Subject	Comment From	Page # or Section	Comment / Suggestion	Reply / Response
Realization rate versus the installation rate	SDG&E	**2**	*"The evaluation estimated the achieved savings and compared them to the expected savings as a ratio called realization rate. This is inclusive of the ex post installation rate and any ex post adjustment to the unit energy savings."* This report indicates that the realization rate includes the installation rate (and any other adjustments to gross savings). Often the installation rate is a separate adjustment from the realization rate (e.g., the E3 calculator). Please confirm that for this report the realization rate is inclusive of installation rate and any ex post adjustments to the savings as stated.	Yes, confirmed that the realization rate is inclusive of the installation rate for this study.
Program differences between IOUs	SDG&E	**3**	*"The AirCare Plus program had a particularly low realization rate because not only did it suffer from the above problem, but also, approximately 90% of the refrigerant charge adjustment claims in the tracking data seemed to be erroneous."* There are obvious technical and methodological differentiators across IOU programs that have not been accounted for in this study. The erroneous PG&E data set that led to over-reporting of savings where no refrigerant charge adjustment was performed should be discarded and the realization rates for each utility reported and applied separately.	Programs have been evaluated separately except where noted. The erroneous PG&E data has been corrected. Refer to research plan where it is stated that data from different programs will be combined where there are no significant differences across programs.

Program differences between IOUs	SDG&E	**6**	*"Through a review of the PG&E Air Care Plus program data, the evaluation team discovered that many of the claimed charge adjustments were actually coded as "test only" in the implementer databases. The installation rate for incorrectly claimed units was set to zero since there are supposed to be no savings claimed for only testing for refrigerant charge."* Please confirm that the statewide installation rates will not be applied across all IOUs equally. If so, the erroneous PG&E ACP program data used to calculate the PG&E ACP refrigerant charge realization rate should be discarded (i.e., the savings should not be set to zero, but the units should be removed from the sample as not representative of the CQM population for SDG&E).	The installation rates were calculated separately for each utility.
Program differences between IOUs	SDG&E	**6**	*"Using equest to simulate savings across population climate zones and building types leads to statewide gross realization rates of 39% for electric energy (kWh) savings and 113% for electric demand reduction (kW)."* There are obvious technical and methodological differentiators across IOU programs that have not been accounted for in this study. The erroneous PG&E data set that led to over-reporting of savings where no refrigerant charge adjustment was performed should be discarded and the realization rates for each utility reported and applied separately.	The erroneous PG&E data did not affect the realization rates in the other IOU programs.
Coil Cleaning	SDG&E	**6**	*"While the laboratory results show impact from condenser coil cleaning, they showed negligible impacts of treating evaporator coil blockage, and currently no impacts from cleaning evaporator coils are supportable based on the laboratory data."* It appears that the evaluators did not consider or evaluate the effects on coil fouling and heat exchange when evaluating the evaporator coil cleaning measure. By limiting the effects measured to airflow blockage, it is not surprising that the systemic/performance effects were not appreciably greater than the measurement error.	We have performed further analysis and found small savings for evaporator coil cleaning. The report was amended.

Coil Cleaning	SDG&E	**27**	"The laboratory test procedure recreated the overall impact of a dirty coil using cardboard to block the surface of the evaporator or condenser coil." Using blanking panels (cardboard in the case of the impact report) simulates reduced airflow associated with dirty coils but perhaps not the reduced heat transfer. According to an HVAC Energy Efficiency Maintenance Study prepared by Davis Energy Group, Inc. from 2010 (see http://www.calmac.org/publications/ HVAC_EE_Maintenance_Final.pdf): *"In the lab, blockage is simulated by reducing airflow with panels. In the field, fouling not only blocks airflow but also coats coil surfaces, changing the heat transfer characteristics. The relationship between lab tested blockage and coil fouling in the field has not been established* " (p.13).	We agree that the area blockage procedure does not fully replicate real world coil fouling conditions in a laboratory. Report edited to acknowledge this limitation and that other studies have yet to develop a procedure to replicate dirty coils or to quantify typical level of dirtiness/change in heat transfer.
Evaporator Coil Cleaning	SDG&E	**32**	Table 11. *Ride-along condenser coil cleaning results. Compare EER change for units not recently cleaned versus new entrants.* Are results available for the capacity impact due to evaporator coil blockage from the laboratory testing? For example, the condenser coil blockage testing results presented in the report included EER impact and capacity impact; the evaporator coil blockage testing results only included EER impact.	Additional tables are for evaporator coil cleaning are included in the next version of the report.
Coil Cleaning	SDG&E	**32**	*The three sites that participated in the 2013-14 program had their coils cleaned 1½ years before the ride-along and the two sites not found in the two most recent cycles had coils cleaned more than three years prior to the ride-along visit.* The evaluators did not state the initial condition of the coils observed in the field. Were they dirty? If the initial state of the coils was not representative of the population, this would skew the results.	The coils that had been cleaned through the program were excluded from the analysis.

