STATE OF CALIFORNIA

Edmund G. Brown Jr., Governor

PUBLIC UTILITIES COMMISSION
505 VAN NESS AVENUE
SAN FRANCISCO, CA 94102-3298

June 21, 2016

Advice Letter: 4956-A (U 904 G)

Ronald van der Leeden
Director, Regulatory Affairs
c/o Lujuanna Medina
Southern California Gas Company
555 W. Fifth Street, GT14D6
Los Angeles, CA 90013-1011

**Subject: Disposition approving Advice Letter 4956-A (U 904 G), Southern California Gas Company's Metered and Performance-Based Retrofits Program as a High Opportunity Program**

Dear Mr. Leeden:

Commission Staff has determined that Southern California Gas Company's (SoCalGas) Advice Letter 4956-A is approved as supplemented. The Tier 1 Advice Letter is effective on June 21, 2016.

SoCalGas submitted the Advice Letter on April 27, 2016. The review team and Commission Staff met with SoCalGas to request a Supplement Advice Letter with an updated proposal to address several comments. SoCalGas resubmitted its proposal as Supplemental Advice Letter 4956-A on June 10, 2016. No comments or protests were submitted to the R.13-11-005 Service List in response to either the original Advice Letter or the Supplemental Advice Letter.

Attachment 1 provides a summary of the requirements and the review team's feedback to SoCalGas's initial proposal. Attachment 2 provides a summary of the requirements and verifies that an ED review team determined that the resubmitted proposal meets each requirement.

Please contact Robert Hansen of the Commission Staff at 415-703-1794 or robert.hansen@cpuc.ca.gov if you have any questions.

Sincerely,

Edward Randolph
Director, Energy Division

Cc: Service list R.13-11-009
Pete Skala, Energy Division
Carmen Best, Energy Division
Dina Mackin, Energy Division
Robert Hansen, Energy Division

ATTACHMENT 1: Background, Discussion, and Conclusions

## I. Background

On April 27, 2016, Southern California Gas Company (SoCalGas) filed a Tier 1 Advice Letter consistent with the Commission's "Assigned Commissioner and Administrative Law Judge's Ruling Regarding High Opportunity Energy Efficiency Programs Or Projects" (HOPP), dated December 30, 2015. In this original submission of the advice letter, SoCalGas proposes a Metered and Performance-Based Retrofits (MPBR) Program which aims to combine the existing monitoring-based commissioning (MBCx) and a retrofit intervention strategy. The MPBR Program targets public higher-educational facilities with partnerships between SoCalGas and the University of California (UC), California State University (CSU), and California Community College (CCC) Systems. These target customers were selected for their proven history of successful energy efficiency projects and the observed necessity for comprehensive, whole-building retrofits to capture the remaining energy efficiency potential. The program will initially launch with three projects: South Hall at UC Santa Barbara, the Social & Behavioral Sciences Building at CSU Dominguez Hills, and the Social Science Building at Cerritos College. These and subsequent projects will entail sub-metering the selected buildings with energy consumption data collected and normalized according to its Measurement and Verification plans, and projects will be approved through the Custom Review Process. SoCalGas will coordinate with UC, CSU, and CCC in selecting buildings for subsequent projects.

Commission Staff and a team of reviewers were assigned to the Advice Letter on May 3, 2016. May 2, 2016, was retroactively established as the start of the 21-day review period prescribed by R.13-11-005, which would end with a Disposition Letter from Commission Staff to SoCalGas on May 23, 2016. Reviewers completed a preliminary review on May 5, 2016, to determine whether the letter included the necessary information to perform a full review. The preliminary review, which followed the standard review checklist for HOPP proposals, revealed several items were missing or insufficiently detailed, causing staff to request a supplemental Advice Letter which was to be submitted by May 13, 2016. Staff and reviewers proceeded to perform a full review with the original Advice Letter, with the assumption that the Supplemental Advice Letter would contain the missing information necessary to complete the review and allow staff to issue a response Disposition Letter within the 21-day review period prescribed by R.13-11-005.

SoCalGas provided on May 13, 2016, an informal response to ED's preliminary review and request for a Supplemental Advice Letter, addressing ED's comments. Commission Staff and reviewers conferred on May 16, 2016, discussing both the review findings regarding the original Advice Letter, and the additional information provided in SoCalGas's response, and determined that still further information would need to be requested from SoCalGas, and submitted in the form of a formal Supplemental Advice Letter. Staff, anticipating the request and subsequent review would be completed after the scheduled end of the 21-day review period, filed a Notice of Suspension of Advice Letter on May 18, which allotted an additional 60 days to coordinate with SoCalGas to produce an acceptable Advice Letter and issue a Disposition Letter. Commission and reviewers then held a teleconference with SoCalGas personnel on May 23, 2016, to discuss the review findings and modifications necessary for an acceptable proposal.

SoCalGas submitted Supplemental Advice Letter 4956-A on June 10, 2016, and ED completed its review of the letter on June 14, 2016. Commission Staff and reviewers found the Supplemental Advice Letter acceptable pursuant to the requirements of R.13-11-005. The following section documents the review.

## II. Discussion and Conclusions of HOPP Proposal

### 1. General Program Description

*The December Ruling established a requirement that a proposal must include a program description.*

SoCalGas's Advice Letter 4956-A (Supplemental AL) contains a general description of the proposed MPBR program. The two attachments elaborate on the general description. Energy Division's (ED's) comments on the original AL submittal noted that it was unclear how SoCalGas would address electrical impacts on whole-building projects. SoCalGas responded by explaining that formal partnerships with electrical utilities would be established after approval of the program proposal, and SoCalGas had begun discussing the program with the electrical utilities. Additionally, ED reviewers observed that the proposal did not address challenges SoCalGas had encountered in previous MBCx projects, particularly regarding regression analyses and the tendency of programs to drop more expensive measures. SoCalGas points to successful MBCx projects and the novel combination of performance-based retro-commissioning and whole-building retrofits as justification for the program. Given the broad nature of this program proposal, Commission staff are satisfied with SoCalGas's description of the program.

### 2. Principles of HOPPs

*The December Ruling summarized that in principle high opportunity programs should focus on activities that are newly permissible as a result of AB 802, and strive to reach stranded potential to achieve energy savings.*

Commission Staff commented on the original submittal of AL 4956, stating that SoCalGas didn't satisfactorily analyze or explain how the combination of retrofit and retro-commissioning measures in whole-building projects is expected to yield greater savings than the sum of the two measures implemented in hypothetical isolation. In response, SoCalGas included an example of a heating system retro-commissioning project working with duct, pipe, and envelope sealing and insulation retrofits to get better results from both. Commission Staff is satisfied that the coordinated efforts will show improved results.

Commission Staff also commented on the absence of discussion regarding treatment of on-site generation and co-generation in the original AL. SoCalGas's response, "that it will account for self-generation projects within this program framework," does not adequately address ED's concern. Therefore, for each project under the MPBR program involving onsite-generation must be assessed in accordance with ED's guidance document entitled "Energy Efficiency Savings Eligibility at Sites with non-IOU Supplied Energy Sources," which was distributed to IOUs on November 18, 2015.

### 3. Measure Treatment

*Per the December Ruling, proposals must describe measures and end uses that will be addressed by the program.*

SoCalGas proposes to submit each project as a Custom Project, and measures will be evaluated through the Custom Review Process. In accordance with the performance-based retrofits aspect of the program, measures are to be selected through metering and trending. In response to comments from ED's preliminary review, SoCalGas submitted a short, non-exhaustive list of potential measures which could be expected to be used in MPBR projects.

## 4. Savings Calculation Methods

*Proposals must describe savings calculation methods and provide access to models used for addressing normalized, metered energy consumption.*

The MPBR program will provide incentives calculated from pre- and post-implementation usage data. Annual energy savings will be calculated using IPMVP Option C, billing regression analysis. Both the pre- and post-implementation data will be collected over the course of "at least three consecutive months (not including January or July)."

Commission Staff expressed concern in review comments that 3 months of usage data is insufficient for establishing a reliable baseline, and, when considering project proposals under the MPBR program, will require a full 12 months of pre- and 24 months of post-implementation data collection as specified in CPUC's HOPPs Ruling.

## 5. Incentive Design

*Proposals must 1) provide the basis and rationale for payment structure including how the structure mitigates the risk that potential upfront payments do not overrun the value of the realized savings, 2) identify the estimated capital costs and what portions of costs are to be borne by ratepayer and by implementer, 3) describe the terms and schedule of the incentive including true up over time, and 4) describe the long term tracking and reporting strategy for sustained savings with ongoing feedback.*

The incentive structure for this program will be broken into two stages: performance period I and performance period II, representing up-front incentives based on projected gross savings and post-installation realized normalized gross savings. Incentives in performance period I will not exceed 50% of the project costs, while total incentives will be capped at 80% of project cost.

SoCalGas intends to use this structure to provide the opportunity to true-up incentives in performance period II in the case that realized savings are higher than projected. However, Commission Staff observe that there is no system for recovering incentives distributed in period I in the case that realized gross savings is less than 62.5% of that expected, based on the following calculation:

| | | |
|---|---|---|
| Expected Savings: | $\hat{S}$ | |
| Realized Savings: | $S_R$ | |
| Performance Period I Incentive: | $I_1$ | |
| Performance Period II Incentive: | $I_2$ | |
| Given: | $I_1 + I_2 = 0.8S_R$ | (1) |
| and: | $I_1 = 0.5\hat{S}$ | (2) |
| Assume: | $I_2 = 0$ | (3) |
| Plug (2) and (3) into (1): | $0.5\hat{S} + 0 = 0.8S_R$ | (4) |
| Solve for Expected Savings: | $S_R = \frac{0.5}{0.8}\hat{S} = 0.625\hat{S}$ | (5) |

This risk should be addressed in each custom project proposal.

6. **Normalized Metered Energy Consumption**

*Proposals must document the methods for normalizing data. The models to normalize the data should use recognized, transparent tools, and methods that are repeatable, and reviewable. Additionally, proposals for non-residential programs must explain the link between the meter or meters and building that is acceptable for projects in the program.*

SoCalGas proposes to use a post-implementation energy model to establish normalized energy savings. Data are normalized according to typical meteorological year weather data, and the regression analysis is described in some depth in Attachment B of the Supplemental AL.

The proposal describes one possible measure which includes addressing deferred maintenance at several facilities, however SoCalGas lists the deferred procedures in aggregate only. Commission Staff will require greater specificity on which maintenance practices are believed to be deficient and how scheduling and budgetary issues will be resolved for the site-specific project proposals. Again, Commission Staff will require at least 12 months of pre- and 24 months of post-implementation data collection for all MPBR projects.

7. **Type of Program**

*Programs must include a minimum of 1 year of post-intervention data for retrofits, and a minimum21 years of post-intervention data for behavioral, retrofit, or operations projects.*

The Supplemental AL describes SoCalGas's proposed MPBR project which will leverage building-level sub-meters for direct energy consumption measurement on college and university campuses, which then will be used to identify appropriate and cost-effective behavioral, retro-commissioning, and operational measures. Projects administered through this program will be approved through the Custom Review Process, and, as previously noted, Commission Staff will ensure that each project includes at least 12 months of pre- and 24 months of post-implementation data.

8. **Threshold for Expected Savings**

*Proposals must include a description of the expected saving from the proposed program or project intervention, and literature or data to support that demonstrate the expected impacts and certainty of the estimates.*

The Supplemental AL states the program has a target energy savings of 20%, which will be applied to the three pilot facilities and all future projects. The program requires an independent EM&V contractor to verify savings.

9. **Baseline Adjustments**

*The proposal must 1) document the baseline assumptions and strategy for collecting necessary information, 2) describe how normalization methods capture (or not) baseline assumptions, and 3) describe the methods that will be used to adjust the baseline for non-routine adjustments.*

Pre- and post-implementation metered data and ambient weather conditions will be normalized to the appropriate typical meteorological year data for the project climate zone. Attachment B of the Supplemental AL provides a step-by-step explanation of the regression model used to establish the baseline.

## 10. Application to Behavioral Operational Retro-Commissioning

*If the program will include BROs, then the proposal must identify that there will be training and maintenance components included in the program. If the program will include behavior and operational activities, then the program must demonstrate multiyear savings.*

According to the Supplemental AL, the MPBR program distinguishes itself through the combination of behavioral operational retro-commissioning measures with retrofit measures. The program carries an emphasis on building owner training and education from previous SoCalGas metered-based commissioning programs. The program also seeks to provide investigation services to train customers in available energy efficiency options for their buildings.

## 11. Financing

*The program proposal should describe any use of financing programs or external financing to support the program or proposed project.*

SoCalGas will offer incentives split between two stages: performance period I which allots pre-implementation funds after measures have been installed, and performance period II, distributing trued-up funds after savings have been verified.

## III. Conclusion

For the reasons stated above, and the details and caveats outlined in the review sheet, the proposal described in the supplemental advice letter is approved. Commission Staff expects to continue collaborating with SoCalGas and the review team as projects are submitted through the Custom Review Process.

