specific modeling inputs, the California Department of Conservation data generally informs the approach to modeling and characterizing the Mining sector. Well counts are increasing steadily, but production is down and injection activities are up. Further, less oil is being produced, but equal and likely more energy is expended to produce it.

- Oil production levels in California are trending down (Figure C-3).
- Well completions (i.e., new wells created and made ready for use) are steady (Figure C-4).
- Total number of producing wells is trending up (Figure C-5).
- Total volume of injected fluids (i.e., liquid water or steam) is trending up (Figure C-6).

Figure C-3: Statewide Oil Production[96]



[94] CA Dept. of Conservation. 2009 Annual Report of the State Oil and Gas Supervisor. Last accessed: March 2015. ftp://ftp.consrv.ca.gov/pub/oil/annual_reports/2009/PR06_Annual_2009.pdf
[95] CA Dept. of Conservation. 2012 Preliminary Report of California Oil and Gas Production Statistics. Last accessed: March 2015. ftp://ftp.consrv.ca.gov/pub/oil/annual_reports/2012/PR03_PreAnnual_2012.pdf
[96] Ibid, CA Dept. of Conservation 2009 and 2012.

Figure C-4: Statewide Well Completions[97]

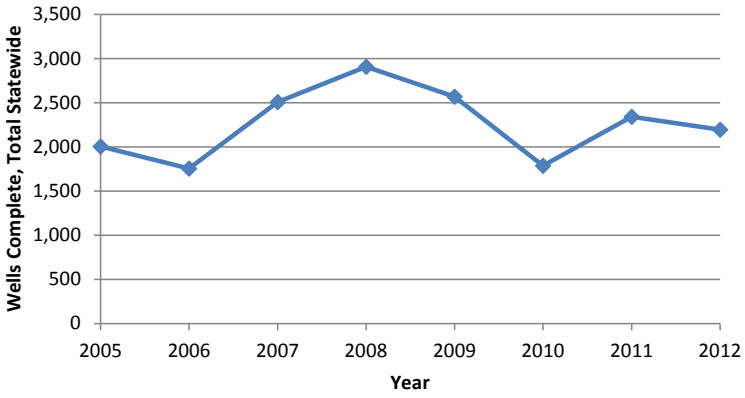
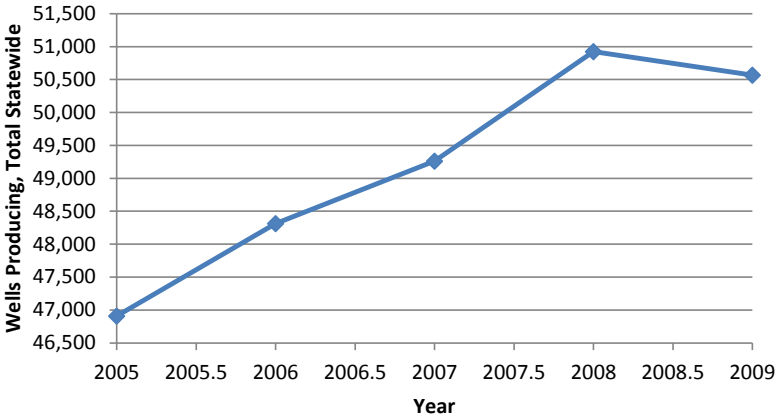
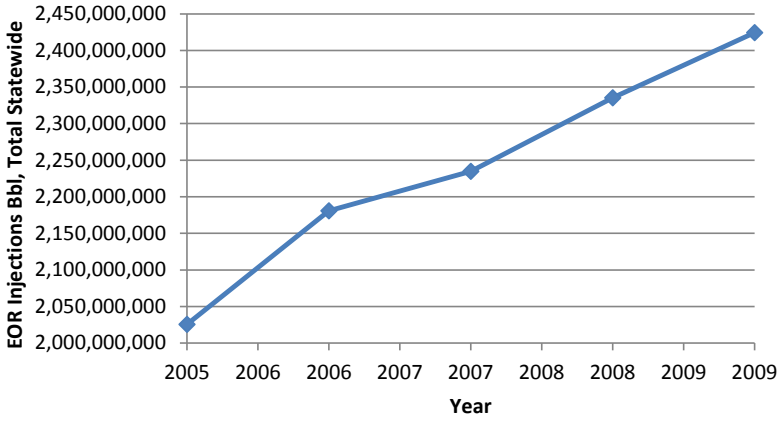


Figure C-5: Statewide Wells in Operation[98]



[97] Ibid, CA Dept. of Conservation 2009 and 2012.
[98] Ibid, CA Dept. of Conservation 2009.

Figure C-6: Statewide Water (steam or liquid) Injection Volumes[99]



Data Vetting

As part of the Stage 1 update vetting activities, Navigant performed similar activities carried out during the 2013 Study. These activities included a comparative metrics vetting of the initial model outputs against IOU compliance filing data.[100]

The Navigant team also reviewed key inputs to conform reasonableness and if any new data sources exists. Team members included subject matter experts familiar with the oil and gas extraction subsector, IOU programs active there, and ISP activities associated with measures within that subsector. These vetting exercises from experts supplement initial input received from other subject matter experts during the 2013 Study. Generally, the 2013 Study inputs reviewed were deemed reasonable and applicable to Stage 1. Therefore, no changes resulted from these reviews.