Coil Cleaning	SDG&E	**32**	*The collected data provides a lower bound for savings values, as new participants, with coils not cleaned for an indefinite period may have additional savings than found here.* It appears that the coil evaluation did not include units representing the common condition where deferred maintenance leads to infrequent or non-existent coil cleaning.	The report was revised to reflect the analysis that excluded coils cleaned through the 2013-14 program.
Sample of Units Representative of Population	SDG&E	**33**	*Unit sizes ranged from 2 tons to 5 tons and all units whose metering device could be determined during field data collection were non-TXV units.* Further concerns about the sample being representative of the population of all units (including the lack of TXV units and given the limited range of the cooling capacity of the units). The above excerpt also implies that the field team could not determine the metering device for some units. What proportion of units lacked the TXV metering devices?	We were able to determine all expansion devices in the ride along sample, and all were non-TXV. Although the sample did not represent TXV units, we do not expect significant difference in the coil cleaning savings with TXV systems.
Coil Cleaning	SDG&E	**34**	Table 11. *Ride-along condenser coil cleaning results. Compare EER change for units not recently cleaned versus new entrants.* The EER change is much greater for the new entrants compared to those where coil cleaning had occurred 18 months prior. Because sites that had participated within the past five years are ineligible for services, and the majority of new entrants do not properly maintain their units, the data based on recent participants should be discarded.	Agreed and that data is discarded.
Coil Cleaning	SDG&E	**35**	*The 2013-14 program-cleaned coils had an average relative discharge pressure change of 3.2% and an average relative efficiency change of 2.3%. The coils that had no record of recent cleaning had an average relative discharge pressure change of 6.3% and an average relative efficiency change of 4.7%.* To the extent that the realization rate is derived from the field data, it is crucial that the sample sites are representative of the average state of coils in the population. Are the two sets significantly different and what is the level of confidence?	We can show the error bounds for each group and combined.

Coil Cleaning	SDG&E	**35**	*Although simulations were performed using averages from all the data, we multiplied the resulting savings by an adjustment factor of 1.39 to account for the higher savings from systems that did not participate in the 2013-14 program. The adjustment factor is the weighted average of EER for each of the systems tested, weighting those not participating in the program by one and those who had previously participated by two, over the un-weighted average.* This weighting scheme appears very arbitrary and assumes that a large portion of sites will enter the program with recently cleaned coils. With nearly double the efficiency improvement and discharge pressure improvement on units that have not been cleaned in the prior three years, it would be more reasonable to adopt the higher values (6.3% relative discharge pressure change and 4.7% relative efficiency change) given that sites that have participated within the past five years are ineligible for this service.	We re-ran the simulations using only data from sites that did not participate in the program. New savings are based on the updated simulations.
Evaporator Coil Cleaning	SDG&E	**37**	Table 14. *Evaporator coil cleaning results by program. Columns 8 and 9, all rows. Zero ex-post kWh and kW savings.* This report did not evaluate evaporator coil cleaning savings beyond a cursory review of the literature and a laboratory simulation of airflow blockage. The effects on heat exchange and coil fouling should be investigated further. Recommendation: Reinstate savings to the 6.75% of RCA savings level recommended by Energy Division in the CQM Workpaper Disposition until more refined testing and/or metering can be performed.	Evaporator coil cleaning data analyzed and included in report.

RCA	SDG&E	**45**	*"DNV GL recognizes that there could have been up to a three year lag time between when the technician left the site and when we arrived and that there could have been changes in the system during this time. In fact, anecdotal evidence collected from site contacts during the field visits suggests that at two sites repair was needed after units were serviced through the program, so a non-program contractor was called in to restore charge to proper levels."* Were these two sites where a non-program contractor "fixed" the units since the original tune-up included in the field evaluation? The "up to three year lag time" is concerning, but evaluating program activities using sample sites where outside parties serviced the charge after the visit would not be representative of the services provided at all. Also, please elaborate on the total number of sites tested with corresponding implementer data to assess the pre- and post-treatment charge levels -- how many sites were represented in the 47 circuits evaluated and how many of the circuits were at the two sites with known exogenous issues?	The sample was expanded to include 110 circuits. One of the units known to have been reserviced was excluded from the study. Sweeping site level exclusions were not made. We agree the lag time is a problem, and hope to shorten it in future evaluation efforts.
RCA	SDG&E	**51**	*"The RCA realization rate is expected to be between 8% and 38% based on the difference between the ex ante and ex post model inputs for HVAC system efficiency and capacity. Table 27 shows the results of the modeled savings applied to each claim in the ex ante tracking data and propagated to the program level."* It is not clear how the statewide RCA realization rate can be estimated at 8% to 38% when the range of realization rates is 3% to 64% (kWh), with bad data accounting for the 3% finding. The SDGE Deemed program shows a 64% RCA Ex Post Realization Rate (kWh) compared to the other programs ranging from 3% to 29%. The disparity across programs further emphasizes the technical and methodological differences between the IOU programs. The large variance further weakens the validity of deriving a "statewide" realization rate for the RCA measure.	This sentence was revised to reflect simulation results.