**Ronald van der Leeden**
Director
Regulatory Affairs

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*RvanderLeeden@semprautilities.com*

June 10, 2016

Advice No. 4956-A
(U 904 G)

Public Utilities Commission of the State of California

**Subject**: **Supplement: Southern California Gas Company High Opportunity Projects and Programs (HOPPs) – Metered and Performance-Based Retrofits (MPBR) Program**

Southern California Gas Company (SoCalGas) hereby requests California Public Utilities Commission (Commission) approval of its proposed Metered and Performance-Based Retrofits (MPBR) Program, consistent with Ordering Paragraph (OP) 2 in the *Assigned Commissioner and Administrative Law Judge's Ruling Regarding High Opportunity Energy Efficiency Programs or Projects* (Ruling), dated on December 30, 2015.

## Purpose

This supplemental filing replaces in its entirety Advice No. 4956, filed on April 27, 2016. Advice No. 4956 includes clarifications to the MPRBR Program as a result of the Energy Division Review Team's assessment.

## Background

On October 8, 2015, the Governor enacted Assembly Bill (AB) 802, which amended Section 381.2 of the Public Utilities Code (Pub. Util. Code). Subsection (b) directed the Commission, by September 1, 2016, to authorize electrical corporations and gas corporations to provide incentives, rebates, technical assistance, and support to their customers to increase the energy efficiency of existing buildings.[1] In addition, subsection (c) authorized, effective January 1, 2016, electrical corporations and gas corporations to implement the provisions for high opportunity projects or programs and that the

[1] Pub Util. Code § 381.2(b)

Commission shall provide expedited authorization for high opportunity projects and programs.[2]

In response to AB 802's directives, the Ruling outlines the necessary framework and guidance for the development and implementation of HOPPs. Additionally, the Ruling included an expedited review and approval process in which Program Administrators (PAs) shall submit program proposals as Tier 1 Advice Letters (AL).[3] Furthermore, the Ruling directed that each AL include the information specified in the Ruling, including the requirements set forth in Attachment A.[4]

**Program Overview**

The SoCalGas MPBR Program will assist public sector customers in retrofitting existing facilities and incorporating innovative monitoring-based commissioning (MBCx). The Program will establish a "proof of concept" that energy efficient equipment retrofits in combination with monitoring-based commissioning of public sector buildings can achieve a higher level of cost-effective energy savings compared to traditional retrofits or retrocommissioning. Although MBCx and retrofits have been separately successful in delivering energy savings, allowing customers to pursue projects on a whole building level will provide greater levels of energy efficiency. Customers will also be able to streamline project implementation timelines by combining formerly separate energy efficiency actions.

The MPBR Program is designed to incentivize projects to go from an existing condition baseline to or above code in order to encourage customers to implement retrofits that they would not have completed absent the program incentive. These incentives will be provided both on a pre- and post-measurement of energy of savings, which is further described in Attachment A. This pre- and post-measurement incentive strategy will be facilitated by metered data, which will help serve to collect the necessary information needed for accurate energy savings evaluation. Additionally, in support of participants employing a whole building retrofit, this program will offer other non-resource benefits such as facility audits, technical assistance, and energy efficiency retrofit education.

In addition, the monitoring-based commissioning approach employed by this program will include permanent upgrade of energy meters and other instrumentation, along with augmentation of energy information systems to facilitate trending and benchmarking of building energy performance. The program will provide both upfront and post-measurement incentives calculated based on existing conditions. The evaluation will rely on pre- and post-installation usage data and be conducted by an external evaluation, measurement, and verification contractor, as described in Attachment B.

Upon approval by the Commission, SoCalGas anticipates full implementation of the MPBR Program by June 2016. To facilitate consistency, coordination, and communication,

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[2] Pub Util. Code § 381.2(c)
[3] OP 1 and 2, p. 36.
[4] OP 4, p. 37.

SoCalGas will work with its public partners and utility partners to ensure all non-resource elements are implemented efficiently.

On March 3, 2016, Energy Division provided parties to Rulemaking (R.) 13-11-005 with a review sheet that will be used by Energy Division Review Teams to assess each PA proposal. In an effort to assist in the review process, SoCalGas provides a reference to each PA proposal requirement as it relates to SoCalGas' MPBR Program in Attachment C.

**Clarifications to the MPRBR Program**

Modifications have been made to Attachment A to:

- Explain how the combination of retrofits and retro-commissioning with performance-based incentives will yield greater savings and sub-metering measurement;
- How future projects will be selected and the threshold for expected savings for future projects within the program;
- Describe how SoCalGas will account for the presence of co-generation plants and how whole-building measures will not be disruptive to occupants;
- How the MPBR program will not be utilizing deemed savings;
- 
- How the MPBR program will address deferred maintenance and how customers will be assisted in overcoming the initial capital costs of the interventions; and
- Clarify SoCalGas' intentions to be actively involved in verifying and monitoring corrective actions during the three year period following implementation as well as how SoCalGas will engage with program participants through the initial year to monitor performance and provide feedback to customers.

Modifications have also been made to Attachment B to clarify the program's actions intended to drive savings. Appendix 2 was also added to Attachment B to address issues and offer solutions for problems that arise concerning regression analysis and market problems.

**Protests**

Anyone may protest this AL to the Commission. The protest must state the grounds upon which it is based, including such items as financial and service impact, and should be submitted expeditiously. The protest must be made in writing and received within 20 days of the date of this AL which is June 30, 2016. There is no restriction on who may file a protest. The address for mailing or delivering a protest to the Commission is:

CPUC Energy Division

Attn: Tariff Unit
505 Van Ness Avenue
San Francisco, CA 94102

Copies of the protest should also be sent via e-mail to the Energy Division Tariff Unit (EDTariffUnit@cpuc.ca.gov). A copy of the protest should also be sent via both e-mail <u>and</u> facsimile to the address shown below on the same date it is mailed or delivered to the Commission.

Attn: Sid Newsom
Tariff Manager - GT14D6
555 West Fifth Street
Los Angeles, CA 90013-1011
Facsimile No. (213) 244-4957
E-mail: snewsom@SempraUtilities.com

**Effective Date**

SoCalGas believes this AL is subject to Energy Division disposition and should be classified as Tier 1 (effective pending disposition) pursuant to General Order (GO) 96-B. It is in compliance with OP 2 of R.13-11-005. Therefore, SoCalGas respectfully requests that this AL be made effective on June 10, 2016, which is the date filed.

**Notice**

A copy of this AL is being sent to SoCalGas' GO 96-B service list and the Commission's service lists for R.13-11-005. Address change requests to the GO 96-B should be directed by electronic mail to tariffs@socalgas.com or call 213 244 3387. For changes to all other service lists, please contact the Commission's Process Office at 415-703-2021 or by electronic mail at process_office@cpuc.ca.gov.

Ronald van der Leeden
Director – Regulatory Affairs

Attachments

# CALIFORNIA PUBLIC UTILITIES COMMISSION

## ADVICE LETTER FILING SUMMARY
## ENERGY UTILITY

MUST BE COMPLETED BY UTILITY (Attach additional pages as needed)

Company name/CPUC Utility No. **SOUTHERN CALIFORNIA GAS COMPANY (U 904G)**

| Utility type: | Contact Person: Sid Newsom |
|---|---|
| ☐ ELC ☒ GAS | Phone #: (213) 244-2846 |
| ☐ PLC ☐ HEAT ☐ WATER | E-mail: SNewsom@semprautilities.com |

EXPLANATION OF UTILITY TYPE

ELC = Electric GAS = Gas
PLC = Pipeline HEAT = Heat WATER = Water

(Date Filed/ Received Stamp by CPUC)

Advice Letter (AL) #: 4956-A

Subject of AL: Supplement - Southern California Gas Company High Opportunity Projects and Programs (HOPPs) - Metered and Performance-Based Retrofits (MPBR) Program

Keywords (choose from CPUC listing): Energy Efficiency

AL filing type: ☐ Monthly ☐ Quarterly ☐ Annual ☒ One-Time ☐ Other

If AL filed in compliance with a Commission order, indicate relevant Decision/Resolution #:

Does AL replace a withdrawn or rejected AL? If so, identify the prior AL No

Summarize differences between the AL and the prior withdrawn or rejected AL[1]: N/A

Does AL request confidential treatment? If so, provide explanation: No

Resolution Required? ☐ Yes ☒ No Tier Designation: ☒ 1 ☐ 2 ☐ 3

Requested effective date: 6/10/16 No. of tariff sheets: 0

Estimated system annual revenue effect: (%): N/A

Estimated system average rate effect (%): N/A

When rates are affected by AL, include attachment in AL showing average rate effects on customer classes (residential, small commercial, large C/I, agricultural, lighting).

Tariff schedules affected: N/A

Service affected and changes proposed[1]: N/A

Pending advice letters that revise the same tariff sheets: N/A

**Protests and all other correspondence regarding this AL are due no later than 20 days after the date of this filing, unless otherwise authorized by the Commission, and shall be sent to:**

**CPUC, Energy Division**
**Attention: Tariff Unit**
**505 Van Ness Ave.,**
**San Francisco, CA 94102**
**mas@cpuc.ca.gov and jnj@cpuc.ca.gov**

**Southern California Gas Company**
**Attention: Sid Newsom**
**555 West 5th Street, GT14D6**
**Los Angeles, CA 90013-1011**
**SNewsom@semprautilities.com**

[1] Discuss in AL if more space is needed.

# ATTACHMENT A

## Advice No. 4956-A

## Detailed High Opportunity Projects and Programs (HOPPs) Proposal for SoCalGas' Metered and Performance-Based Retrofits (MPBR) Program

**Attachment A**

**Detailed High Opportunity Projects and Programs (HOPPs) Proposal for SoCalGas' Metered and Performance-Based Retrofits (MPBR) Program**

## SECTION 1: HOPPS PRINCIPLES AND PROGRAM RATIONALE

The SoCalGas' HOPPs Metered and Performance-Based Retrofits (MPBR) program proposal resides under four overarching principles outlined in Assembly Bill (AB) 802: (1) the proposal addresses high opportunity; (2) greatly increases savings in existing buildings; (3) reaches stranded savings potential by utilizing new approaches; and (4) enlists interventions that have not been previously done together.

SoCalGas' MPBR Program specifically targets existing public sector buildings and provides performance-based incentives for a new, innovative whole building approach utilizing a retrofit intervention strategy combined with monitoring based commissioning (MBCx) and unconstrained behavioral and operational interventions. The MPBR Program also focuses on a continuous building improvement process with ongoing building energy system monitoring, thus providing measurable and persistent energy savings based on customer performance. This program will capture stranded energy savings and untapped potential by providing the approach and incentives necessary to public sector partners, while limiting risk to ratepayers by paying only for energy savings achieved at the meter.

Based on California's Existing Buildings Energy Efficiency Action Plan, there are over 12,000 existing state buildings with over 125 million square feet of floor space. In addition, more than 13,000 buildings are owned or leased by California State University (CSU), the University of California (UC) and California Community College systems, with a total of 294 million additional square feet.[1] These numbers along with recent executive orders from the governor's office and pledges made by the UC system to have carbon-neutral campuses,[2] present a great opportunity to capture the potential energy savings offered in this sector.

For over ten years, UC and CSU have developed a strong track record of delivering energy savings as part of the Statewide Investor Owned Utility (IOU) Higher Education Partnership Program (the Partnership). However, one outcome of this significant effort to date is that the primary remaining energy efficiency potential comprises more costly and complex "deep" energy efficiency retrofits, which in the customer's judgement would be best captured through a comprehensive, whole-building approach. The whole building approach is not just how savings are quantified – it is doing multiple and systematic improvements at once, including hard-to-quantify measures and measures

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[1] CEC. Existing Buildings Energy Efficiency Action Plan. September 2015. p. 21. http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-05/TN205919_20150828T153953_Existing_Buildings_Energy_Efficiency_Action_Plan.pdf

[2] http://www.ucop.edu/initiatives/carbon-neutrality-initiative.html

not normally done under energy efficiency programs. Additionally, there are cost-efficiencies inherent in the comprehensive approach in working with contractors, designers, service providers. As further evidence of the enormous savings potential waiting to be tapped, a UC-wide study in 2014 identified an estimated 427 million kWh and 16 million therms available in buildings greater than 40,000 gsf.[3] Other internal UC assessments consider these numbers conservative once building stock under 40,000 GSF is taken into consideration. Adding savings potential from the CSU system significantly increases the available untapped potential. As discussed in Section 3, the MPBR program is designed among other things to overcome one of the key barriers in realizing this potential, the current piecemeal energy efficiency project delivery approach.

MPBR draws its underlying monitoring and commissioning philosophy from MBCx, which emphasizes permanent energy performance metering and trending – for diagnosis of energy waste, for savings accounting, and to enable persistence of savings. Emphasis on monitoring represents a paradigm shift from the traditional retrocommissioning (RCx) industry, which has traditionally relied upon test protocols and modeled savings estimates. Unlike traditional RCx, MBPR will require the installation of permanent building-level sub-meters for direct measurement of energy consumption before and after the measures and retrofits are installed. Emphasizing a permanent energy performance strategy, MPBR combines behavioral, retrocommissioning, and operational measures (BRO measures) with retrofit measures, under an MBCx approach to prove the concept is a cost-effective strategy for achieving energy efficiency savings in existing buildings. These commissioning measures are not currently a part of the universities' maintenance practices.