C.4 Street Lighting

Similar to the other AIMS sectors, Navigant considered the full range of inputs for the Street Lighting sector to determine where new data sources exists and where existing data sources received significant updates since the 2013 Study.

The 2015 Study update generally follows the methodology developed for the 2013 Study. First, Navigant used the IOU-supplied inventories and consumption data from the 2013 Study to estimate baseline and energy efficient measures for customer owned and IOU owned lamps. Sub-sector energy consumption distributions (i.e., street lights, sign lights, traffic lights) were updated from recent QFER data[101] using a bottoms-up approach and triangulated with other consumption data sources. The cost data for LEDs

[99] Ibid, CA Dept. of Conservation 2009.
[100] Ibid, IOU Compliance Filings.
[101] Ibid, QFER data.

were updated based on a forecasting study conducted by the Department of Energy (DOE) in 2014.[102] Navigant also used this study to forecast improvements in efficacies for LEDs.[103] Finally, Navigant recently obtained 2015 Street lighting inventories and consumption data from the IOUs and leveraged this data for vetting these updates.

The majority of updates relate to street lights whereas nominal changes to sign and traffic lights occurred for this update. The following sections primarily relate to street lights and additional details on sign and traffic lights can be found in the 2013 Study Appendix.

IOU Densities and Inventories

The Navigant team reviewed the inventories supplied by the IOUs for the streets subsector. The streets subsector includes incandescent, mercury vapor, low-pressure sodium, high-pressure sodium, metal halide, LED, and induction lamps. Because the Potential Model uses 2013 as a basis year, the Navigant team maintained the 2013 Study distribution of these technologies by lamp count across the subsector while the 2015 distributions supplied by the IOUs provided a calibration point for the Model's output. The 2015 inventories obtained from two IOUs (PG&E and SCE) reflect actual inventories. Secondary sources such as reports on Retrofit Activities for Street Lighting[104] in San Diego and Citywide Broad Spectrum Street Lighting Retrofits[105] by the City of San Diego were used to estimate SDG&E's 2015 inventory.

Similar to the 2013 Study approach, LEDs and induction lamps are considered efficient technologies while the baseline is the current mix of baseline lamp technologies: high-pressure sodium, low-pressure sodium, metal halide, mercury vapor, and incandescent. The Navigant team represented these baseline lamp types with a single lamp based on a weighted average. Estimates for the streets subsector consumption relied on the IOU-provided lamp inventories that are tied to rate schedules (e.g., LS-1 and LS-2) that specify monthly kWh charges.[106]

Per CPUC guidance for the 2015 Study, Navigant accounted for lamp ownership: customer owned versus utility owned. The potential results reflect all lamps, and Table C-16 and Table C-17 can be used to estimate separate potential for customer or IOU owned lamps only.

[102] DOE. Energy Savings Forecast of Solid-State Lighting in General Illumination Applications. August 2014, http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/energysavingsforecast14.pdf
[103] See the Emerging Technology report section for more details.
[104] City of San Diego. Retrofit Activities Summary. Last accessed March 2015 http://www.sandiego.gov/environmental-services/energy/pdf/energysavings.pdf
[105] City of San Diego. Citywide Broad Spectrum Street Lighting Retrofits. Last accessed March 2015. http://www.sandiego.gov/environmental-services/energy/programsprojects/saving/broadspectrumretrofit.shtml
[106] LS-1 and LS-2 Rate Schedules. IOU-specific. Last accessed April 2015.
PG&E: http://www.pge.com/tariffs/ERS.SHTML#ERS
SCE: https://www.sce.com/NR/sc3/tm2/pdf/ce36-12.pdf
SDG&E: http://www.sdge.com/business/street-lighting/understanding-your-street-lighting-rates

As seen in Table C-16, the percentage of efficient lamps has increased from the previous study for PG&E and SDG&E whereas SCE remains the same in its distribution of baseline lamps and efficient lamps. This table represents both customer and IOU owned lamps.

Table C-16: Percentage of Baseline and Efficient Street Lamps by Utility

Year	Efficient Lamps (%)			Baseline lamps (%)		
	PG&E	SCE	SDG&E	PG&E	SCE	SDG&E
2013	4%	1%	23%	96%	99%	77%
2015	26%	1%	31%	74%	99%	69%

Source: Navigant team analysis of IOU-provided lamp inventories (2015)

As shown in Table C-17, the majority of lamps for PG&E and SDG&E are owned by customers, and that has not changed significantly since the last update. There is a slight increase in customer owned lamps for PG&E and a similar decrease for SCE. The majority of SCE lamps are utility owned. Navigant's analysis of secondary sources for SDG&E maintained a consistent distribution across years.