Economizers	SDG&E	**59**	*"Combined, the installation rate of the three program is 56% and this is applied to the SDGE programs that had no representation in our sample since economizers were claimed extremely rarely in the SDGE programs."* The application of SCE/PG&E combined installation rates to SDG&E installation rates is inconsistent with other areas of the report where a "pass-through" is granted where the data is not evaluated. Where there is no evidence to the contrary and claimed savings are low, the reported savings should be passed through. Examples include PGE's AirCare Plus program fan controls, SCE QM fan controls.	The research plan states that data from one program will be applied to the other programs. SDGE did not show up in the sample because very few economizer measures were claimed through SDGE programs.
Application of Savings to Program	SDG&E	**60**	Table 33, Column 7, *SDGE Deemed and SDGE Direct Install Ex Post kWh Savings values estimated at 24,640 and 5,141.* These savings should be at 44,000 and 9,180 kWh respectively (pass-through) because the installation rates and realization rates were not evaluated for these programs and the savings claims are fairly small.	We applied our findings to all coil cleaning measures across programs since the underlying data was assessed across programs.
Program differences between IOUs	SDG&E	**61**	*The initial investigation will determine why SDG&E tracks similar measures differently in different programs.* The programs use different technical platforms and different standards for validating data. For example, the SDG&E deemed incentives program requires both superheat and subcooling parameters be met in non-TXV units. The four DEER items used in the Commercial Direct Install program is a carry-over from DEER 2008 when refrigerant charge savings were broken into categories based on typical or high undercharge/overcharge. DEER 2011 combined these into one typical savings category. The latter was used in the SDG&E deemed incentives program.	Noted

Sampling Precision and Validity of Conclusions	SDG&E	**72**	Table 43: *Dataset Size for Measure Parameters with Corresponding Sampling Precision* Achieved sampling precision was generally poor in this study, with +/- 34% for coil cleaning and +/-56% for RCA. Thermostats and supply fan controls were at +/- 72% and +/- 70% respectively, and economizers were at +/- 24% but not tested in the SDG&E service area. Recommend that measures with greater than +/- 50% precision are given a pass-through until further research with increased precision can be completed.	expected. Based on the samples fielded in some cases we found more variability and we also took a conservative approach to calculating precision by considering sites and not units. Ultimately the unit level data is used in the analysis and projected to the population via simulations for coil cleaning and refrigerant charge. For thermostats and supply fan controls the primary adjustment is based on data recorded by the program on pre-maintenance conditions. We revisited the precisions in the cases where we made adjustments based on
kW Savings	PG&E	Appendices	In the IESR Tables DNV GL reports much lower kW realization rates than those reported for kWh. Can DNV GL provide an explanation for this in the report? Why is the PG&E lifecycle kW gross realization rate (0.02) so much smaller than that of the other utilities?	Appendices reviewed. Measures with more capacity impacts than efficiency impacts like RCA and evaporator coil cleaning will reduce runtime more than reduce peak power demand
Laboratory data	PG&E		For several high impact measures, the final determination of ex post savings was based on limited laboratory data offered outside the context of a full review. In particular, savings for refrigerant charge adjustment and coil cleaning relied on correlations to laboratory analysis that is not supported with sufficient detail to be verified. This is especially problematic for evaporator coil cleaning for which no savings were awarded based exclusively on laboratory analysis. PG&E is willing to trust such findings when we can also verify the methodology and analysis. It is much more difficult to support a 0% GRR with no opportunity to verify methods.	More detail about laboratory procedures and data added to the report.
Economizers	PG&E		DNV GL assigns a low realization rate for economizer measures (0.43). Can DNV GL provide a quantative breakdown of the reasons for economizer failures?	It was not within scope to diagnose the reasons for economizer failure. Determining the cause of economizer failure is much more time intensive than the functional tests which