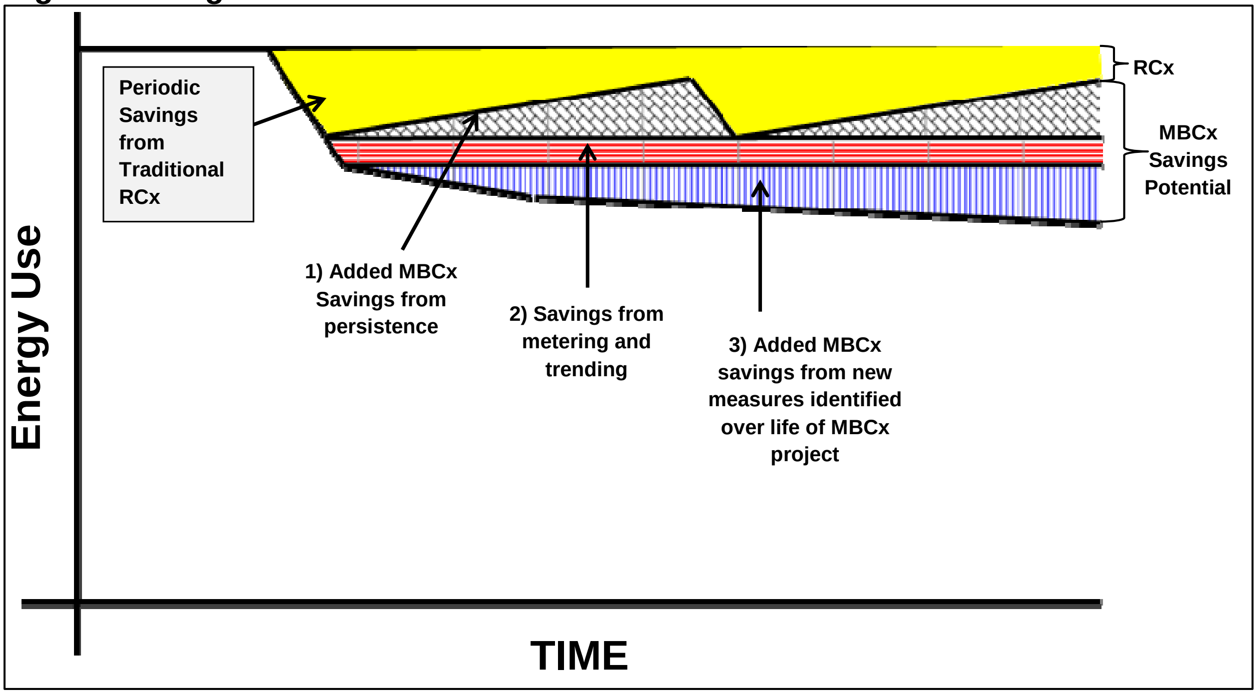
MBCx involves the implementation of improvement measures along with ongoing service and insights necessary for full transparency, measurement, and reporting. That is, what energy conscious facility engineers have attempted to do manually for decades can now be completed more efficiently, more comprehensively, and more accurately by combining building and energy system data with an engineering team's expertise through the MBCx process. It can improve overall building performance, reduce building operating costs, and even result in a lower likelihood of premature equipment failure.

Universities will be directed to seek deep savings opportunities, where the sum of individual measure savings installed separately is less than that from similar measures installed in the same time frame. For example, universities will seek space heat load reduction measures by reducing heat loss within the building and its systems – through duct sealing, duct and pipe insulation, envelope sealing, and elimination of simultaneous heating and cooling in HVAC systems. This can enable boiler or furnace downsizing. Adding efficient control strategies can further improve system wide efficiencies.

[3] Deep Energy Efficiency and Cogeneration Study Findings Report, September 12, 2014; http://www.ucop.edu/facilities-management-services/_files/deep-efficiency-and-cogen.pdf

In addition, through MPBR the innovative approach of MBCx has the potential to add three primary streams of additional energy savings relative to Retrofit and RCx alone[4]: (1) savings from persistence and optimization of savings from all measures; (2) savings from measures identified through metering and trending; and (3) continually identified new measures. Figure 1 provides an illustrative example of the potential for the additional savings streams that can come about with MBCx compared to traditional RCx.[5]

**Figure 1. Marginal Benefit streams of MBCx**




Although MPBR presents significant opportunities to capture otherwise stranded savings it also carries with it substantial costs. These costs come from the on-going data analytics and monitoring required as well as the equipment and labor costs.[6] These cost poses a significant challenge for the public building sector because institutional organizations, such as universities, do not typically prioritize energy improvements as part of their overall capital improvement budgets, especially when utility bill savings accrue to their operating budget.[7]

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[4] Typically, Retrofits and traditional RCx projects have been done mutually exclusive, the MPBR program now hopes to combine Retrofits and the more modern RCx of MBCx to increase the potential of savings.

[5] Adapted from Meiman, A., Anderson M., Brown, K., 2012. "Monitoring-Based Retrocommissioning: Tracking the Evolution and Adoption of a Paradigm-Shifting Approach to Retro-Commissioning." ACEEE 2012 Summer Study Proceedings.

[6] Labor costs include, but are not limited to, intensive onsite visits/audits, analysis of hundreds/thousands of data streams, project management, training, and reporting.

[7] CEC. Existing Buildings Energy Efficiency Action Plan. September 2015. p. 22.

As stated in the recent protest to SDG&E Advice Letter 2864-E by the University of California:

> "MBCx is an extremely important element of the Partnership as it not only provides enhanced metering in buildings that may have limited or no metering at all (as most campuses are master metered), but also enables significant energy savings accomplishments – critical to meet the University's aggressive 2025 Carbon Neutrality Goal. MBCx also is arguably the closest active program in the entire CPUC energy efficiency portfolio to delivering on "taking into consideration the overall reduction in normalized metered energy consumption as a measure of energy savings," currently required by AB 802."[8]

Retrofits and retro-commissioning have had a long and lengthy history of providing necessary upgrades to existing buildings. And in recent years, Monitor Based Commissioning has made significant gains on transforming existing buildings into energy efficient buildings. But while successful in that vein, buildings were still being left unaddressed. Fortunately, there is an opportunity to utilize an innovative approach that would allow for two intervention strategies to be concurrently utilized in combination with pay for performance incentives. We believe this strategy will effectively move these buildings forward. With the enactment of AB 802 and the ruling on the AB 802 framework, IOUs were given a great opportunity to introduce pioneering approaches that would capture old existing buildings stranded potential which significantly exists in the state of California. It is true that the MPBR program utilizes two approaches that currently exist, but this program utilizes them collectively to maximize the savings to a resource constrained customer; thus achieving high impact on a high opportunity potential building.

In addition, although Prop 39 funding has been made available to pursue energy efficiency retrofits and clean energy installations, the need to achieve Prop 39 cost effectiveness requirements and verified energy savings have led community colleges to pursue energy efficiency opportunities where intervention methods from the IOUs are available and most economically attractive. This has prioritized projects where to-code savings impacts are minimized as shown in the CA Community College Chancellor's Office "Project Type Comparison Chart" where over 50% of funded Prop 39 projects have been lighting measures.[9]

The UC/CSU/IOU partnership program is in its 11th year and several MBCx projects have been reviewed as part of an evaluation of custom projects in Work Order 33 (WO33), produced in 2014. WO33 provided results of the 10 sampled MBCx projects

[8] University of California's protest to SDG&E Advice Letter 2864-E, subject: Submission of High Opportunity Projects and Programs (HOPPs) Proposal – HOPPS Retro-Commissioning Program.
[9] California Community College Chancellor's Office. Proposition 39 Project Types as of January 2016 http://extranet.cccco.edu/Portals/1/CFFP/Facilities/Proposition%2039/CCCCO%20Project%20Type%20Chart.docx

and a discussion of issues in its Appendix G.2. Most of these issues concerned the MBCx's program's implementation of the whole building regression analysis, for example:

- Buildings selected for evaluation 1 or 2 years after completion and presence of non-routine adjustments;
- Regression analysis not accounting for process loads in science and technology buildings;
- No regression validity criteria used for models;
- Recommendation that baseline and post-period models use more than three months data – preferably up to six months or more;

These and additional issues identified in App. G of WO33 are addressed in Appendix 2 of Attachment B. Some of the issues identified provided important considerations for the design of the MPBR program. SoCalGas has reviewed each WO33 Appendix G recommendation and discussed how they have been addressed in the MPBR program.

Recognizing this importance, along with the potential for retrofits and the desire for a holistic, building-focused delivery approach, SoCalGas has worked closely with UC and CSU and other IOU partners to develop this MPBR HOPPs offering. Through MPBR, we intend to demonstrate that this program framework applied to two or three specific building projects identified in Section 4, will be a cost-effective approach scalable to other higher education buildings and ultimately to the broader building stock of California's public sector.

As described above, and throughout the remainder of this document, the MPBR program includes many key attributes in alignment with recent legislation and state goals. To highlight a few:

- Alignment with AB 802. The program will directly align with the requirements of AB 802 by paying customer incentives based on metered savings from existing conditions for all retrofit, behavioral, commissioning and operational measures to and beyond code.
- Alignment with AB 758. The program employs multi-year, performance-based incentives to support savings realization, persistence and to mitigate incentive payment risk.
- Innovative design. This program allows the flexibility to implement the best package of measures, innovative technology, and newly authorized approaches to achieve comprehensive, deep energy savings in existing buildings ~*Its innovative concurrent use of two intervention strategies – which have historically been done separately limiting the amount of savings that could be achieved– along with a new pay-for-performance element that has not been done with these type of projects.*

## SECTION 2: PROPOSED PROGRAM

The SoCalGas MPBR Program will assist public sector partners in retrofitting existing facilities, incorporating innovative monitoring based commissioning. The program will establish "proof of concept" that retrofits accompanied with monitoring based commissioning of public sector buildings at local campuses is both feasible across California and can achieve a higher impact of savings compared to traditional retrofits or RCx alone. MBCx and retrofits have been separately successful in delivering energy savings. Allowing the customer to pursue energy efficiency projects on a whole building level rather than in separate efforts will bring synergy to efficiency efforts. Customers will be able to streamline project implementation timelines by combining formerly separate energy efficiency programs and focus on comprehensive energy efficiency at a building level rather than at the measure level.

The MPBR Program is designed to incentivize projects to go from an existing condition, metered baseline to or above code in order to encourage customers to implement retrofits and BRO measures that they would not complete absent the program. Performance based incentives will be provided on a post-implementation measurement of energy of savings based on meter data, which is further described below. A project specific Measurement and Verification (M&V) plan will be developed for each project. To maximize the usefulness of these plans and data collected, and realize process efficiencies between project-level and program-level analysis, each M&V Plan will be developed consistent with the gross savings methodology as specified for the program Evaluation, Measurement and Verification (EM&V) methodology included in Attachment B: EM&V Plan.

Additionally, in support of participants employing a whole building approach, this program will offer other non-resource benefits such as facility audits, technical assistance, and energy efficiency education related to retrofits, performance tracking and savings persistence. The program will include calibration and permanent upgrade of energy meters and other instrumentation, along with augmentation of energy information systems to facilitate trending and benchmarking of building energy performance.

The MPBR Program will aim to achieve at least an overall 20% reduction in energy consumption for each project. Future selected buildings will also be expected to achieve at least 20% reduction of energy consumption to qualify for the MBPR program.[10] Program evaluation will be conducted by an external EM&V contractor, as described in Attachment B.

Full implementation of the MPBR Program is anticipated by June 2016. To facilitate consistency, coordination, and communication, SoCalGas will work with its public

[10] As soon as the AL is approved, the process for assessing program eligibility based on a threshold building EUI will be included in the subsequent Program's Implementation Plan.

partners and utility partners (i.e. electric utility) program to ensure all non-resource elements are implemented most efficiently.[11]

## SECTION 3: INTERVENTION STRATEGY AND MARKET BARRIERS ADDRESSED

The MPBR program is uniquely positioned to demonstrate how a whole building approach with one traditional approach, retrofits, and fairly recent approach of MBCx, can address several barriers that prevent buildings from achieving deep and long-lasting savings. This collectively demonstrates the value of deep retrofit upgrades and the high frequency data made available from the customer's meters. The customer's meters deliver to the building operators actual building level data that can inform operators to act when the building efficiency is degraded (i.e. the building consumes more energy than it should). This also helps capture "true measured savings" of retrofits and commissioning measures. In addition, the program can demonstrate the effectiveness of new empirical modeling methods in M&V applications and pay-for-performance incentives for driving a persistence of savings at the same time shortening payback periods in EE investments and accurately measuring savings. The associated data and analysis methodologies may also be integrated into building management practices, which serve to maintain and continue achievement of gains in energy efficiency over longer terms. These are the key steps to success identified in California's energy efficiency policies and strategic plans.

The following intervention strategies, shown in Table 1, will be used to reduce specific market barriers in order to increase adoption of targeted energy efficiency improvements.