Table C-17: Percentage of Customer Owned and Utility Owned Street Lamps

Year	Customer Owned (%)			Utility Owned (%)		
	PG&E	SCE	SDG&E	PG&E	SCE	SDG&E
2013	74%	17%	81%	26%	83%	19%
2015	76%	15%	81%	24%	85%	19%

Source: Navigant team analysis of IOU-provided lamp inventories (2015)

Subsector Consumption Data: Quarterly Fuel and Energy Report (QFER)

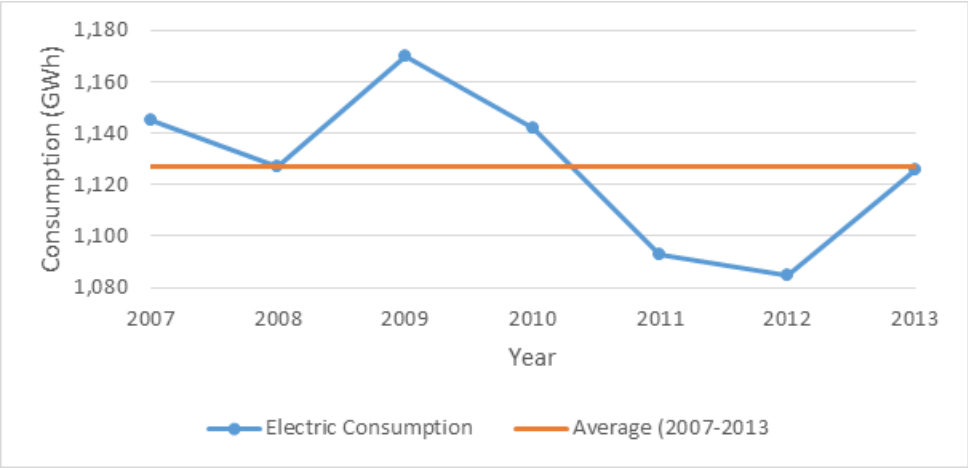
Navigant obtained updated QFER data from the CEC to support the Stage 1 updates.[107] For the Street Lighting sector inputs, Navigant relies on the total QFER data to vet the sector-wide roll up of consumption developed as part of the bottoms-up analysis approach. New electric consumption data for 2013 (the most recent year available from QFER) has been incorporated into the inputs to inform the estimate of equipment distributions of street, sign, and traffic lighting. The IOU consumption data for street lighting along with the QFER data (that represents all streets, signs, and traffic lighting) allow Navigant to parse out consumption for traffic and sign lighting.

As see in Figure C-7, the consumption data for the street lighting subsector varies. Consumption increased from 2007 to 2009, decreases from 2009 and 2012, and increases slightly in 2013. A portion of the decrease can be attributed to LED adoption, but Navigant is unable to account for all trends. Additionally, the data trend does not appear to align with IOU lamp inventory changes or growth trends (e.g., suburban sprawl). Navigant has therefore normalized the data by taking a seven year average (2007-2013) in order to mitigate the fluctuation. In turn, this average mitigates the year-over-year

[107] Ibid, QFER.

fluctuation seen in the distribution of consumption across the three subsectors: street, sign, and traffic lights.

Figure C-7: Street Lighting Sector Electric Consumption (GWh)[108]



LED Costs – Department of Energy Data

Navigant updated the cost data from the 2013 Study for LED lamps. Navigant relied on the DOE study[109] which provides a comprehensive forecast of costs and efficacies of solid-state street lighting to update the cost for LED lamps. The DOE report informed inputs in terms of normalized cost ($/klumen) and efficacy (lumens/watt). An average LED wattage of 71W from the lamp data provided by the IOUs was combined with these DOE parameters to calculate the cost per lamp for LEDs. The improvement of efficacy and reduction of LED costs in general resulted in a 22 percent decrease in LED costs from the 2013 Study. See the Emerging Technology report section for more details on how this DOE study also informed ET vectors for LEDs.

[108] Ibid, QFER data.
[109] Ibid, DOE Solid-State Lighting.

Appendix D. Codes & Standards

Table D-1: C&S Vectors

Measure Name	Sector	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Ag HVAC - Equipment (High Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag HVAC - Equipment (Mid Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Motor Pmp - Equipment (High Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Motor Pmp - Equipment (Low Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Motor Pmp - Equipment (Mid Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Motor Pmp - O&M (High Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Motor Pmp - O&M (Low Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Motor Pmp - O&M (Mid Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Process Dry - Equipment (High Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Process Dry - Equipment (Low Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Process Dry - Equipment (Mid Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Process Dry - O&M (High Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Process Dry - O&M (Low Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Process Dry - O&M (Mid Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Process Mtr - Equipment (High Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Process Mtr - Equipment (Low Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Process Mtr - Equipment (Mid Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Process Mtr - O&M (High Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Process Mtr - O&M (Low Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Process Mtr - O&M (Mid Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Ag Refrigeration - Equipment (High Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Refrigeration - Equipment (Low Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Refrigeration - Equipment (Mid Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Refrigeration - O&M (High Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Refrigeration - O&M (Low Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag Refrigeration - O&M (Mid Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag SHWC - Equipment (High Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag SHWC - Equipment (Low Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag SHWC - Equipment (Mid Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag SHWC - O&M (High Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag SHWC - O&M (Low Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ag SHWC - O&M (Mid Cost)	Agricultural	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Clothes Washer (Electric)	Residential	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
AppPlug - Clothes Washer (Electric) - Emerging	Residential	100%	100%	100%	79%	79%	79%	79%	79%	79%	79%
AppPlug - Clothes Washer (Gas)	Residential	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
AppPlug - Clothes Washer (Gas) - Emerging	Residential	100%	100%	100%	79%	79%	79%	79%	79%	79%	79%
AppPlug - Computer Monitor	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Computer Monitor	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Desktop Computer (Com - Power Management)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Desktop Computer (Res - ES Plus)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Desktop Computer (Res - ES)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Dishwasher (Electric)	Residential	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
AppPlug - Dishwasher (Electric) - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Dishwasher (Gas)	Residential	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
AppPlug - Dishwasher (Gas) - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