Baseline	PG&E		Can DNV GL please be more specific throughout the report on exactly what defines baseline for each of the investigated measures? Is it always existing conditions before the unit was enrolled in the program? Is it based on standard maintenance and if so, what defines standard maintenance? Is it a mix of pre existing conditions and assumed standard maintenance practices? Are program non participants all assumed to have their HVAC systems serviced at a regular time interval?	The baselines for each of the measures are described in the workpapers and summarized in each measure section.
kW Savings	PG&E		Can DNV GL please discuss why PG&E programs have negative kW economizer savings both ex ante and ex post while other programs have zero (SDG&E) or positive (SCE) kW economizer savings?	This is an artifact of the ex ante claims; the negative got carried through from the ex ante in cases where a realization rate was
kW Savings	PG&E		Was any research conducted as part of HVAC3 into coincidence factors for kW savings?	No
Laboratory data	PG&E		Which multiple fault scenarios did DNV GL collect laboratory data for? Does DNV GL have laboratory data to show energy efficiency impacts of simultaneous dirty filter and dirty evaporator coil? What about undercharged RCA with dirty condenser coil? Can DNV GL please publish any data on multifault scenarios they have collected as part of HVAC5?	Yes, multiple fault data will be published as part of HVAC-5
Sample of Units Representative of Population	PG&E		**. For every high impact measure that DNV-GL identified and researched, sample sizes were too small to yield reasonable precision.** In Table 43 DNV-GL reports achieved precision at the 90% confidence interval to be between 24% and 72% for the high impact measures. With such large standard errors, any adjustment to ex ante savings is questionable and workpaper/DEER updates are not reliable. Beyond insufficient sample sizes, very little of the analysis is presented in a fashion that permits thorough verification or facilitates a deeper understanding of underlying issues that would inform program improvements.	Poor precision was expected in the plan, precisions were never planned to reach 90/10 given the variability expected. We got that variability and more.
Disaggregated Methodology	PG&E		**2. The primary objective of PG&E's CQM program is to bring HVAC equipment from as-found condition into compliance with Air Conditioner Contractors of America (ACCA) 180 standards. However, only a small portion of the common ACCA 180 maintenance activities was considered in the ex post savings analysis.**	PG&E claimed savings through disaggregated measures and those measures yielding highest savings were investigated. Greater than 95% of ex ante kWh claims were evaluated.

Disaggregated Methodology	PG&E		Upon enrollment of an HVAC unit in the CQM program, the participating contractor has six months to achieve the ACCA 180 performance criteria. *The ACCA 180 standard cannot be met by performing only measures that are individually incentivized.* For this reason, PG&E also pays the customer an incentive on each unit to perform the ACCA 180 treatments that are not tied to a specific measure or definitive savings claim. This general incentive is significant (about 30% of total program incentive is awarded based on achieving ACCA 180) and allows for the broader and more robust treatment demanded by ACCA 180 compared to standard maintenance. *As part of the program, contractors are required to clean coils, change filters and perform any and all maintenance/repair tasks necessary to achieve the ACCA 180 standard, regardless of if those actions are explicitly incentivized or tied to savings claims.* In fact, of the 22 tasks specified by ACCA 180 and required by the program, only six are explicitly incentivized and linked to a savings claim. Aside from coil cleaning and filter changes, other non-incentivized tasks that are likely to have energy impacts include blower wheel cleaning and control system repair, among many others. Instead of assessing savings representative of the full program, DNV-GL required a categorical savings claim in the standardized program tracking data to consider a measure for ex post savings.	None - See response to questions

Coil Cleaning	PG&E		Why doesn't PG&E claim coil cleaning savings? Upon implementing direction in the Workpaper Disposition for *Non-Residential HVAC Rooftop Quality Maintenance* issued by the CPUC on May 2, 2013, which reduced savings for condenser coil cleaning by more than 80%, it was no longer tenable to incentivize the measure and program dollars were reassigned. Because other statewide programs either did not adhere to the disposition or claimed savings at the reduced level (AirCare Plus), condenser coil cleaning remained a high impact measure (HIM) and was evaluated with a resulting gross realization rate of more than 600%. If it weren't for another utility mistakenly foregoing the Ex Ante Team's direction, condenser coil cleaning would not likely have met HIM criteria, DNV GL would not have investigated the associated results, and the dramatic underestimation of ex ante savings for this measure would not have been discovered.	Noted
Precision	PG&E		In some cases, a measure may have such high uncertainty that workpaper development and/or Ex Ante Team approval is not feasible. Though this may preclude ex ante savings claims, it should not preclude an evaluator from investigating the associated savings and assigning them on an ex post basis. In fact the opposite is true! A measure that carries too much uncertainty for approved savings claims is *most* in need of evaluation. In these cases evaluation can give the workpaper teams more reliable information, reduce risk to the program administrator and uncover untapped opportunities.	Agreed

Coil Cleaning	PG&E		Despite the loss of the ex ante savings opportunity, PG&E CQM contractors cleaned more than 4,500 condenser coils and more than 4,500 evaporator coils in the 2013 – 2014 program cycle in compliance with program requirements. In each instance, Honeywell kept detailed records, which were submitted to DNV-GL as part of the larger HVAC3 data request. In fact, DNV-GL completed ride along visits to CQM program participants in PG&E service territory to develop coil cleaning savings parameters, reporting results[1] in Table 11 of the report. Yet the associated savings were not considered due to the lack of corresponding explicit ex ante claims. PG&E is thankful that DNV-GL has voiced openness to including coil cleaning savings for our CQM program and we are hopeful that upon furnishing data that links implementer records to standardized program tracking (completed on March 11), DNV-GL will validate and assign the associated savings in the final draft.	Noted
Evaporator Coil Cleaning	PG&E		Similar to coil cleaning, DNV-GL presumably did not consider savings for filter changes for any of the statewide programs due to the lack of explicit claims. Again, per ACCA 180 standards, dirty filters were routinely changed as required by the programs. Changing a dirty filter will render a greater impact from evaporator coil cleaning as it will alleviate airflow restriction before the coil. Therefore, savings for the combination of evaporator coil cleaning and filter change are likely higher than either measure in isolation. Along with evaporator coil cleaning, in PG&E's CQM program, upon inspection or replacement, filters were initialed and dated by the contractor, leaving a definitive mark that should have been readily observable by evaluation and correlated with implementer data.	Energy Division considers filter change standard practice, while coil cleaning is not. We followed the current definition of standard practice when not considering filter changes in impacts.