**Table 1. MPBR Intervention Strategies**

| Existing Buildings Public Sector | MPBR Program Intervention Strategies |
|---|---|
| **Unfavorable economics of buildings that function adequately, but lack the financial and technical ability to upgrade to higher levels of energy efficiency.** | The Program's whole building, multiple measure approach takes advantage of the built-in M&V from MBCx and the flexibility to implement retrofits cost-effectively as a portfolio of measures of different paybacks within a building. |
| **Energy inefficiency alone simply not enough of a driver to pursue longer term payback on efforts to improve building energy consumption.** | The Program is designed to incentivize the local partner to improve building energy consumptions by offering both an up-front post-installation incentive payment and as well as a pay-for-performance payment. |

[11] Once approved, SoCalGas will look to work with an Electric Utility to co-fund the program and pay for all electric incentives on energy saved and any necessary electric sub metering costs. This agreement will be reflected in the filed implementation plan once the proposal is approved as directed in the AB 802 December Ruling.

| | |
|---|---|
| **Piecemeal approach to implementing energy efficiency projects necessitating multiple building touches and repetitive project application and review processes leaving stranded energy savings** | MPBR aligns with the way customer desires to conduct their work, addressing all efficiency opportunities in a building at once, which is less disruptive to occupants and more cost-effective with a portfolio approach than multiple touch approach |

***<u>Documented Market Barriers To the Existing Building Public Sector</u>***

- Barriers to Ensuring Persistence of Savings Through Monitoring[12]
- Limited Progress Toward Monitoring for Problem Diagnosis of building inefficiencies due to budget cutbacks in California Higher Education[13]
- Financial Constraints: Government and institutional organizations do not typically prioritize energy improvements as part of their overall capital improvement budgets, especially when utility bill savings accrue to their operating budget.[14]
- Small Jurisdiction Capacity and Resources: There is a general lack of technical assistance and procurement service support[15], as well as a lack of technical knowledge, staff, and resources to make energy efficiency management operational and effective.[16]

## <u>SECTION 4: SCOPE OF WORK</u>

This Program provides a framework for a project-based approach of the University of California, California State University, and Investor-Owned Utility Energy Efficiency Partnership and the California Community College/Investor Owned Utility Energy Efficiency Partnership. Projects will be submitted through the Custom Measure Project Archive (CMPA). SoCalGas will work with customers (UC, CSU, and CCC campuses) to identify buildings that have not been comprehensively retrofitted or commissioned previously. Buildings will be selected based on the principle that simple retrofits or basic MBCx alone are economically unfeasible and thus would not capture the full cost effective potential of energy savings given the building's characteristics. Some of these characteristics include building vintage, building type, and occupant type. Selected building(s) will be sub-metered with energy consumption data collected and normalized per M&V plans discussed in Section 2 above. Currently, three buildings have been

[12] ACEEE. Monitoring-Based Commissioning: Tracking the Evolution and Adoption of a Paradigm-Shifting Approach to Retro-Commissioning. http://aceee.org/files/proceedings/2012/data/papers/0193-000137.pdf
[13] *I.d.*
[14] Harcourt, Brown, and Carey, Energy Efficiency Financing in California Needs and Gaps: Preliminary Assessment and Recommendations, San Francisco: CPUC, 2011, p. 34.
[15] *I.d.*
[16] PG&E, Pacific Gas and Electric Company 2010-20112 Energy Efficiency Portfolio Local Program Implementation Plan Government Partnership Master, San Francisco: PG&E, 2011.

selected for the first three projects: South Hall at UC Santa Barbara (1970's vintage, 131,688 sq.ft.), Social & Behavioral Sciences Building at CSU Dominguez Hills (1971 vintage, 81,000 sq.ft.), and the Social Science Building at Cerritos College (1960 vintage, 112,144 sq.ft.).

Pre-implementation baseline of building energy consumption will be used to compare against post implementation data. In order to create accurate energy models, at least three consecutive months (not including January or July) of baseline and post-implementation whole-building energy trends will be requested. The purpose of this requirement is to ensure that energy use is trended over a period which captures a range of independent variables (typically outside air temperature) representative of most of the annual operating conditions. More than three months of data may be required to create acceptable model correlations.[17] This model of three months of representative pre- and post- energy consumption data has been independently verified as a statistically acceptable building energy consumption model for sub metered buildings on California university campuses.[18], [19] The customer or their commissioning agent will perform functional testing of building systems and develop a behavioral, commissioning, and operational improvements measure list.[20] Working with the IOU program manager and Account Executive, customer or customer's agent will also identify equipment that can be retrofitted to be more energy efficient.[21] Customers will be required to consider and implement multiple BRO and retrofit measures to ensure deep energy savings are achieved. This program will cause multiple measures to be installed in the same time period but is expected to have limited disruption on occupants.

After the portfolio of measures is implemented, a post-implementation energy model will be established with the data collected, again per M&V plans previously discussed. This post-implementation energy model will be used to establish normalized energy savings against the pre-implementation data and compare against future building consumption. The customer or commissioning agent will then do an analysis of the normalized pre- and post-trend data per IPMVP Option C.[22] Annual energy savings will also be calculated using IPMVP Option C. The customer or their commissioning agent will document the measures identified and implemented for the customer's reference.

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[17] Note that January and July data can and should be used in the energy analyses if available; those months just do not count toward the three consecutive month requirement.

[18] Assessment of the Whole Buildings Savings Verification Approach in the University of California Monitoring-Based Commissioning Program. Quantum Energy Services & Technologies, Inc. April 3, 2015. http://www.ucop.edu/facilities-management-services/_files/whole_building_study.pdf

[19] Monitoring-Based Commissioning: Benchmarking Analysis of 24 UC/CSU/IOU Projects, Lawrence Berkeley National Laboratory, June 2009. http://evanmills.lbl.gov/pubs/pdf/MBCx-LBNL.pdf

[20] Commissioning Agent can be hired by Program Participant and costs will be included in the overall project costs.

[21] The customer through its hired/contracted commission agent and engineers would include in its contracting an in-depth, retro commissioning process audits. The program will not be covering the in depth retrocommissioning process audit fees.

[22] http://www.nrel.gov/docs/fy02osti/31505.pdf

Finally, SCG acknowledges that it will account for self-generation projects within this program framework where self-generation exists on site.

### *Monitoring Based Commissioning (MBCx) Background*

The SoCalGas MPBR program relies on the concepts and experience gained through the Partnership MBCx program and expands it further by embracing a comprehensive whole building approach to include retrofits and all BRO measures, and by adding a pay for performance element.

According to a report by the Lawrence-Berkeley National Laboratory, "Monitoring based commissioning (MBCx) combines ongoing building energy system monitoring with standard retro-commissioning (RCx) practices with the aim of providing substantial, persistent, energy savings."[23] It contains a sophisticated package of software applications that combines building data from a wide variety of sources to better manage building performance and efficiency.

MBCx involves the implementation of energy efficiency improvement measures along with ongoing service and insights necessary for full transparency, measurement, and reporting for savings persistence. When MBCx is built into a continuous building improvement process, it allows combined technologies involved in data mining to identify faults or issues in building systems with the necessary human analysis to determine how to address those faults or issues. Truly advanced MBCx solutions could also help identify and prioritize resolution paths. For example, if there is simultaneous heating and cooling in an air handler, facility engineers would investigate a leaking chilled water valve to avoid a potential costly expenditure.

### *Maintenance Plan*

Building maintenance is an important part of the MPBR program. Through the MBCx component, MPBR is a comprehensive business process to improve the way buildings are maintained by using the technology installed through the program as an enabler to ensure energy savings are realized and persist.

Participants will be required to commit to a maintenance plan for a minimum of three years in order to receive incentives. SoCalGas will request that the customer maintain a maintenance log in the case of building maintenance performed by internal staff. In addition, SoCalGas will request that the customer maintain a database of energy consumption as measured by the sub-meters for up to three years. SoCalGas intends to be actively involved in verifying and monitoring corrective actions during the three

[23] Assessment of the Whole Buildings Savings Verification Approach in the University of California Monitoring-Based Commissioning Program. Quantum Energy Services & Technologies, Inc. April 3, 2015. http://www.ucop.edu/facilities-management-services/_files/whole_building_study.pdf

year period following implementation so this data will be used by the IOUs to verify persistence of energy savings over time.

As maintenance practices and gaps therein are unique to each campus and project, SoCalGas will document through the CMPA process any extraordinary maintenance practices and the impact of retrofit and BRO measures expected thereupon.

### *Training Plan*

MBCx by its nature involves educating building owners and operators with the failures of their building to provide human comfort in an energy efficient manner. In absence of the commissioning investigation and intervention, buildings would continue to function, albeit while consuming more energy than is necessary. Commissioning agents documenting and debriefing the customer on what measures were identified and implemented provides training to the customer about their building(s), and what measures the building operator can turn to in the future if a building drifts away from its restored efficient status. Similarly, the investigation with the IOUs and energy engineers into energy efficient retrofits is a training process where the customer learns of the energy efficient options for their buildings**.** Part of the scope of this program will include commissioning assistance focused on training in-house staff, which along with the permanent monitoring capability, will increase persistence of savings. In addition, SoCalGas will engage with program participants throughout the initial year to monitor performance and provide feedback to customers.

### *Program Development*

After the SoCalGas MPBR program has been implemented, SoCalGas will evaluate the effectiveness of the MPBR Program and its innovative approach in achieving cost-effective long term persistent energy savings in public sector existing buildings. Should the approach be determined viable, the data could inform an expansion of the MPBR Program to other public sector customers. At that point, the program will work to identify other buildings at other campuses that are also of a vintage and in a condition where they would benefit from a comprehensive, whole building approach. The lessons learned from these first three projects will inform a larger effort to identify potential buildings at other campuses (of similar vintage and condition that have otherwise remained stranded outside of participation in the current EE programs).

## SECTION 5: INCENTIVE STRUCTURE

The MPBR Program will utilize a hybrid, performance-based incentive approach. Upon execution of an agreement, customers that commit to a MPBR project portfolio will be informed of their eligible incentives:

1. **Performance Period I Incentive[24], [25]**
   Customers who participate in the MPBR program are eligible to receive a standard up-front payment at $1.00 per therm based on projected gross savings from existing conditions. These payments will be based on at least three consecutive months (not including January or July) of pre-implementation historical baseline and post-implementation whole-building energy trends.[26] The maximum first incentive payment may not exceed 50% of the project costs.

2. **Performance Period II Incentive**
   One year after project installation, the energy consumption trend data will again be compared to the historical baseline data to determine the persistence of energy savings. The confirmed normalized gross savings from existing conditions will be incentivized post 12 months at $1.50 per therm. The maximum incentives available to each project (Performance Period I and II combined) will be capped at 80% of the customer's project costs.

Once the post measurement has been conducted evaluated and verified, SoCalGas would only pay for incentives on energy savings materialized. If after verification SCG finds that some energy savings did not materialize that were paid out in performance period 1 it would be netted out from the post-Performance Period II payment, thus ensuring all financial risks are mitigated.

***Payment Process***

Customer will receive the first incentive at the "Estimate Phase" upon the completion of the project, and then after the post implementation baseline has been collected and the savings projection has been calculated (Performance Period I). One year later the consumption data will be compared to the pre implementation baseline; savings will be calculated using this data set. The customer will be paid for the savings that have been proven to be persistent. Furthermore, if the savings level is higher or lower than what was realized at Performance Period I, the customer's Performance Period II incentive payment will be adjusted to true up the incentives with the realized savings after one year of performance.

[24] Deemed savings will not be used as a basis for upfront incentives.

[25] The Basis for this upfront incentive is to assist customers overcome the capital burden of bringing very old and below code buildings to become more efficient and provide long term energy savings that will have significant impacts on the state environmental goals as well as alleviate grid constraints by reducing energy load.

[26] This model of three months pre- and post-data has been independently verified as an acceptable building energy consumption model for sub metered buildings on California university campuses. As reported in the Assessment of the Whole Buildings Savings Verification Approach in the University of California Monitoring-Based Commissioning Program. Quantum Energy Services & Technologies, Inc. April 3, 2015. http://www.ucop.edu/facilities-management-services/_files/whole_building_study.pdf and Monitoring-Based Commissioning: Benchmarking Analysis of 24 UC/CSU/IOU Projects, Lawrence Berkeley National Laboratory, June 2009. http://evanmills.lbl.gov/pubs/pdf/MBCx-LBNL.pdf

## SECTION 6: MEASURE TREATMENT

The MPBR Program offers the fullest range of measures available without limitation including all retrofit, behavioral, commissioning and operational measures. Energy savings performance will be evaluated at the whole building level from existing conditions. Distinction between below and above code will be differentiated by the creation of a building energy model by IOU engineers as needed.

MPBR fits within the recently published "Staff White Paper on Energy Efficiency Baselines" framework identified for "Types of Programs for Which existing Conditions Baseline is Appropriate," namely the NMEC and BRO programs. Both of which are key elements of MPBR. As such, individual measure accounting is not required. However, typical measures will include any combination of retrofit, commissioning, behavioral or operational measures that customers want to pursue as part of their whole building projects. For reference a representative, non-comprehensive list of the commissioning type measures is included below. The list below is not an exhaustive list of measures, but an example. Other commissioning measures could also apply, for instance any variety of retrofit, behavioral, and operational optimization measures are anticipated.