AppPlug - HP Clothes Dryer - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Occupancy Sensor Plug Strip	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Recycle Refrigerator	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Self-Contained Refrigerator	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Self-Contained Refrigerator - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Smart Strip Home Office - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Smart Strip Home Theater - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Variable Speed Pool Pump	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
AppPlug - Vending Machine Controls	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BldgEnv - Attic Batt Insulation	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BldgEnv - Attic Batt Insulation	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BldgEnv - Wall Spray On Insulation	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BldgEnv - Wall Spray On Insulation	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BldgEnv - Window Film	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BldgEnv - Window Film	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ComRefrig - Door Gasket (Reach-In Refrigerator)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ComRefrig - Door Gasket (Walk-In Refrigerator)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ComRefrig - Refrigerated Case Night Cover (Low Temp)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ComRefrig - Refrigerated Case Night Cover (Med Temp)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ComRefrig - Strip Curtain for Walk In Refrigerator	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
FoodServ - Electric Griddle	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
FoodServ - Electric Steamer	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
FoodServ - Fryer (Electric)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
FoodServ - Fryer (Gas)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
FoodServ - Grill to Order Cabinet	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

FoodServ - Oven (Electric)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
FoodServ - Oven (Gas)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Comprehensive Rooftop Unit Quality Maintenance	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Advanced Package Rooftop AC (> EER 12) - Emerging	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - AFUE Rated Boiler (High)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - AFUE Rated Boiler (Standard)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Chiller (Centrifugal)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Chiller (Reciprocating)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Chiller (Screw)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Demand Controlled Ventilation	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Direct Evaporative Cooler	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Direct Evaporative Cooler	Residential	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%
HVAC - EER Rated Package Rooftop AC (EER 11)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - EER Rated Package Rooftop HP (EER 11)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Energy Management System	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Energy Recovery Ventilation - Emerging	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - ET Rated Boiler (High)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - ET Rated Boiler (Standard)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Gas Furnace	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Gas Furnace	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Gas Furnace - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Repair Duct System	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Repair Duct System	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - SEER Rated Package Rooftop AC (Recharge)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - SEER Rated Package Rooftop AC (SEER 14)	Commercial	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

HVAC - SEER Rated Package Rooftop AC (SEER 15)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - SEER Rated Package Rooftop HP (SEER 14)	Commercial	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
HVAC - SEER Rated Package Rooftop HP (SEER 15)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - SEER Rated Split System AC (Recharge)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - SEER Rated Split System AC (SEER 14)	Commercial	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
HVAC - SEER Rated Split System AC (SEER 15)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - SEER Rated Split System AC (SEER 15)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - SEER Rated Split System AC (SEER 18)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - SEER Rated Split System AC (SEER 22) - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - SEER Rated Split System HP (SEER 14)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - SEER Rated Split System HP (SEER 15)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - SEER Rated Split System HP (SEER 15)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - SEER Rated Split System HP (SEER 18)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - SEER Rated Split System HP (SEER 21) - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HVAC - Thermostat	Commercial	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
HVAC - Whole House Fan	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind HVAC - Equipment (Electric - High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind HVAC - Equipment (Electric - Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind HVAC - Equipment (Electric - Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind HVAC - Equipment (Gas - High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind HVAC - Equipment (Gas - Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind HVAC - Equipment (Gas - Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind HVAC - O&M (Electric - High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind HVAC - O&M (Electric - Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind HVAC - O&M (Electric - Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Ind HVAC - O&M (Gas - High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind HVAC - O&M (Gas - Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind HVAC - O&M (Gas - Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind Lighting - Equipment (High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind Lighting - Equipment (Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind Lighting - Equipment (Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind Lighting - O&M (High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind Lighting - O&M (Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind Lighting - O&M (Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind MachDr - Equipment (High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind MachDr - Equipment (Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind MachDr - Equipment (Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind MachDr - O&M (High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind MachDr - O&M (Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind MachDr - O&M (Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcHeat - Equipment (Electric - High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcHeat - Equipment (Electric - Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcHeat - Equipment (Electric - Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcHeat - Equipment (Gas - High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcHeat - Equipment (Gas - Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcHeat - Equipment (Gas - Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcHeat - O&M (Electric - High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcHeat - O&M (Electric - Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcHeat - O&M (Electric - Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcHeat - O&M (Gas - High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Ind ProcHeat - O&M (Gas - Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcHeat - O&M (Gas - Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcRefrig - Equipment (High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcRefrig - Equipment (Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcRefrig - Equipment (Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcRefrig - O&M (High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcRefrig - O&M (Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind ProcRefrig - O&M (Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind SHW - Equipment (High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind SHW - Equipment (Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind SHW - Equipment (Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind SHW - O&M (High Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind SHW - O&M (Low Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Ind SHW - O&M (Mid Cost)	Industrial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Cold Cathode Lamp	Commercial	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Compact Fluorescent Fixture (Indoor)	Commercial	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Compact Fluorescent Fixture (Indoor)	Residential	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Compact Fluorescent Fixture (Outdoor)	Residential	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Compact Fluorescent Lamp (Basic High - Indoor)	Commercial	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Compact Fluorescent Lamp (Basic High - Indoor)	Residential	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Compact Fluorescent Lamp (Basic High - Outdoor)	Residential	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Compact Fluorescent Lamp (Basic Low - Indoor)	Commercial	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Compact Fluorescent Lamp (Basic Low - Indoor)	Residential	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Compact Fluorescent Lamp (Basic Low - Outdoor)	Residential	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Compact Fluorescent Lamp (Reflector - Indoor)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Lighting - Compact Fluorescent Lamp (Reflector - Outdoor)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Compact Fluorescent Lamp (Specialty - Indoor)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Compact Fluorescent Lamp (Specialty - Outdoor)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Exit Fixture (LED)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Halogen Lamp (A-Line)	Commercial	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Halogen Lamp (A-Line)	Residential	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Halogen Lamp (Reflector)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Halogen Lamp (Reflector)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - High Bay HID to T5	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Induction Fixture (Indoor)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Induction Fixture (Outdoor)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Induction Fixture (Outdoor)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - LED Fixture (Replacing T8) - Emerging	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - LED Lamp (Basic High - Indoor) - Emerging	Commercial	100%	100%	100%	13%	13%	13%	13%	13%	13%	13%
Lighting - LED Lamp (Basic High - Indoor) - Emerging	Residential	100%	100%	100%	21%	21%	21%	21%	21%	21%	21%
Lighting - LED Lamp (Basic High - Outdoor) - Emerging	Residential	100%	100%	100%	17%	17%	17%	17%	17%	17%	17%
Lighting - LED Lamp (Basic Low - Indoor) - Emerging	Commercial	100%	100%	100%	15%	15%	15%	15%	15%	15%	15%
Lighting - LED Lamp (Basic Low - Indoor) - Emerging	Residential	100%	100%	100%	18%	18%	18%	18%	18%	18%	18%
Lighting - LED Lamp (Basic Low - Outdoor) - Emerging	Residential	100%	100%	100%	17%	17%	17%	17%	17%	17%	17%
Lighting - LED Lamp (Reflector - Indoor) - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - LED Lamp (Reflector - Outdoor) - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - LED Lamp (Specialty - Indoor) - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - LED Lamp (Specialty - Outdoor) - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - LED Plug-In Indoor Fixture - Emerging	Commercial	100%	100%	100%	6%	6%	6%	6%	6%	6%	6%
Lighting - LED Plug-In Indoor Fixture - Emerging	Residential	100%	100%	100%	7%	7%	7%	7%	7%	7%	7%