Evaporator Coil Cleaning	PG&E		One may argue that filter change and certain other ACCA 180 tasks are considered standard maintenance, and PG&E agrees. However, according to recently released research,[2] 31% of non-participating small/medium business customers in California *never* have their HVAC units serviced,[3] which is a clear indication that baseline standard practice should reflect a significant percentage of dirty filters causing major airflow blockage, along with other standard maintenance tasks left undone. At the March 8 public webinar, John Hill of the CPUC Ex Ante Team mentioned that as part of the HVAC5 laboratory study, several sets of multiple fault situations were investigated. PG&E is hopeful that laboratory data in the report will shed light on the energy efficiency impacts of replacing dirty filters *in coincidence with* cleaning dirty evaporator coils as well as remedying other common multiple fault scenarios.	Note that field data are for cleaning a coil where a clean filter was installed pre and post. The key limitation to this request is a lack of field data on airflow and performance changes when both a filter is changed and a coil is cleaned.
Coil Cleaning	PG&E		In conclusion, where data exists to reasonably verify condenser and evaporator coil cleaning, filter changes and other non-incentivized ACCA 180 tasks, DNV-GL should investigate the validity and impact of those measures as part of the onsite data collection activities and report corresponding savings regardless of coincidental ex ante savings claims. Since much of this analysis was not done, PG&E requests laboratory and existing field data be used to estimate ex post savings for condenser and evaporator coil cleaning including filter change and disqualified thermostat adjustment savings (discussed below).	Lab data may be insufficient to quantify all of these measures in all combinations. See previous response for field data limitations.
Evaporator Coil Cleaning	PG&E		**3. Evaporator coil cleaning savings should be based on a clear degradation of sensible energy efficiency ratio as a function of reduced airflow, instead of the apparent unchanging energy efficiency ratio.** On page 32 of the HVAC3 report, DNV GL presents the following figure that shows evaporator coil blockage causes no immediate discernable change in EER:	Evaporator coil cleaning data analyzed and included in report. Evaporator coil cleaning savings are now non-zero.

Evaporator Coil Cleaning	PG&E		Based on these results, DNV GL assigned no savings for the evaporator coil cleaning measures. However, on page 3 of Appendix I, DNV GL provides the following figure, which shows a significant reduction in both Sensible capacity and Sensible EER as a function of reduced airflow due to evaporator coil blockage.	Evaporator coil cleaning data analyzed and included in report. Evaporator coil cleaning savings are now non-zero.
Evaporator Coil Cleaning	PG&E		It is PG&E's understanding that EER accounts for latent heat changes but that Sensible EER* does not. Since California has a largely dry climate, dehumidification is most often not necessary and thermostats that control HVAC cycling are sensitive to dry bulb temperature. Therefore, Sensible EER is the more appropriate metric to assign savings to evaporator coil cleaning and filter replacement. PG&E requests that DNV GL assign savings for evaporator coil cleaning and elsewhere in the evaluation where needed according to Sensible EER.	Evaporator coil cleaning data analyzed and included in report. Evaporator coil cleaning savings are now non-zero.
Evaporator Coil Cleaning	PG&E		Also, filter and evaporator blockage can cause ice formation on the evaporator coils, which can eventually lead to 100% blockage in extreme cases. Therefore a savings determination based only on instantaneous measurements does not account for the catastrophic longer term energy efficiency, safety and equipment functionality effects that evaporator coil cleaning and filter replacement can avoid.	Evaporator coil cleaning data analyzed and included in report. Evaporator coil cleaning savings are now non-zero.
Collaboration	PG&E		**4. Throughout the evaluation process, more opportunities for true collaboration would have benefited both the program and the evaluation.** Aside from brief updates on sample plans and logistical matters, very little insight was offered into research findings or issues that would have engendered the robust back and forth that could have improved both the evaluation and the programs.	Lack of early feedback noted. This will be addressed in the 2015 cycle work.