Example List of Possible Measures:

- Scheduled Loads
    - Equipment Scheduling: Time of Day
    - Equipment Scheduling: Optimum Start-Stop
    - Equipment Scheduling: Lighting Controls
- Economizer/Outside Air Loads
    - Economizer Operation: Inadequate Free Cooling
    - Over-Ventilation
    - Demand Controlled Ventilation
- Control Problems
    - Simultaneous Heating and Cooling
    - Sensor/Thermostat Calibration and/or Optimal Relocation
    - Hunting and Loop Tuning
    - Damper/Valve Actuator Calibration
    - Zone Rebalancing
- Controls: Setpoint Changes
    - Duct Static Pressure Setpoint
    - Piping Differential Pressure Setpoint
    - Reduction of VAV Box Minimum Setpoint
    - Implementation/Adjustment of Heating/Cooling, and Occupied/Unoccupied Space Temperature Setpoints
- Controls: Reset Schedules
    - HW Supply Temperature Reset or HW Plant Scheduling
    - CHW Supply Temperature Reset

  - CW Supply Reset for Chiller Efficiency Optimization (for Newer VFD Chillers)
  - Supply Air Temperature Reset: Cooling and Heating
  - Duct Static Pressure Reset
- Equipment Efficiency Improvements / Load Reduction
  - De-Lamping of Over-Lit Spaces
  - Pump Discharge Throttled, Over-Pumping, and Low Delta T–Trim Impeller
- Variable Frequency Drives (VFDs) or Variable Speed Drives (VSD)
  - VFD/VSD Retrofit - Fans
  - VFD/VSD Retrofit - Pumps
- Equipment Maintenance
  - Leaking Valves (hot water or chilled water valves)
  - Actuator / Damper Operation

***Measure Costs and Capital Burden***

Consistent with AB 802 and the adopted HOPPs framework, the MBPR Program pays an incentive rate based on achieved savings according to the structure described in Section 5 of the Advice Letter. There is an initial payment based on analysis of energy use data 3 months after the measures have been installed, and a true-up payment after analysis of the energy use data 12 months after the measures were installed. The initial incentive rate is $1.00 per therm saved and payments are capped at 50% of the project costs. The final incentive rate is $1.50 per therm saved and payments are capped at 80% of project costs. SCG/ratepayer will cover the incentive payment costs.
The customer will bear the costs for the installed measures. These costs include materials and labor for new efficient equipment installations (chillers, boilers, HVAC units, lighting, etc.) and their commissioning, and add-on equipment (such as variable speed drives, and new controls that enable efficient control strategies) and project management. For RCx measures, it is anticipated that these costs will consist mainly of controls system programming, and some minor additions of control system hardware, such as additional temperature and pressure sensors, and similar devices. The MPBR program is specifically targeting buildings that would otherwise not be considered for an energy efficiency project due to lack of priority (Social and Behavioral Sciences Building not scheduled to receive any funding for renovations until 2020/2021),[27] or would continue running inefficiently until funds for renovation were finally acquired (South Hall currently has no funding for significant reservations, and the funding that was slated for 2019-2020[28] was deferred once again to 2020-2021[29]). Furthermore, the upgrades

[27] CSU 2016-2017 Capital Outlay Program – Capital Improvement Plan 2016/2017 through 2020/2021, page 44, http://www.calstate.edu/cpdc/Facilities_Planning/documents/2016-17through2020-21CIP.pdf
[28] UC Capital Financial Plan 2014-2024, page 54, http://regents.universityofcalifornia.edu/regmeet/nov14/gb2attach.pdf
[29] UC Capital Financial Plan 2015-2016, page 48, http://regents.universityofcalifornia.edu/regmeet/nov15/gb1attach.pdf

proposed for many of these buildings, when they receive funding, are to bring the building up to: "meet health, safety and other code issues."[30]

SoCalGas intends to overcome initial capital cost barriers associated with installed measures by offering higher incentive rates though its hybrid approach phasing the traditional up-front post-installation incentive payment customers are familiar with to the designed performance based incentive payment. Non-resource benefits aiding in preliminary development and identification such as facility audits, technical assistance, and energy efficiency education related to retrofits, performance tracking and savings persistence will also be offered to reduce uncertainty in capital cost investment.

The customer may solicit service providers or use internal staff to perform the work, which includes building systems investigations, measure identification, business case development (savings and cost estimation) and assessment, and work with contractors to assure measures are properly installed. Both internal personnel and service provider costs are borne by the customer.

***Minimum Measure Guidelines***

MBCx and retrofits have been separately successful in delivering energy savings. Allowing the customer to pursue energy efficiency projects on a whole building level rather than in separate efforts (individual measure replacement) will bring synergy to efficiency efforts. Customers will be able to streamline project implementation timelines by combining formerly separate EE programs and focus on comprehensive energy efficiency at a building level rather than at the measure level.

Although not clearly stated, the objective will be to incorporate deep retrofits and will require that multiple measures be implemented per project. However, SCG is cognizant of capital constraints and will work with each program participant to ensure that is able to upgrade as much as possible in an effort to achieve the highest cost benefits in energy reductions and project cost effectiveness.

[30] CSU 2016-2017 Capital Outlay Program – Capital Improvement Plan 2016/2017 through 2020/2021, page 46, http://www.calstate.edu/cpdc/Facilities_Planning/documents/2016-17through2020-21CIP.pdf

# ATTACHMENT B

# Advice No. 4956-A

# Evaluation, Measurement & Verification (EM&V) Plan

**Attachment B**

**Evaluation, Measurement & Verification (EM&V) Plan**

## A. Savings Calculations General Method

A whole building approach, described as Option C Whole Facility of the industry-standard IPMVP[1] will be employed to determine the natural gas savings for each participant, and for the program. Under Option C, a measurement boundary is drawn around the whole facility, and data from all of the facility's energy meters is used to determine the energy savings. Option C determines the collective savings from all measures implemented in the treated facility, and is most appropriate given the characteristics of the target market and M&V protocol of this program where:

- Baseline meter data is available to establish a facility's baseline energy performance.
- The expected savings could exceed 10% and is large in comparison with the random or unexplained variation in the energy use data.
- No significant changes to the facility are expected before or after program intervention, such as major renovations, addition or removal of new loads, and so on.
- There is a reasonable correlation between energy consumption and routine (independent) variables.
- Non-routine adjustments can be made to account for unexpected changes, as necessary.

Regression-based energy models may be used to describe how selected parameters such as weather, operation schedule, and occupancy rate 'explain' the change in baseline period energy use. Typically, the parameters with the most explanatory power for energy use in a facility are used. While these models do not explain all energy use variations, if the savings are large in comparison, then the determination of savings is more reliable.

University campuses are typically master metered – one meter for the entire campus. The MBCx process allows for installation of energy meters on individual campus buildings. Campuses often have central plants that generate hot water or steam, and chilled water, and distribute it to individual buildings. Thus, five types of campus building whole facility data are expected from building meters: natural gas, electric, hot water, steam, and chilled water energy use data measured in short-time intervals. We will refer to this data as "short time energy monitoring" data or "STEM data." STEM data may be modeled using advanced regression techniques that generally exhibit a degree of serial correlation. The M&V analysis of data using different measurement

[1] International Performance Measurement and Verification Protocol (IPMVP), 2012, or IPMVP Core Concepts, 2014, available from the Efficiency Valuation Organization (EVO), at www.evo-world.org.

frequencies is discussed in ASHRAE Guideline 14 Measurement of Energy, Demand, and Water Savings, 2014.[2] ASHRAE Guideline 14 is a more technically detailed guideline than IPMVP. Therefore, concepts and formulas from ASHRAE Guideline 14 will be used in the estimation of savings and uncertainties for this program.

The most recent evaluation work for the UC/CSU/IOU partnership's MBCx program identified and discussed a number of issues regarding use of regression analysis for savings determination. These recommendations were examined in the Whole Building Study published last year.[3] Several of these recommendations have been incorporated into the MPBR program. For a full discussion, please see Appendix 2.

The EM&V Plan describes the methods employed to determine gross savings for natural gas, hot water, or chilled water, depending on the building's energy sources. Natural gas savings will be determined directly for buildings that have natural gas equipment and supply. For cases when absorption chillers use heat generated by steam or hot water boilers to generate chilled water, natural gas savings will be determined from the chilled water savings determined at the building level and applying the energy conversion factors for upstream equipment (central plant absorption chillers and boilers). Similarly, for hot water energy savings determined at the building, the natural gas savings will be determined by applying conversion factors of upstream equipment (central plant boilers).

## B. Data Collection Strategy

Required Energy Data

The required energy data to be used in the whole building approach spans the baseline, installation, and post-installation periods. STEM data from the building meters may be set up to provide data in various intervals. Hourly or daily time intervals are the preferred analysis time interval for the method described below. Data in shorter time intervals will be added up to the preferred analysis time interval.

Twelve (12) months of STEM data will be collected for the period prior to the installation of the program measures; this is referred to as the baseline period. The same data will be collected for the 36 month period following confirmation of measure installation and commissioning; the first 12 months of which is the reporting period. An additional 24 months of data are required to report savings in the following two years. It is often the case that less than 12 months of STEM data will be available for the baseline period. In such cases, we will evaluate the accuracy of the models developed on a case-by-case basis.

[2] American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) Guideline 14, Measurement of Energy,Demand, and Water Savings, 2014. Available at www.ashrae.org.
[3] http://www.ucop.edu/facilities-management-services/_files/whole_building_study.pdf

Data Quality

The quality of data will be evaluated to ensure data collected is continuous and accurate. Except for some natural gas meters, none of the meters are revenue grade utility meters. BTU meters simultaneously monitor water flow and temperature differences between incoming and returning water streams. Steam condensate meters are typically used. Each of these meters has a higher potential for error, and their data streams will be examined for accuracy. Calibration records will be requested, and in some cases, re-calibration of meters may be required. The collected data will be reviewed to assure there is enough acceptable continuous data to complete the defined analysis procedures. Buildings with STEM data that have an excessive number of outliers and missing data will be flagged, and may require additional data collection to meet the twelve months of continuous data requirement during the baseline and reporting period.

Independent Variables

Gas use in university buildings is primarily for space heating and hot water generation. As described above, sometimes absorption chillers provide chilled water to university buildings. The influencing parameters expected to explain natural gas use are therefore ambient weather conditions which drive space heating and cooling energy use, hot water use, building occupancy, and building operation schedule.

- Ambient weather data from a local weather station will be collected and checked for outliers and gaps.
- If a building has data on domestic hot water use, it will be collected and verified.
- Different university buildings have different schedules of use and occupancies. It is rare to find reliable “head count” data at the same analysis time interval as the energy use data, however it will be collected and verified if available.
- Building occupancy schedules will be used to develop the models. Since occupancy rates are different during occupied and unoccupied periods, a model based on occupied periods and a model based on unoccupied periods may be developed. Such daily operation schedules are determined by the energy use patterns. Schedules may be consistent throughout the year, or may vary by semester or season. These are modeling techniques that have been demonstrated in past MBCx projects.[4]

## C. Calculations, Regression Models, and Description of Normalization

The following methodology describes the use of hourly or daily interval data when developing whole building energy models. To estimate gross savings for each customer using their STEM data, a regression model using up to 12 months of energy use data, and corresponding ambient dry-bulb temperature (T) and other independent variable data will be developed. The model and its variables will be checked for

[4] Cite previous ACEEE reports, or MBCx reports.

explanatory power and accuracy. Should the model be unsatisfactory, the input parameters will be adjusted and the regression process repeated until a valid regression model is achieved. Regression parameters that may be adjusted include adding or removing additional independent variables, switching from hourly to daily time intervals, and modeling building occupied and unoccupied periods separately. When a valid and accurate regression model has been developed, the selected measures may be installed. After 12 months of post-installation reporting period data is collected, the normalized metered energy use and savings are determined. Program gross savings are determined from the cumulative sum of savings from all participants. The following provides a detailed step-by-step procedure of this analysis.

An advanced regression modeling algorithm developed by Lawrence Berkeley National Laboratory will be used to develop energy models for this program. A detailed description of this model is provided in Appendix 1. It may be used for natural gas, hot water, steam, or chilled water use.

**Step 1**. Fit a time-of-week and temperature model using the baseline period energy and dry-bulb temperature for each HOPP customer. The model is shown in equation (1). Note that this model accounts for occupancy internally by flagging occupied and unoccupied time periods and creating separate regression coefficients for these periods.

$\hat{E}_{o,b}(t_i, T(t_i), OV(t_i)) = \alpha_i + \sum_{j=1}^{n} \beta_j T_{c,j}(t_i) + \sum_{j=1}^{n} \gamma_j OV_{c,j}(t_i)$, and

$\hat{E}_{u,b}(t_i, T(t_i), OV(t_i)) = \alpha_i + \beta_u T(t_i) + \gamma_u OV(t_i)$, and

$$\hat{E}_b = \sum_{i=1}^{n} \left(\hat{E}_{o,b} - \hat{E}_{u,b}\right) \quad (1)$$

Where:

The coefficients, $\alpha_i$ and $\beta_i$ are the regression coefficients for the time indicator, temperature and other variables t, T, and OV, respectively, and
$\hat{E}_{o,b}$, $\hat{E}_{u,b}$, and $\hat{E}_b$ are the occupied, unoccupied, and total baseline energy use, respectively.

The model coefficients may be determined using the Python or R programs or the M&V analysis module in PG&E's Universal Translator, version 3, as described in Appendix 1. Due to their extensive number of components and coefficients, it is impractical to provide these models in spreadsheets.

Calculate the model goodness-of-fit and accuracy metrics CV(RMSE) and mean bias error (MBE) using equations (2) and (3) to determine whether the model can be improved.

$$CV(RMSE) = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(E_i - \hat{E}_i)^2}}{\bar{E}} \quad (2)$$

$$MBE = \frac{1}{n}\sum_{i=1}^{n}(E_i - \hat{E}_i) \quad (3)$$

Good values of CV(RMSE) and MBE are as low as possible. For daily gas models, good values of CV(RMSE) are about 10%, and the absolute value of MBE less than 1% (MBE can be negative). If the values are too high and not acceptable, repeat the regression after adjusting input parameters or by eliminating the extraneous variables. Record the metrics CV(RMSE) and MBE.