Lighting - LED Plug-In Outdoor Fixture - Emerging	Residential	100%	100%	100%	5%	5%	5%	5%	5%	5%	5%
Lighting - Light Sensor	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Linear Fluorescent Delamping	Commercial	75%	50%	25%	0%	0%	0%	0%	0%	0%	0%
Lighting - Linear Fluorescent Delamping	Residential	75%	50%	25%	0%	0%	0%	0%	0%	0%	0%
Lighting - Linear Fluorescent Fixture (Low Wattage T8)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Linear Fluorescent Fixture (T8)	Commercial	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Lighting - Low Bay HID to T5	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Night Light Fixture (LED)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Occupancy Sensor	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Occupancy Sensor	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Plug-In Fixture (Compact Fluorescent)	Commercial	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Plug-In Fixture (Exterior)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Plug-In Fixture (Exterior)	Residential	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Plug-In Fixture (Induction)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Plug-In Fixture (Linear Fluorescent)	Commercial	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
Lighting - Plug-In Fixture (Linear Fluorescent)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Plug-In Fixture (MH Directional)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Plug-In Fixture (PSMH with Electronic Ballast)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Plug-In Fixture (PSMH)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Lighting - Seasonal Lighting	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Oil - Pump Controls	Mining	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Oil - Pump Motor	Mining	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Oil - Pump Motor and Controls	Mining	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Oil - Steam Boiler	Mining	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Oil - Steam Boiler Controls and Improvements	Mining	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

ProcHeat - Boiler Controls	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ProcHeat - Boiler Draft Fan	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Service - HVAC Fault Detection & Diagnositics	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Service - Retro-Commissioning (Electric)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Service - Retro-Commissioning (Gas)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SHW - EF Rated Heat Pump Water Heater	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SHW - EF Rated Instantaneous Water Heater (Electric)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SHW - EF Rated Instantaneous Water Heater (Electric)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SHW - EF Rated Instantaneous Water Heater (Gas)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SHW - EF Rated Instantaneous Water Heater (Gas)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SHW - EF Rated Storage Water Heater (Electric)	Commercial	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
SHW - EF Rated Storage Water Heater (Electric)	Residential	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
SHW - EF Rated Storage Water Heater (Gas)	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SHW - EF Rated Storage Water Heater (Gas)	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SHW - EF Rated Storage Water Heater (Gas) - Emerging	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SHW - EF Rated Storage Water Heater (Gas) - Emerging	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SHW - ET Rated Instantaneous Water Heater	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SHW - ET Rated Storage Water Heater	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SHW - ET Rated Storage Water Heater - Emerging	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
SHW - Pipe and Tank Insulation	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
StreetLight - Base with Controls	Street Lighting	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
StreetLight - Induction	Street Lighting	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
StreetLight - Induction with Controls	Street Lighting	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
StreetLight - LED	Street Lighting	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
StreetLight - LED with Controls	Street Lighting	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