Supply Fan Control	PG&E		As an example, the low GRR (17%) PG&E received for Supply Fan Control measures resulted primarily from elimination of 80% of claims due to a misclassification of the measure in our standard program tracking data. In these instances, during unoccupied building periods the supply fan control was set to 'intermittent' or 'auto' both before and after the program intervention. In contrast, to qualify as a Supply Fan Control measure, the initial Supply Fan Control setting was required to be 'always on.' In these cases, though not changing the setting, technicians did reprogram the thermostat during unoccupied time periods to setpoints of ≥ 85 °F for cooling and ≤ 60 °F for heating. This action had a significant effect on energy usage as the supply fan and compressor would cycle on much less frequently. While DNV-GL noted a legitimate mischaracterization of this measure, instead of disqualifying savings all together, a realization rate could have been developed that accounted for the savings from changing the heating and cooling setpoints. But even more importantly, despite having regular PCG2 meetings with HVAC_3 updates, DNV-GL never informed PG&E of this issue or requested clarification. Thus we are only now being made aware of a technicality that could have been fixed much earlier and is likely to negatively impact savings and realization rates for all of the corresponding 2015 claims.	The fan savings associated with changing the thermostat setting are taken account of in the thermostat measure.
Supply Fan Control	PG&E		In the 80% of cases in which Supply Fan Control measure installation rates were assigned zero savings, PG&E requests that DNV GL investigates the significant savings that did occur due to reprogramming of the thermostats and crediting the ex post results accordingly.	Thermostat savings are treated separately from supply fan savings in this evaluation.
RCA	PG&E		Similarly, refrigerant charge adjustment measures in PG&E's AirCare Plus program were assigned a 3% kWh (1% kW) GRR due to confusing data. On page 20 of the draft report, DNV-GL states,	Updated with new data
RCA	PG&E		*"The PGE AirCare Plus implementer data showed the majority of units had no refrigerant adjustment and were test only. Yet, ex ante savings were claimed for adjusting charge on these units. It is not clear which is wrong. We are assuming the implementer data is correct and no savings accrue from these sites."*	Updated with new data

Collaboration	PG&E		More than 5,600 AirCare Plus RCA claims and 1.4 GWh of savings were simply eliminated with no follow up or request for clarification from PG&E. In the draft report, what boils down to an important yet honest mistake from a database manager resulted in the nearly complete elimination of more than 20% of the entire program's savings. While we are sympathetic to DNV-GL's observation that multiple data requests were required to obtain all the information the evaluation team was seeking, PG&E was not made aware of the AirCare Plus RCA tracking data irregularities until publication of the draft evaluation on March 1. Again, even a short communication could have solved this problem in the early stages of evaluation. Nevertheless, PG&E and CLEAResult have since then fixed the error, repopulated the database with the definitive data and we provided the new database to the CPUC on March 11. We request that DNV GL assigns the savings for these measures in the final report.	Updated with new data
Collaboration	PG&E		Finally, as noted in point 2 above, achieved sample sizes were small and standard errors are large. DNV GL notes several instances in which evaluation plans were not met and issues with obtaining reliable data. PG&E has offered, and continues to offer, access to the programs for evaluation purposes as new customers enroll for quality maintenance services. This would ensure timely feedback for the programs, and easier sampling for evaluation.	We appreciate PG&E's willingness to collaborate and hope to take better advantage of the opportunity in the future
Disaggregated Methodology	PG&E		**5. A fundamentally different approach to the CQM impact evaluation is needed.** The interdependence of filter change and evaporator condenser coil cleaning impacts discussed above in point 2 is a good example of the interactive nature of individual HVAC system components. If one is considered without the other, the evaluation cannot accurately capture savings and will underreport ex post results. In other cases interactive effects may cause an overestimation of savings when each measure is treated independently. For this reason alone a fundamental change is needed in the CQM impact evaluation approach. It is essential that a full unit measurement procedure is developed and enacted in coordination with the programs.	The evaluation methodology was motivated in large part by the format of the ex ante claims which did not include interactive effects. We continue to investigate these effects through the ongoing laboratory work under HVAC-5

Disaggregated Methodology	PG&E		Furthermore, in the current approach, the evaluation is delayed up to three years after program treatment. As a result, the assessment cannot reliably replicate post conditions and has no ability to measure pre conditions. New methodology may take the form of billing analysis, metering or more comprehensive measurements that take into account all program actions, not just those few for which savings are explicitly claimed. While none of these approaches are perfect, their challenges need to be weighed against the status quo, which is simply not succeeding.	We will investigate additional evaluation methodologies, and anticipate using a billing analysis to evaluate 2013-2015 residential QM programs.
Disaggregated Methodology	PG&E		For three evaluation cycles dating to 2006 – 2008, the CQM impact studies have suffered from the same maladies: small sample sizes, large standard errors, lack of reliable data for workpaper development and DEER updates, failure to take into account all program actions, failure to coordinate with the programs, no attention paid to interactive effects, lack of collaboration and timely feedback to the programs, and little or no baseline assessment. With only iterative adjustments to the current approach, it is hard to envision the improvement needed to cost effectively evaluate the CQM programs while providing accurate results in which stakeholders can be confident and that lead to much-needed workpaper and DEER updates. The CPUC, IOUs and public stakeholders need more from the substantial resources devoted to these efforts.	We had substantial early feedback during WO32; early feedback for this round was taken over by the ESPI reporting. Valuable data was provided in this evaluation to update coil cleaning and RCA workpapers.
Delay Final Report	PG&E		PG&E is devoted to quality maintenance and recognizes that the programs have room to improve. However, we do not feel that the HVAC3 study accurately captured program impacts for the reasons given above. In light of these considerations and concerns, PG&E requests that the CPUC and DNV GL delay a final draft until sufficient effort is devoted to address them. This is a very important study that can either help the utilities evolve these programs with constructive feedback and accurate analysis, or can cause lasting damage if ex post impacts are mischaracterized and misunderstood.	Not possible per CPUC direction