**Step 2**. After 12 months of reporting period data has been collected, fit a time-of-week and temperature model, using the reporting period energy and dry-bulb temperature from the reporting period for each HOPP customer.

$\hat{E}_{o,r}(t_i, T(t_i), OV(t_i)) = \alpha_i + \sum_{j=1}^{n}\beta_j T_{c,j}(t_i) + \sum_{j=1}^{n}\gamma_j OV_{c,j}(t_i)$, and

$\hat{E}_{u,r}(t_i, T(t_i), OV(t_i)) = \alpha_i + \beta_u T(t_i) + \gamma_u OV(t_i)$, and

$$\hat{E}_r = \sum_{i=1}^{m}(\hat{E}_{o,r} - \hat{E}_{u,r}) \quad (4)$$

Where:

The coefficients, $\alpha_i$ and $\beta_i$ are the regression coefficients for the time indicator, temperature and other variables t, T, and OV, respectively, and
$\hat{E}_{o,r}$, $\hat{E}_{u,r}$, and $\hat{E}_r$ are the occupied, unoccupied, and total reporting period energy use, respectively.

**Step 3**. Normalize the baseline period and reporting period energy use models to typical meteorological year (TMY) weather data. Use the TMY data set for the building's climate zone. This is accomplished by inputting the TMY data from the reporting period year into the baseline and the reporting period models.

**Step 4**. Calculate the savings by subtracting the normalized reporting period energy use from the normalized baseline period energy use. Calculate the savings uncertainty using equation 5 below, which is from ASHRAE Guideline 14-2014 for weather-dependent models with correlated residuals.

$\Delta E_{save} = \sqrt{(\Delta\hat{E}_{b,norm})^2 + (\Delta\hat{E}_{r,norm})^2}$, where

$\Delta\hat{E}_{b,norm} = 1.26t_{(1-\alpha)/2,n'-p}\frac{E_{b,g}}{E_{b,n}}\sqrt{MSE\left(1+\frac{2}{n'}\right)g}$, and

$$\Delta\hat{E}_{r,norm} = 1.26t_{(1-\alpha)/2,m'-p}\frac{E_{r,g}}{E_{r,m}}\sqrt{MSE\left(1+\frac{2}{m'}\right)g} \quad (5)$$

Where:

| | | |
|---|---|---|
| n = | | number of points in baseline period |
| m = | | number of points in reporting period |
| g = | | number of points in typical year |
| n' = | | n × (1-ρ)/(1+ρ) |
| m' = | | m × (1-ρ)/(1+ρ) |
| ρ = | | autocorrelation coefficient, see ASHRAE Guideline 14-2014. |
| p = | | number of parameters in the baseline or reporting period regression models |
| $t_{(1-\alpha)/2,n-p}$ = | | 100(1-α)/2 percentage point of a t-distribution with n-p degrees of freedom (see Table 1, this specifies the confidence interval) |

$MSE = \frac{1}{n-p}\sum_{i=1}^{n}\left(E_i - \hat{E}_i\right)^2$, the mean squared error of the regression model

| | |
|---|---|
| $\bar{E}_{b,n}$= | mean energy use per period in the baseline period |
| $\bar{E}_{b,g}$ = | mean of the predicted normalized baseline energy use in the typical year, i.e., $\hat{E}_{b,g}/g$ |

Selected values of student's t-statistic are shown in Table 1 for various confidence intervals and values of n – p (degrees of freedom). Note that for hourly models and a year of baseline data, n = 8760. The number of parameters in the TTOW model will be on the order of 168 (hours of week) + 10 (temperature segments) ≈ 190. This means that n – p is very large. For daily models, n= 365. The number of parameters is 7 (days per week) + 6 (temperature segments) ≈ 13, and n – p is still large. We use the n – p = ∞ row from Table 1 by convention.

**Table 1. Selected t-statistics.**

| | Confidence | | | |
|---|---|---|---|---|
| n-p | 68% | 80% | 90% | 95% |
| 5 | 1.00 | 1.48 | 2.02 | 2.57 |
| 10 | 1.00 | 1.37 | 1.81 | 2.23 |
| 15 | 1.00 | 1.34 | 1.75 | 2.13 |
| 20 | 1.00 | 1.33 | 1.73 | 2.09 |
| 25 | 1.00 | 1.32 | 1.71 | 2.06 |
| Infinite | 1.00 | 1.28 | 1.65 | 1.96 |

To be discernable for each building, the savings uncertainty should not exceed half of the estimated savings amount, expressed as a percentage of annual energy use. This means that the savings uncertainty should not be more than 50% of the estimated savings, a large value which we anticipate the projects will not approach. We will record the savings uncertainty for each HOPP customer.

Once the building's gross savings for natural gas, hot water, steam, or chilled water is determined with the above method, the conversion factors for central plant equipment will be applied to determine actual natural gas savings for each building. For hot water and steam savings, the boiler conversion efficiency will be used to determine gross natural gas savings. For chilled water served by central plant absorption chillers, the absorption chiller efficiency, and the upstream boiler efficiency will both be applied to determine gross natural gas savings.

Program Savings

Program savings will be reported as the total gross normalized natural gas savings achieved from each participating building. Gross normalized savings will be reported for each project in each of the post-implementation reporting years. The following equations will be used to sum up the total gross savings for this program each year.

$$E_{tot} = \sum_{i=1}^{PY} E_{sav,i}$$

$$\Delta E_{sav,tot} = \sqrt{\sum_{i=1}^{PY} \Delta E_{sav,i}^{\;2}}$$

Where:

$E_{sav,i}$ = annual normalized energy savings for customer i

$\Delta E_{sav,i}$ = annual normalized savings uncertainty for customer i

*PY* = total number of completed projects in current reporting year

Absolute Changes Expressed with a Common Denominator

For each building, the baseline period annual energy use for natural gas will be summed to determine the total annual use without adjustments. When natural gas is used to generate hot water, steam, or chilled water for the building, the same conversion factors described above will be used to determine the natural gas use. Energy use intensities (EUIs) will be determined by dividing by the building's square footage. This process will be repeated using the annual reporting period energy use to determine the post-installation energy use intensity for natural gas. The differences between baseline and reporting period energy use and energy use intensity will be determined. All values will be recorded and used in the program evaluation.

Non-Routine Adjustments

When unexpected or one-time changes occur during the reporting period, non-routine adjustments to the energy savings must be made. Unexpected changes include static factors which are not usually expected to change, examples include:

- Changes to building size
- Additions of heating and cooling loads in the building
- Addition of load such as computers or data processing equipment

The baseline conditions of these static factors need to be fully documented during the baseline period, and continually monitored for change throughout the reporting period, so that changes can be identified and proper non-routine adjustments made. The tracking of conditions may be performed by the building owner, a program M&V contractor, or the program's implementer. Engineering calculations will be used to quantify the energy impact from such changes using retrofit isolation techniques, and used to adjust the meter-based energy savings. To the degree possible, energy impacts from non-routine events will be calculated based on actual measurements.

<u>Persistence</u>
Energy savings can be tracked at 12 months, 24 months, and 36 months after measures are installed to ensure savings persist throughout and beyond the reporting period. At each time interval, calculate the energy savings and evaluate savings persistence with the following steps:

1. Calculate the Adjusted Baseline Energy Use with equation (1) for interval data analysis, using ambient temperatures from the reporting period.
2. Calculate the Actual Reporting Period Energy Use over the 12, 24, or 36 month reporting period directly from metered data.
3. Energy savings at the specific time interval is the difference between the Adjusted Baseline Energy Use and the Actual Reporting Period Energy Use.
4. Chart the Adjusted Baseline Energy Use and the Actual Energy Use each day, week, or month to determine if savings are accruing properly or whether non-routine events (NRE) have taken place.
5. If evidence exists that an NRE has occurred, alert the program team to investigate. See the Non-Routine Adjustment section for procedures to calculate the impact of the non-routine event.

<u>Program Actions Intended to Drive Savings</u>
MBCx, RCx, and retrofits are acknowledged and fairly well-documented actions and that in combination with the new performance-based incentive, we believe will drive savings here, per Requirement 1b. The MPBR program planned comprehensive multi-measure whole building approach in which retrofits, behavioral, commissioning and operational optimization measures are delivered within a single project and measured with NMEC are not allowed under current policy. The MPBR program will utilize this newly authorized approach under AB802 HOPPS. UC and CSU do have history with MBCx, but that has only been able to address a fraction of the potential of the program as evidenced by the enormous outstanding deferred maintenance and renewal backlog. For example, UC alone has over $4.4B of backlog (include table below) and much of this is tied to energy consuming infrastructure. This new whole building MPBR approach will facilitate the Universities efforts to scale and go after this stranded potential. Table 1 below contains documentation of this backlog.

**Table 1. UC Deferred Maintenance Backlog**

| | |
|---|---|
| **UC Deferred Maintenance Backlog** | |
| **4/29/2016** | |
| | |
| | |
| **Campus** | **Identified Deferred Maintenance*** |
| UC Berkeley | $545 million** |
| UC Davis | $1.16 billion |
| UC Irvine | $450 million |
| UC Los Angeles | $770 million |
| UC Merced | $20 million |
| UC Riverside | $200 million |
| UC San Diego | $300 million*** |
| UC San Francisco | $457 million |
| UC Santa Barbara | $415 million |
| UC Santa Cruz | $160 million |
| **TOTAL** | **$4.47 billion** |
| | |
| * Total Deferred Maintenance need identified in the 2015-25 UC Capital Financial Plan, unless otherwise indicated (http://www.ucop.edu/capital-planning/_files/capital/201525/2015-25-capital-financial-plan.pdf) | |
| ** Deferred Maintenance Planned in 2015-25 UC Capital Financial Plan, but may not represent the total amount of deferred maintenance at UCB | |
| *** from UCSD Facilities Management website: http://blink.ucsd.edu/sponsor /facilities-mgmt/faq.html#How-are-maintenance-and-repair- | |

### Threshold for Expected Savings

As described in the Savings Calculation section above, the threshold for savings depends upon multiple factors: the amount of anticipated savings expected from the project, the accuracy of the baseline and post-installation models used to calculate savings, the number of monitoring points in the baseline and reporting periods, and the confidence level at which savings uncertainty is reported. These factors combine to provide an estimate of the savings uncertainty for each project. Discernable savings requires that the maximum allowable savings uncertainty be 50% of the reported savings, however this level of uncertainty is certainly too high for stakeholders. The lower the uncertainty the better. With this proposed gross savings approach, we will be able to establish acceptable levels of uncertainty at the project level, as well as for the population of program participants.

This methodology will enable evaluation of typical rules of thumb that are used to establish a threshold for savings, such as a requiring a minimum of 10 to 15% savings on annual energy use when using Option C methods with monthly data.

### F. Baseline Adjustments

Baseline adjustments are categorized as routine and non-routine. Routine adjustments to energy use are due to regular and expected changes in influential parameters. In many buildings, these parameters include ambient weather conditions, production rate, and operating schedule. Data for these parameters are collected and used to establish regression-based energy models that describe how baseline or reporting period energy use are adjusted so that savings may be calculated for a common set of conditions. This is the basis for the AMI data modeling approaches described in the savings calculation section.

<u>Baseline Assumptions</u>
The following is a list of the assumptions used to develop baseline energy models. Additional assumptions have been documented in Section C.

i) The data we collect and use in development of the STEM energy models will be appropriate and have sufficient influence on each building's energy use.
ii) Building operating schedules are available from facility managers or are detectable from the building data. Concurrent data for weather (ambient dry bulb and humidity, etc.) may be collected for the entire baseline and post-installation periods.
iii) Natural gas, hot water, steam, and chilled water energy use in university buildings may be accurately modeled using the STEM data and methods described in Section C.

### G. Net-to-Gross Adjustment for Net Energy Savings

The above energy savings calculation and methodology will derive the HOPP's gross energy savings. The proposed M&V protocol will go one step further to collect NTG data using a generally accepted NTG survey instrument at end of project installation.[5] The benefit of this approach is timely free-ridership data collection before either memory or personnel changes. This survey instrument will be designed to look at the degree of free-ridership for each measure individually as well as in aggregate per project. The project will adopt generally applied survey design and methodology used by Energy Division and consultants. SoCalGas understands that CPUC is planning to conduct

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[5] The survey instrument will be developed following the framework in the California Public Utilities Commission Energy Division's "Methodological Framework for Using the Self-Report Approach to Estimating Net-to-Gross Ratios for Nonresidential Customers," prepared by the non-residential working group, dated Oct. 16, 2012.

additional independent impact evaluation to verify the reported gross and net energy savings.

While the ALJ HOPP ruling did not require that the program's net savings claim account only for savings from measures that exceed California's energy code requirements, a method for such accounting may be explored in this program. For each capital expense retrofit or upgrade measure recommended in a building, a business case that describes the measure and its costs and benefits (energy savings) will be developed prior to implementation. For each measure recommended, and subject to CA Title 24 requirements, engineering calculations will be used to estimate the total savings, and the to-code and above-code components. If directed by CPUC, an algorithm will be developed to determine net savings from each building's gross savings as defined in Section C, and each individual installed measure's estimates of to-code and above-code savings. A similar algorithm will be developed for estimating the projects incremental measure cost. The estimated useful life of each project will be determined from a weighted sum of individual useful lives of each installed measure, using that measures savings as the weighting factor.