WholeBlg - Com NC Level 1	Commercial	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
WholeBlg - Com NC Level 2	Commercial	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
WholeBlg - Com NC Level 3	Commercial	18%	18%	5%	5%	5%	0%	0%	0%	0%	0%
WholeBlg - Com NC ZNE	Commercial	62%	62%	50%	50%	50%	37%	37%	37%	25%	25%
WholeBlg - Com RET Level 1	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
WholeBlg - Com RET Level 2	Commercial	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
WholeBlg - Low Income	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
WholeBlg - Res NC Level 1	Residential	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
WholeBlg - Res NC Level 2	Residential	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
WholeBlg - Res NC Level 3	Residential	17%	17%	0%	0%	0%	0%	0%	0%	0%	0%
WholeBlg - Res NC ZNE	Residential	100%	100%	62%	62%	62%	38%	38%	38%	38%	38%
WholeBlg - Res RET Energy Upgrade CA - Advanced Path	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
WholeBlg - Res RET Energy Upgrade CA - Basic Path	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
WholeBlg - Res RET Energy Upgrade CA - Flex Path	Residential	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table D-2: C&S Measures

Regulation	Code or Standard Name	Compliance Rate	Effective Date	Policy View
2005 T-20	Commercial Refrigeration Equipment, Solid Door	70%	1/1/2006	On the books
2005 T-20	Commercial Refrigeration Equipment, Transparent Door	70%	1/1/2007	On the books
2005 T-20	Commercial Ice Maker Equipment	70%	1/1/2008	On the books
2005 T-20	Walk-In Refrigerators / Freezers	91%	1/1/2006	On the books
2005 T-20	Commercial Refrigeration Equipment, Solid Door	70%	1/1/2006	On the books
2005 T-20	Refrigerated Beverage Vending Machines	37%	1/1/2006	On the books
2005 T-20	Large Packaged Commercial Air-Conditioners, Tier 1	70%	10/1/2006	On the books
2005 T-20	Large Packaged Commercial Air-Conditioners, Tier 2	70%	1/1/2010	On the books
2005 T-20	Residential Pool Pumps, High Eff Motor, Tier 1	100%	1/1/2006	On the books
2005 T-20	Portable Electric Spas	70%	1/1/2006	On the books
2005 T-20	General Service Incandescent Lamps, Tier 1	69%	1/1/2006	On the books
2005 T-20	Pulse Start Metal Halide HID Luminaires, Tier 1(Vertical Lamps)	100%	1/1/2006	On the books
2005 T-20	Pulse Start Metal Halide HID Luminaires, Tier 2 (All other MH)	100%	1/1/2008	On the books
2005 T-20	Modular Furniture Task Lighting Fixtures	70%	1/1/2008	On the books
2005 T-20	Hot Food Holding Cabinets	70%	1/1/2006	On the books
2005 T-20	External Power Supplies, Tier 1	100%	1/1/2007	On the books
2005 T-20	External Power Supplies, Tier 2	99%	7/1/2008	On the books
2005 T-20	Consumer Electronics - Audio Players	100%	1/1/2007	On the books
2005 T-20	Consumer Electronics - TVs	96%	1/1/2006	On the books
2005 T-20	Consumer Electronics - DVDs	31%	1/1/2006	On the books
2005 T-20	Water Dispensers	70%	1/1/2006	On the books
2005 T-20	Unit Heaters and Duct Furnaces	100%	1/1/2006	On the books

2005 T-20	Commercial Dishwasher Pre-Rinse Spray Valves	100%	1/1/2006	On the books
2006 T-20	Residential Pool Pumps, 2-speed Motors, Tier 2	86%	1/1/2008	On the books
2006 T-20	General Service Incandescent Lamps, Tier 2	87%	1/1/2008	On the books
2006 T-20	General Service Incandescent Lamps, Tier 2	87%	1/1/2008	On the books
2006 T-20	General Service Incandescent Lamps, Tier 2	89%	1/1/2008	On the books
2006 T-20	BR, ER and R20 Incandescent Reflector Lamps: Residential	82%	1/8/2008	On the books
2006 T-20	BR, ER and R20 Incandescent Reflector Lamps: Commercial	82%	1/8/2008	On the books
2008 T-20	Metal Halide Fixtures	95%	1/1/2010	On the books
2008 T-20	Portable Lighting Fixtures	93%	1/1/2010	On the books
2008 T-20	General Purpose Lighting -- 100 watt	88%	1/1/2011	On the books
2008 T-20	General Purpose Lighting -- 75 watt	40%	1/1/2012	On the books
2008 T-20	General Purpose Lighting -- 60 and 40 watt	85%	1/1/2013	On the books
2009 T-20	Televisions - Tier 1	98%	1/1/2011	On the books
2009 T-20	Televisions - Tier 2	85%	1/1/2013	On the books
2011 T-20	Battery charger - consumer - Tier 1	85%	2/1/2013	On the books
2011 T-20	Battery charger - large - Tier 1	85%	1/1/2014	On the books
2011 T-20	Battery charger - large - Tier 2 incremental	85%	1/1/2014	On the books
Future Title 20	Air Filter Labeling	85%	1/1/2016	Expected
Future Title 20	Commercial Clothes Dryers	85%	1/1/2016	Expected
Future Title 20	Computers - Tier 1 | Desktops, Notebooks	85%	6/1/2016	Expected
Future Title 20	Dimming Ballasts	85%	1/1/2016	Expected
Future Title 20	Electronic Displays	85%	1/1/2016	Expected
Future Title 20	Faucets (Residential)- Gas Water Heaters	85%	1/1/2016	Expected
Future Title 20	Faucets (Residential)- Electric Water Heaters	85%	1/1/2016	Expected
Future Title 20	Game Consoles (Tier 1)	85%	1/1/2016	Expected