Laboratory data	Proctor Engineering Group, Ltd.		It is problematic that ex post savings estimates are derived from work that has not been subject to public review, and is not currently available to the public. Savings estimates for several measures are based entirely on laboratory measurement of fault impacts. While this is theoretically a technically valid method of estimating energy savings, the laboratory work has not been subject to public review. It is impossible for the public to make informed comments on the ex post savings estimates without: the ex post savings estimates without: a. A detailed description of the laboratory test procedures, including a complete description of all methods used to simulate faults. b. The complete data set from the laboratory tests. c. A detailed description of analysis methods and results.	Appendix added with lab data relevant to report
Laboratory data	Proctor Engineering Group, Ltd.		2) It is problematic that ex post savings estimates are derived solely from the laboratory tests performed during this evaluation and neglect the results of all other laboratory studies. The draft report indicates that fault impacts measured during this evaluation differ from the results of other studies (section 4.2.2.2). Scientific explanations for the differences in results are not discussed and presumed to be unknown. There is no evidence provided to demonstrate that the results of other studies are less valid than the results of this study. The installed population of HVAC equipment is diverse. In the absence of data identifying the causes of differences between test results, there is no reason to believe that the average existing unit is better represented by the particular units that were tested under this study than by the units that have been tested under other studies. We suggest that savings estimates based on the average of all available data will be more robust than estimates based on a single source.	Agreed we didn't look at other studies directly for the analysis. The study referenced in the comments and others should be compiled into a revised workpaper. Additional testing should be completed with an economizer and at field average static pressure conditions which we have not found in literature to date.

Coil Cleaning	Proctor Engineering Group, Ltd.		3) The field evaluation of coil cleaning measures performed cleaning and associated measurements after refrigerant charge was weighed in. Standard field practice is to clean the heat exchange coils prior to attempting to diagnose or adjust refrigerant charge. It is understood that the evaluation procedure was designed to reduce differences between the field condition and the laboratory condition. However this approach creates a disconnect between the pre/post coil cleaning refrigerant pressures measured in the field during this evaluation, and measurements that would occur in a QM program. This could result in under or overestimation of program savings. For example, if coil cleaning produces a smaller change in refrigerant pressure in a system that also has insufficient refrigerant charge, then program savings would tend to be underestimated because the reported program data and evaluation results indicate a higher incidence of refrigerant undercharge than overcharge.	We acknowledge that we did not look at other studies directly for the analysis. The study referenced in the comments and others should be compiled for future ex ante and ex post analysis along with testing completed under HVAC5 with an economizer and at field average static pressure conditions which is not part of other unit tests in literature we have found to date.
Coil Cleaning	Proctor Engineering Group, Ltd.		4) Please clarify what population is represented by the HVAC units measured in the field to evaluate condenser coil cleaning impacts. There are at least three possibilities: a. General population of all existing units served by contractors participating in the QM programs b. Units that were identified as needing cleaning by some qualitative method such as "it looks dirty", or "it has been a while since it was last cleaned, so it probably needs it" c. Units that were identified as needing cleaning based on a quantitative diagnostic method Given the sample size and selection methods, what level of confidence does the study team have that the intended population is accurately represented? How do observations from the population of HVAC units sampled through this study compare to the fraction of units receiving coil cleaning through the QM programs?	It is not representative; we re-did the analysis to consider only the never cleaned coils. Sample will be added during the 2015 work.