## Appendix 1

## Description of the LBNL Temperature and Time-of-Week Model

The following description includes paraphrased descriptions of the temperature and time-of-week model (TTOW model). For a more comprehensive description of the modeling algorithm, please consult the publication by Matthieu, et. al.[6]

- A building's energy use (natural gas use, hot water, steam, or chilled water, as well as electricity) is generally a function of ambient temperature and the time of week. In some cases, additional parameters influence energy use in buildings, such as humidity and a production variable. The TTOW model may include independent variables in addition to the time-of-week and temperature, if their data are provided in concurrent time intervals (such as hourly or daily time intervals). As the dominant influencing parameters for building energy use is the schedule of operation and ambient temperature, this model description focuses on the use of these parameters. The following discussion uses electric kWh as the energy data, however it applies equally well for other energy sources.
- The time-of-week parameter is modeled as an indicator variable. This allows some flexibility to define this parameter according to the time-interval of the data. Electric energy use data (kWh) from advanced metering systems is typically available in 15-minute intervals, ambient temperature data from weather stations are typically available in hourly intervals. Natural gas energy use data (therms) from advanced metering systems is also available in hourly time intervals from SoCalGas. Therefore, the time intervals used in the TTOW models will be hourly, and models based on daily time intervals will be used if more accurate models are needed. The following description assumes hourly time intervals, but also applies for daily time intervals.
- Each week is divided into hourly intervals (indexed by i), with the first interval from midnight to 1 am Monday morning, the second from 1 am to 2 am, and so on for the 168 hours each week (7 for daily time intervals). A different regression coefficient for each time of week indicator variable, $\alpha_I$, allows each time-of-week to have a different predicted load.
- Energy response to temperature in a building is non-linear but may be modeled as continuous and piecewise linear. At low temperatures, electric energy use may increase as temperatures lower due to more use of heating system equipment such as pumps, fans, and electric heating elements. In moderate temperatures, the building does not require heating and cooling and therefore energy use is not sensitive to temperature. At warm temperatures, energy use increases with increasing temperature due to use of cooling system equipment. At the highest

[6] Matthieu, J.L., P.N. Price, S. Kiliccote, and M.A. Piette, "Quantifying Changes in Building Electricity Use, With Application to Demand Response," IEEE Transactions on Smart Grid, 2:507-518, 2011.

temperatures, energy use may again be insensitive to temperature as cooling equipment has reached its maximum load. There may be multiple regimes of energy response to temperature.

- For natural gas use in multi-family buildings, we expect high gas use at low ambient temperatures, with use decreasing as temperature warm. At some point, space heating is no longer required, and the only use for gas is for water heating, which is expected to have a milder relationship with ambient temperature. We therefore also expect multiple regimes for natural gas use, though they are likely fewer than for electric use.
- The piecewise linear and continuous temperature at time $t$, $T(t_i)$ (which occurs at time of week interval $i$) is broken down into a number of component temperatures, $T_{c.j}(t_i)$, with $j$ = 1 to $n_s$ ($n_s$ being the number of line segments, usually no more than 10 to avoid overfitting). Each $T_{c.j}(t_i)$ is multiplied by $\beta_j$ and then summed to determine the temperature dependent load.
- Boundary values of the temperature segments are defined by $B_k$ ($k = 1 \ldots n_s$-1). And component temperatures are determined with the following algorithm (assuming $n_s$ = 6):
  - If $T(t_i) > B_1$, then $T_{c,1}(t_i) = B_1$. Otherwise, $T_{c,1}(t_i) = T(t_i)$ and $T_{c,m}(t_i) = 0$ for $m = 2 \ldots 6$ and algorithm is ended.
  - For $n = 2 \ldots 4$, if $T(t_i) > B_n$, then $T_{c,n}(t_i) = B_n - B_{n-1}$. Otherwise, $T_{c,n}(t_i) = T(t_i) - B_{n-1}$ and $T_{c,m}(t_i) = 0$ for $m = (n + 1) \ldots 6$ and algorithm is ended.
  - If $T(t_i) > B_5$, then $T_{c,5}(t_i) = B_5 - B_4$ and $T_{c,6}(t_i) = T(t_i) - B_5$.
- The building is anticipated to have a different response to temperature in occupied periods versus unoccupied periods. The occupied load is estimated using the following equation:

$$\hat{E}_o(t_i, T(t_i)) = \alpha_i + \sum_{j=1}^{n} \beta_j T_{c,j}(t_i)$$

- Unoccupied loads are expected to have a single temperature parameter, since the building is expected to operate without sensitivity to temperature when systems are off during these periods. Unoccupied load is modeled with the following equation:

$$\hat{E}_u(t_i, T(t_i)) = \alpha_i + \beta_u T(t_i)$$

- The parameters $\alpha_i$, for $i$ = 1 to 168, $\beta_j$ for $j$ = 1 to n and $\beta_u$ are estimated using the data from the baseline and post-installation periods with ordinary least squares.
- The total energy use estimated by the model is the sum of the occupied and unoccupied terms for each time interval.

$$\hat{E} = \sum_{i=1}^{n} (\hat{E}_o - \hat{E}_u)$$

- The model produces residuals that are auto correlated and heteroscedastic, and the regression parameters $\alpha_i$ and $\beta_j$ are correlated. This means that the standard errors associated with each regression parameter underestimates their level of uncertainty.

However, uncertainty on the load predictions can be approximated with the standard error, which can be computed at each interval *i*.

- Two methods for implementing the TTOW model exist:
    1. This algorithm is available in Python programming language at the following link: https://pypi.python.org/pypi/loadshape/0.2.1. This includes an R program and a Python wrapper so that it can be called from within Python. The software allows the user to input streams of dates and time stamped energy use and ambient temperature data, manipulate parameters and develop linear regression models with time-of-week indicators and ambient temperature as independent variables. The software calculates the $\alpha_i$ and $\beta_j$ parameters according to the user-specified analysis time interval (e.g. hourly or daily) and number of line segments for the piecewise continuous temperature dependence. The Python and R programming environments are free to the public.

Under a California Energy Commission Public Energy Interest Research program grant, the TTOW model has been programmed as an analysis module in PG&E's Universal Translator version 3 software, available at no cost at the website www.utonline.org. The freely available software enables program administrators to prepare and develop M&V analysis, and allow technical reviewers to review the analysis for consistency, accuracy, and conformance with program and policy rules.

## Appendix 2

### MPBR Program: Addressing Work Order 33 Appendix G Evaluation Issues.

As described in Attachment A, the MPBR program draws its underlying monitoring and commissioning approach from the UC/CSU/IOU Partnership's MBCx program, which emphasizes permanent energy performance metering and trending. MBCx is over 10 years old and completed projects have been included in past program cycle evaluations. The most recent evaluation in 2014, termed Work Order 33 (WO33), included an Appendix G with section G.2 specifically discussing MBCx projects.

The section presents the gross savings results for the 10 sampled projects, and then provides a discussion of issues observed during the impact evaluation along with recommendations on ex-ante savings estimates may be improved for future MBCx projects. Many of these issues were addressed in the UC Office of the President and PG&E – sponsored Whole Building Study,[7] which was cited in Attachment A. In this appendix, we provide a review of these recommendations and describe how we have adapted the MPBR program to improve the gross savings estimation methodology. Our responses are provided in an issue-by-issue format below.

**Issue 1.** Gross natural gas savings estimates. WO33 showed that *evaluated* ex-post gross savings values in most cases were lower than their ex-ante estimates (which are technically ex-post savings estimates, as they are made after the installation, not before). No particular reason for lower qas savings was provided. We surmise, based on the additional issues raised in WO33 Appendix G, that there may have been problems with energy metering, the conversion of hot water to natural gas energy units, or with the M&V approach. The Whole Building Study, in its review of 20 UC Berkeley and UC Davis buildings, found inconsistent interpretation and application of the M&V approach, and recommended centralizing this activity to one skilled group rather than to the different service providers campuses may select. In this MPBR HOPP, SCG will centralize the gross savings analysis to one group who will apply a consistent methodology and quality assurance process to each participating building.

**Issue 2.** WO33 Appendix G describes on p. G-5 that an MBCx building is selected for evaluation typically one or two years after project completion. It cites that changes in building functional use and operations make it difficult to separate those impacts from the MBCx program impacts. It describes that this is often the case in science and technology buildings.

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[7] "Assessment of the Whole building Savings Verification Approach in the University of California Monitoring-Based Commissioning Program." Prepared by Quantum Energy Services & Technologies, Inc. (QuEST), April 3, 2015. Available at http://www.ucop.edu/facilities-management-services/_files/whole_building_study.pdf.

We note that the requirements of HOPPs for two years post-monitoring will enable such changes to be tracked from an energy perspective, enabling program administrators to notify campuses to address these issues. These types of changes are known as "non-routine adjustments" to energy use in M&V guidelines. Specific remedies and adjustments to baseline or post-installation period energy use depend on the nature of the non-routine event (NRE). NREs may be temporary or permanent, constant or varying. Detection (or notification by campuses) of NREs will trigger an investigation and a resolution will be proposed, carried out, and documented.

The Whole Building Study noted that laboratory buildings were in general more predictable than the other building types in the study. Buildings with high EUIs also tended to be more predictable. This is helpful in that we can be more assured that the regression models used to project what baseline energy use would have been under post-installation conditions will be more robust, and help in the identification of NREs, such as the additions of systems and equipment and processes that WO33 describes.

**Issue 3**. On p. G-4, WO33 described one of the biggest challenges to the evaluation process was the characterization of heating and cooling loads – that almost all of the science and technology buildings have significant process loads that are dynamic, non-weather sensitive, and subject to variation that cannot be controlled for in regression models based on outdoor temperature alone.

We note the Whole Building Study's response: "the presence of process loads does not disqualify application of the whole building approach, even if its regressions are based on outdoor air temperature alone. If the process loads are sporadic and highly variable, and significant in relation to whole building usage, these buildings should be screened from applying the whole building approach. Often however, the loads are constant, and while they raise the building's base load, they do not affect its variability which may still be explained by measureable independent variables. Again, this is a matter of screening and modeling assessment."

Other issues that WO33 Appendix G indicated has notable impacts on the gross realization rates of selected project are discussed below.

**Issue 4**. Validity of Ex-Ante Regression Model. WO33 Appendix G states that one of the major errors in the MBCx program is that rules do not prescribe the statistical parameters that need to be considered for any regression model, nor do they provide a quantitative threshold for statistical parameters, specifically citing R.[2] It goes on to state that if the statistical correlation of energy consumption with outside air conditions is insufficient, using the regression equation can propagate errors. It states that relying on models without good statistical precision may lead to inappropriate savings estimation. It recommends that regression guidelines should be developed and its requirements reviewed as part of the MBCx program process.

**Issue 5**. Regression Models with Outdoor Weather Conditions. WO33 Appendix G states that the evaluator did not find good regression correlation of building energy use with outdoor temperature in some cases. It is stated that the model based on three post period months can fall apart over extended periods. It recommended that the baseline and post trending periods should be extended to six months, and stated that its California Evaluator Protocols recommended twelve months for billing analysis.

SCG notes that its gross savings estimation methodology will use up to a year of baseline data when possible. The amount of data available depends on when buildings' meters are installed, calibrated, and operational. However, the most descriptive energy use patterns of the building may be the most recent months immediately prior to measure installations. We will assure that baseline data includes the time period whennatural gas is most used, whether for space heating through boilers and furnaces, or cooling through absorption chillers, if present. In the case of space and water heating, we anticipate that ambient weather conditions will be the most relevant independent variable, however, we will document the explanatory power of each variable used in each model. Since the HOPP framework is to monitor energy use over the next two years, we will have available all post-installation energy use data and not require shorter durations for the normalization process.

**Issue 6**. Adjusted Energy Use Baselines. This issue concerned adjustments to baseline energy caused by major changes in the building that called for modifying the baseline use after baseline models were established. It further described that these adjustments were often found to be in error. It recommended that more thorough data collection and analysis be done, that the whole building approach is not appropriate in all cases.

SCG agrees with this recommendation, and steps will be taken to assess the baseline regression models for NREs, identify their causes, and quantify impacts. Implementers will be required to collect more data and quantify the non-routine energy impacts, in order that they may be removed from the savings analysis. We will investigate potential methods and procedures for implementers to follow.

**Issue 7**. Negative Claimed Savings. WO33 Appendix G described negative savings occurring in a few cases that can be attributed to non-program induced changes or faulty energy modeling, and that because of the short three month baseline and post monitoring periods, these effects can be missed. It recommends that records of each measure and other events be recorded in order to verify that the work was done correctly, and to allow the evaluators to implement a retrofit isolation approach.

SCG agrees that measure installation dates should be recorded and further recommends that the EM&V gross savings method be expanded to first assess the meter based approach, examine factors that prevent it from proper implementation, if any, and then pursue an Option B or A method should the meter based approach prove untenable.

**Issue 8**. Retrofit measures implemented during and after MBCx. WO33 Appendix G stated that this situation was found frequently and created challenges in isolating MBCx from retrofit impacts. Similar to Issue 7, it recommended that a record of all changes to the building be kept and passed to evaluators.