Future Title 20	Game Consoles (Tier 2)	85%	1/1/2019	Expected
Future Title 20	Pool Pumps & Spas	85%	1/1/2016	Expected
Future Title 20	Set Top Boxes (Tier 1)	85%	1/1/2016	Expected
Future Title 20	Small Diameter Directional Lamps (Tier 1)	85%	1/1/2016	Expected
Future Title 20	Small Diameter Directional Lamps (Tier 2)	85%	1/1/2016	Expected
Future Title 20	Small Network Equipment	85%	1/1/2016	Expected
Future Title 20	Toilets (Commercial)	85%	1/1/2016	Expected
Future Title 20	Toilets (Residential)	85%	1/1/2016	Expected
Future Title 20	Urinals	85%	1/1/2016	Expected
Future Title 20	Water Meters	85%	1/1/2016	Expected
Federal	Electric Motors 1-200HP	91%	12/1/2010	On the books
Federal	Refrigerated Beverage Vending Machines	37%	8/31/2011	On the books
Federal	Commercial Refrigeration	70%	1/1/2012	On the books
Federal	Residential Electric & Gas Ranges	100%	4/9/2012	On the books
Federal	General Service Fluorescent Lamps	95%	7/14/2012	On the books
Federal	Incandescent Reflector Lamps	7%	7/14/2012	On the books
Federal	Commercial Clothes Washers	95%	1/8/2013	On the books
Federal	Residential Pool Heaters	95%	4/16/2013	On the books
Federal	Residential Direct Heating Equipment	95%	4/16/2013	On the books
Federal	Residential Refrigerators & Freezers	95%	9/15/2014	On the books
Federal	Residential Room AC	95%	6/1/2014	On the books
Federal	Fluorescent Ballasts	95%	11/14/2014	On the books
Federal	Residential Clothes Dryers	95%	1/1/2015	On the books
Federal	Residential Gas Fired Water Heaters	95%	4/16/2015	On the books
Federal	Residential Electric Storage Water Heaters	95%	4/16/2015	On the books

Federal	Residential Gas Instant Water Heaters	95%	4/16/2015	On the books
Federal	Residential Oil Fired Water Heaters	95%	4/16/2015	On the books
Federal	Small Electric Motors	95%	3/9/2015	On the books
Federal	Residential Clothes Washers (Front Loading)	95%	3/7/2015	On the books
Federal	Residential Clothes Washers (Top Loading) Tier I	95%	3/7/2015	On the books
Federal	Residential Clothes Washers (Top Loading) Tier II	95%	1/1/2018	On the books
Federal	Residential Central AC and Heat Pumps	95%	1/1/2015	On the books
Federal	External Power Supplies	95%	2/10/2016	On the books
Federal	Battery Chargers	95%	3/1/2015	Possible
Federal	Walk-in Coolers & Freezers	95%	6/5/2017	On the books
Federal	Distribution Transformers	95%	6/1/2016	On the books
Federal	Commercial Refrigeration (Cycle 2)	95%	3/27/2017	On the books
Federal	Metal Halide Lamp Fixtures	95%	2/10/2017	On the books
Federal	High-Intensity Discharge Lamps	95%	6/1/2017	Possible
Federal	General Service Fluorescent Lamps	95%	1/26/2018	On the books
Federal	ASHRAE Products (Commercial boilers)	95%	3/2/2012	On the books
2005 T-24	Time dependent valuation, Residential	0%	1/1/2006	On the books
2005 T-24	Time dependent valuation, Nonresidential	0%	1/1/2006	On the books
2005 T-24	Res. Hardwired lighting	113%	1/1/2006	On the books
2005 T-24	Duct improvement	59%	1/1/2006	On the books
2005 T-24	Window replacement	80%	1/1/2006	On the books
2005 T-24	Lighting controls under skylights	8%	1/1/2006	On the books
2005 T-24	Ducts in existing commercial buildings	75%	1/1/2006	On the books
2005 T-24	Cool roofs	75%	1/1/2006	On the books
2005 T-24	Relocatable classrooms	100%	1/1/2006	On the books