SCG notes that for this program, the intent is to implement several measures of various types in the same time frame in order to achieve deep energy savings. SCG will track implementation start and finish dates of each measure. Implementers will also be tasked to perform diagnostic and functional tests before and after measure installation in order to show the improved and more efficient operation of the systems. These tests can be used in the future to verify that systems continue their efficient operation, or show that system performance has degraded, and should be remedied.

**Issue 9**. Recommended Changes Incompatible with Building Equipment. WO33 Appendix G cited discussions with building operators who said that constraints in their HVAC equipment prevented them from fully implementing recommended control sequences, and that manufacturer's recommendations for equipment operating procedures prevented them from fully implementing the MBCx measures.

SCG notes that the HOPPs pay for performance program rewards building owners for achieving actual and verifiable savings. Measures that are partially implemented will reduce incentive payments. This payment structure should signal to owners and operators to fully implement and commission the installed measures.

**Issue 10**. Reliability of Energy Meters and Flawed Metered Data. WO33 Appendix G described that the majority of meters were old and not calibrated. Also, new meters did not meet the meter accuracy requirements specified in program documents. Use of this data produced flawed and inaccurate models. It recommended that building level meters be supplemented with additional monitoring of building process parameters to isolate the impact of measures. It notes that most campuses have EMS capability to trend data for 6 months.

SCG will follow the recommendations in the Whole Building Study: the first recommendation should be to establish a data quality regimen for the buildings that are metered on each campus. It was noted that campus building managers are beginning to recognize the metering and data as a resource, and use it in managing buildings.

Many steps must be taken, including establishing data review platforms and training on data review procedures.  The diagnostic algorithms described earlier should also be included.  Establishment of data quality control procedures and regular review of the data by stakeholders, will provide a timely method to identify and correct metering and data problems.  We do not recommend that facility managers be made responsible for measure-by-measure savings calculations as a means to prolong savings benefits.  We agree collecting and providing six months of data trends to evaluators will help with evaluation activities.

# ATTACHMENT C

# Advice No. 4956-A

## Review Sheet Reference Matrix for SoCalGas Metered and Performance-Based Retrofits Program

# Attachment C

## Review Sheet Reference Matrix for SoCalGas Metered and Performance-Based Retrofits Program

| Compliance Area | PA Proposal Requirements | Not applicable | Initial Review: Included? Y/N | Full Review: Accept/ Don't Accept | Resubmission: Accept/ Don't Accept | Referenced Section in SoCalGas Advice Letter 4956-A |
|---|---|---|---|---|---|---|
| **Principles of HOPPs (p. 6)** | 1. Proposal will increase energy efficiency in existing buildings | | | | | Described in the Attachment A, Section "HOPPs Principles and Program Rationale" |
| | 2. Proposal references studies, pilots, EM&V etc. that support the idea that this project/program is a high opportunity. | | | | | Described in the Attachment A, Section "HOPPs Principles and Program Rationale" |
| | 3. Proposal demonstrates how the program/project will focus on activities that are newly permissible under CPUC code 381.2 (b), by<br>a) Program/project will reach stranded energy savings potential by utilizing the new approaches to value and measure savings | | | | | Described in the Attachment A, Section "HOPPs Principles and Program Rationale" |
| | b) Focus on interventions that PAs could not previously do. | | | | | Described in the Attachment A, Section "HOPPs Principles and Program Rationale" |
| | c) If proposal is a modification to an existing program, then proposal should clearly identify the differences with the existing program and benefits of the proposal consistent with the HOPPs principles stated on p. 6. | | | | | Not Applicable; MPBR program is a new approach to the Public Sector |
| **General Program Description (p.24)** | 1. Description of the intervention strategy employed, with reference to the type of known existing business model being employed (e.g. Standard Performance Contracting, ESCO models, retro-commissioning, experimental design, financing) | | | | | Described in the Attachment A, Section "Proposed Program" |
| | 2. Provides specifics on the terms of the program structure | | | | | Described in the Attachment A, Section "Scope of Work" |

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| | 3. Explains how the project/proposal addresses past challenges that have arisen with the business model being employed? | | | | | Described in the Attachment A, Section "Intervention Strategy and Market Barriers Addressed" |
| **Measure Treatment (p.25)** | 1. Measures and end uses that will be addressed-describe what type of intervention activities will be applied to what measures. If implementers propose to use deemed savings values, then the DEER value applicable to the site's existing condition baseline treatment must be identified (or an alternative work paper offered per CalTF vetting process) | | | | | Not applicable; MPBR Program won't know what measures we'll be applicable until the RCx investigation is performed, and not all of them will be known measures, CMPA process will be applied as appropriate. The program will identify RCx and retrofits, plus measures that are synergistic with each other to generate more savings. |
| **Savings Calculation Methods (p.25)** | 1. For normalized metered energy consumption, detailed description of the savings calculation methods and provide access to models used for addressing normalized, metered and energy consumption, detailed in Attachment A. | | | | | Described in Attachment B, Section C, in the following sub-sections:<br>• Savings Calculation General Method<br>• Calculations & Regression Models – Within the Monthly Data and AMI Data sections, Step 3 discusses normalized metered energy consumption and energy savings calculation, Step 4 addresses savings uncertainty. |
| | 2. For deemed savings projects that are providing incentive payments based on ex ante values, standard custom project savings calculation methods apply. | | | | | Not Applicable; Not a deemed program for natural gas. |
| **Incentive Design (p. 25 & 26) &<br><br>Customer incentives (Attachment A** | 1. Basis and rationale for payment structure-Explain the payment structure, including the basis for setting the upfront payment (if any) and how the structure mitigates the risk that potential upfront payments do not overrun the value of the realized savings. | | | | | Described in the Attachment A, "Incentive Structure" |

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| **p. 11-12)** | 2. Measure costs and capital burden—Identify the estimated capital costs, the sources of capital funding the project, and what portions of costs are to be borne by ratepayer and by implementer. | | | | | Described in the Attachment A, Sections, "Scope of Work" and "Incentive Structure" |
| | 3. Partial or incremental payments with true-up over time-Describe the terms and schedule of the incentive payments | | | | | Described in the Attachment A, Sections, "Scope of Work" and "Incentive Structure" |
| | 4. Strategy for tracking persistence—Describe the long term tracking and reporting strategy for sustained savings with ongoing feedback. | | | | | Described in the Attachment A, Sections, "Maintenance Plan" and "Scope of Work" |
| **Normalized Metered Energy Consumption (Attachment A p. 1-4)** | 1. Programs and projects must document the method for normalization and list<br>a) the variables included in the normalization process and | | | | | Described in Attachment B, Section D and E, in the following sub-sections:<br>• Independent Variables – Discusses the variables included in the normalization process (weather, production volume/occupancy)<br>• Calculations & Regression Models – Within the Monthly Data and AMI Data sections, Step 3 discusses normalization methodology |
| | b) Documentation of specific program actions that are intended to drive savings. | | | | | Described in the Attachment A, Sections, "Intervention Strategy and Market Barriers Addressed" and "Maintenance Plan" |
| | 2. Models, methods, and tools must use recognized engineering, economic, or statistical approaches to normalization. | | | | | Described in Attachment B, Section C and E, in the following sub-sections:<br>• Savings Calculation General Method<br>• Calculations & Regression Models and Description of Normalization – Monthly Data, AMI Data, Steps 3 & 4<br>• Appendix 1: Description of the LBNL Temperature and Time-of-Week Model |

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| | 3. Models, methods, and tools must be transparent, reviewable, and replicable by peer reviewers. | | | | | Described in Attachment B, Section C and E, in the following sub-sections:<br>• Savings Calculation General Method<br>• Calculations & Regression Models and Description of Normalization – Monthly Data, AMI Data, Steps 3 & 4<br>• Appendix 1: Description of the LBNL Temperature and Time-of-Week Model |
| | 4. In addition to normalized savings as defined here, programs and projects shall also report absolute changes in consumption expressed with a common denominator. | | | | | Described in Attachment B, Section E, Step 4, in the "Absolute Changes Expressed with a Common Denominator" sub-section |
| | 5. Models must include pre- and post-intervention data streams. Minimum 1 year post data for retrofits, and minimum 3 years for Behavior Retrofit or Operations. | | | | | Described in Attachment B, Section C, D, and E, in the following sub-sections:<br>• Savings Calculation General Method<br>• Data Collection Strategy, Sub Sections:<br>  o Required Energy Data<br>  o Required Water Data<br>  o Data Quality<br>• Calculations & Regression Models and Description of Normalization |
| | 6. Models, methods, tools must be transparent, reviewable and repeatable | | | | | Described in Attachment B, Section C, in the following sub-sections:<br>• Savings Calculation General Method<br>• Calculations & Regression Models and Description of Normalization – Monthly Data, AMI Data, Steps 3 & 4<br>• Appendix 1: Description of the LBNL Temperature and Time-of-Week Model |

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| | 7. Meter does not necessarily equal whole building, so proposals must make clear the link between meter and building | | | | | Described in Attachment B, Section C:<br>• Savings Calculation General Method |
| | 8. Proposals for programs or projects must document the market barriers they are designed to address and the interventions planned to achieve reductions in energy consumption | | | | | Described in the Attachment A, Section, " Intervention Strategy and Market Barriers Addressed" |
| | 9. If proposal deviates from Attachment A, PA must provide clear rationale. | | | | | Not Applicable |
| **Type of Program or Project (Attachment A p. 5-6)** | 1. Description of the nature of the proposed program or project intervention with respect to whole building or single measures | | | | | Described in the Attachment A, Section "Proposed Program" |
| | 2. Site level results will be discernable at building level for verification purposes. | | | | | Technical basis for discernibility described in Attachment B, in the following sections:<br>• Section E, Calculations & Regression Models and Description of Normalization – Monthly Data, AMI Data, Step 4<br>  o Sub section, Threshold of Expected Savings |
| **Threshold for Expected Savings (Attachment A p. 6-7)** | 1. Description of the expected saving from the proposed program or project intervention | | | | | Described in the following:<br>• Attachment A, Section, "Proposed Program" p. 4<br>• Attachment B Section F, sub section, Threshold of Expected Savings |
| | 2. Literature or field performance data demonstrating the expected impact and expected certainty of estimates. | | | | | Described in Attachment B, in the following sections:<br>• Section E, Calculations & Regression Models – Monthly Data, AMI Data<br>• Section F, Threshold of Expected Savings<br>• Appendix 1: Description of the LBNL Temperature and Time-of-Week Model |

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| **Baseline Adjustments (Attachment A p. 8-9, and under "Normalized", p. 2)** | 1.Documentation of the baseline assumptions and strategy for collecting necessary information | | | | | Described in Attachment B, in the following sections:<br>• Section D, Data Collection Strategy<br>• Section E, Calculations & Regression Models and Description of Normalization - Monthly Data, AMI Data,<br>• Section F, Baseline Adjustments, sub section, Baseline Assumptions |
| | 2.Description of how normalization methods capture (or not) baseline assumptions | | | | | Described in Attachment B, Section E, in the following sub-sections:<br>• Calculations & Regression Models and Description of Normalization – Monthly Data, AMI Data, Steps 3 & 4 |
| | 3. Description of the methods that will be used to adjust the baseline for non-routine adjustments, when applicable for the type of proposal. | | | | | Described in Attachment B, Section E, "Calculations & Regression Models and Description of Normalization" sub section, "Non-Routine Adjustments" |
| **Application to Behavioral, Operational, Retro-commissioning (B.R.Os) (Attachment A p. 9-10)** | 1. Program/project proposals shall: Include requirement that participant sign up for a maintenance plan for at least three years. | | | | | Described in the Attachment A, Section, "Maintenance Plan" |
| | 2.Program/project proposal shall: Include requirement that participants commit to install a minimum set of measures according to PA pre-defined criteria. | | | | | Described in the Attachment A, Section, "Scope of Work" |
| | 3.PA is encouraged to include a training component to program/project offerings. | | | | | Described in the Attachment A, Section, "Training" |
| | 4. Performance post-intervention:<br>a) Must ensure persistence of savings that ensures multiyear savings for measures that are based in changes in behavior or operational practices. | | | | | Described in Attachment B, in the following Sections,<br>• Elements of HOPP Program Design<br>  ○ Sub Section, "Element-1. MBCx with Retrofits"<br>• Section E, Calculations & Regression Models and |

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| | | | | | | Description of Normalization<br>o Sub Section" Persistence" |
| | b) During the claimable expected useful life (EUL) period of one year, continuous feedback should be in place. | | | | | Described in Attachment B, Section E, Sub Section "Persistence" |
| | c) PAs shall consider incentive structures that encourage long term savings | | | | | Described in the Attachment A, Section, "Incentive Structure" |
| | d) Incentives shall only be paid once participant commits to a maintenance plan for a minimum of three years (evidence should be made available to Commission staff upon request). | | | | | Described in the Attachment A, Section, "Maintenance Plan" |
| **Financing (Attachment A p. 12)** | 1. Description of any use of financing programs or external financing to support the program or proposed project. | | | | | Not Applicable |
| **Additional Comments from Review Team** | | | | | | Regulatory Lead: Elizabeth Baires<br>EBaires@semprautilities.com<br>Policy Lead: Lujuanna Medina<br>LMedina@semprautilities.com<br>EM&V Lead: Loan Nguyen<br>LNguyen@semprautilities.com |