2005 T-24	Bi-level lighting control credits	79%	1/1/2006	On the books
2005 T-24	Duct testing/sealing in new commercial buildings	82%	1/1/2006	On the books
2005 T-24	Cooling tower applications	88%	1/1/2006	On the books
2005 T-24	Multifamily Water Heating	78%	1/1/2006	On the books
2005 T-24	Composite for Remainder - Res	120%	1/1/2006	On the books
2005 T-24	Composite for Remainder - Non-Res	85%	1/1/2006	On the books
2005 T-24	Whole Building - Res New Construction (Electric)	120%	1/1/2006	On the books
2005 T-24	Whole Building - Non-Res New Construction (Electric)	0%	1/1/2006	On the books
2005 T-24	Whole Building - Res New Construction (Gas)	235%	1/1/2006	On the books
2005 T-24	Whole Building - Non-Res New Construction (Gas)	0%	1/1/2006	On the books
2008 T-24	Envelope insulation	86%	10/1/2010	On the books
2008 T-24	Overall Envelope Tradeoff	141%	10/1/2010	On the books
2008 T-24	Skylighting	141%	10/1/2010	On the books
2008 T-24	Sidelighting	141%	10/1/2010	On the books
2008 T-24	Tailored Indoor lighting	462%	10/1/2010	On the books
2008 T-24	TDV Lighting Controls	0%	10/1/2010	On the books
2008 T-24	DR Indoor Lighting	0%	10/1/2010	On the books
2008 T-24	Outdoor Lighting	0%	10/1/2010	On the books
2008 T-24	Outdoor Signs	83%	10/1/2010	On the books
2008 T-24	Refrigerated warehouses	83%	10/1/2010	On the books
2008 T-24	DDC to Zone	141%	10/1/2010	On the books
2008 T-24	Residential Swimming pool	0%	7/1/2010	On the books
2008 T-24	Site Built Fenestration	83%	10/1/2010	On the books
2008 T-24	Residential Fenestration	83%	7/1/2010	On the books
2008 T-24	Cool Roof Expansion	400%	10/1/2010	On the books

2008 T-24	MF Water heating control	141%	9/1/2010	On the books
2008 T-24	CfR IL Complete Building Method	459%	9/1/2010	On the books
2008 T-24	CfR IL Area Category Method	456%	9/1/2010	On the books
2008 T-24	CfR IL Egress Control	141%	9/1/2010	On the books
2008 T-24	CfR HVAC Efficiency	141%	9/1/2010	On the books
2008 T-24	CfR Res Cool Roofs	83%	9/1/2010	On the books
2008 T-24	CfR Res Central Fan WL	83%	9/1/2010	On the books
2013 T-24	2013 T-24 - Single family NC	83%	7/1/2014	On the books
2013 T-24	2013 T-24 - Multi-family NC	83%	9/1/2014	On the books
2013 T-24	2013 T-24 - Nonres NC	83%	10/1/2014	On the books
2013 T-24	2013 T-24 - others	70%	9/1/2014	On the books
2016 T-24	2016 T-24 - Single family NC	83%	7/1/2017	Expected
2016 T-24	2016 T-24 - Multi-family NC	83%	9/1/2017	Expected
2016 T-24	2016 T-24 - Nonres NC	83%	10/1/2017	Expected
2019 T-24	2019 T-24 - Single family NC	83%	7/1/2020	Possible
2019 T-24	2019 T-24 - Multi-family NC	83%	9/1/2020	Possible
2019 T-24	2019 T-24 - Nonres NC	83%	10/1/2020	Possible
2022 T-24	2022 T-24 - Single family NC	83%	7/1/2023	Possible
2022 T-24	2022 T-24 - Multi-family NC	83%	9/1/2023	Possible
2022 T-24	2022 T-24 - Nonres NC	83%	10/1/2023	Possible

Appendix E. Behavior Analysis Data Sources

The team reviewed close to a dozen sources to inform the non- residential behavior updates. The key sources are listed below.

- Cadmus Group Inc., Focus on Energy MEEA Training Program Evaluation, January 2015, Public Service Commission of Wisconsin
- Opinion Dynamics Corporation, Impact Evaluation Of The California Statewide Building Operator Certification Program, February 2014, California Public Utilities Commission
- Research Into Action, BOC-Expansion Initiative Market Progress Evaluation Report #1, April 2014 , Northwest Energy Efficiency Alliance
- Navigant Consulting Inc., Opinion Dynamics Corporation, and Itron, Program Year 3 DCEO Building Operator Certification (BOC) Program Evaluation, May 2012, Illinois Department of Commerce and Economic Opportunity
- Research Into Action and Energy Market Innovations (EMI), Summary Of Building Operator Certification Program Evaluations, November 2011, Consumers Energy
- Navigant Consulting, Inc., Long Term Monitoring and Tracking Report on 2011 Activities , July 2012, Northwest Energy Efficiency Alliance
- Navigant Consulting, Inc., Evaluation Of MN BOC Training, March 2011, Midwest Energy Efficiency Alliance and Minnesota Office of Energy Security
- Navigant Consulting, Inc., Long Term Monitoring and Tracking Report on 2010 Activities, June 2011, Northwest Energy Efficiency Alliance
- Navigant Consulting, Inc., Long Term Monitoring and Tracking Report on 2009 Activities, October 2010, Northwest Energy Efficiency Alliance
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- RLW Analytics, Impact and Process Evaluation Building Operator Training and Certification (BOC) Program, September 2005, Northeast Energy Efficiency Partnerships

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