RCA	Proctor Engineering Group, Ltd.		5) Table 41 indicates that there were 2,103 refrigerant charge adjustment measures implemented in the SCE QM program. Table 22 lists only 200 units and the distribution of unit types is significantly different from other programs, with 87% having TXVs. What are the reasons for the differences in measure counts and unit type distribution?	The implementer data was incomplete and while 2103 records indicated that refrigerant charge was adjusted only 200 contained the information necessary to form the distribution in Table 22.
Supply Fan Control	Proctor Engineering Group, Ltd.		6) Do the SCE QM program savings reflect the findings in section 4.5.3.3, that supply fans which were originally in the Auto or Off state during unoccupied hours were adjusted to On in 45% of cases?	these cases is not reflected in the ex post savings. Fan control savings are embedded in the thermostat portion of the aggregated SCE QM measures, and only the thermostat realization rate was applied. No additional adjustment was made
eQuest	Proctor Engineering Group, Ltd.		7) Reliance on simulation models that are not proven to produce accurate or reliable results is an ongoing problem. The first table in Appendix 3 illustrates simulation results that don't make sense. Condenser coil cleaning at a large office building in San Francisco (CZ3) is listed as producing annual savings of 38.3 kWh/ton, while savings for the same measure in Sacramento (CZ12) is listed at 44.9 kWh/ton. This indicates a difference in savings of only 17% between San Francisco and Sacramento, implying a difference in annual cooling energy use of approximately 17%. The Title 24 annual weather files for San Francisco and Sacramento indicate 4,401 base 65 cooling degree hours for San Francisco vs. 40,417 cooling degree hours for Sacramento (difference of 818%). Given the obvious difference in climates, it does not stand to reason that a 10 ton RTU in Sacramento uses only slightly more cooling energy than a 10 ton RTU in San Francisco, yet this is exactly what is implied by the simulation results presented in this study, and by extension the simulation results used in DEER since this study applied the DEER models. What field data exists demonstrating that the energy use and savings estimates produced by these models are representative of reality?	The research plan relied on the DEER models to extrapolate savings for measures.

Program design	John Proctor, P.E., Independent Consultant		The first problem is that the evaluation does not pinpoint the cause of low energy savings from the programs. These programs are applying criteria that are inappropriate for "Quality Maintenance" which, by definition is different from new installation. The criteria need to be changed to perform only work that will save a significant and measurable amount of energy and peak.	Program design issue we generally agree with.
Laboratory data	John Proctor, P.E., Independent Consultant		The second problem is that the evaluation depends heavily on "new laboratory tests" without regard to how those tests confirm or call into question existing laboratory test results that have been documented, vetted, and reviewed by other scientists. The "new laboratory tests" are for the most part undisclosed and have not been subject to scrutiny by the scientific HVAC community. This is a huge problem as it can lead the evaluators to incorrect conclusions, which are subject to multiplication in applications across the utility sphere. It is unprofessional to base an evaluation on un-vetted and undisclosed data. It is even worse to totally ignore other research that may call into question or contradict the conclusions drawn from the "new laboratory tests".	Appendix added with lab data relevant to report

Evaporator Coil Cleaning	John Proctor, P.E., Independent Consultant		**Beginning with Problem 2.** In some cases it is already clear that these "new laboratory tests" contradict previous laboratory tests. For example it is stated "Even without considering the instrumentation error band, the results showed minimal efficiency and total capacity impacts from reducing evaporator coil blockage. Because of this, we decided that evaporator coil cleaning has savings that are too small to be measured." (Page 31 and Figure 12). Scientifically, the issue is not what percentage of the coil is "blocked" but rather how much the evaporator coil airflow is reduced. This fact pulls together both the program design problem and the evaluation problem (it is flow not % blockage). In Figure 2 of Appendix I (page I-3) there is a graph of efficiency impact due to evaporator coil air flow deficiency (or maybe it is the effect of condenser coil blockage as stated in the text). It shows both total EER and sensible EER effects. Note that only the sensible ERR effect is important for 90+% of California. It appears to support the conclusion on page 31 with respect to total EER (change within measurement error), but indicates an 8% sensible EER loss for a 10% deficiency in airflow. Prior work at numerous labs, including the two below, show that both total and sensible EERs are lowered by reduced airflow.	This has been updated
Evaporator Coil Cleaning	John Proctor, P.E., Independent Consultant		The first graph is from work by Heflin and Keller of Carrier Corporation. It plots from right to left, the Total efficiencies (both in cooling and heating) as the airflow across the evaporator coil is reduced. Note that the total efficiency does in fact drop as the flow is reduced. *Source* : Heflin, C. & F. Keller. 1993. "Steady-State Analysis of Single-Speed Residential Split Systems with Zoning Bypass." *ASHRAE Transactions,* Vol. 99, Part 2, Paper number 3693, Pages 40-51. American Society of Heating Refrigeration and Air-Conditioning Engineers. Atlanta GA. Note that in this case the reduced airflow effect was created by a bypass. This is the same phenomenon whether it is caused by a bypass or a restrictive duct system, fouled coil, or whatever. This is evident in the second graph, which is strictly reduced airflow.	Noted

Evaporator Coil Cleaning	John Proctor, P.E., Independent Consultant		The second graph is from laboratory tests at Purdue University (Shen, Braun & Groll 2004). This shows the efficiency effect of low airflows outside the range normally published in the manufacturers' extended data tables. *Source* : Shen, B., J. Braun, & E. Groll. 2004. "Other Steady-state Tests for ASHRAE Project" in Steady-state Tests1, Section Title: Series V: Change indoor airflow rate under wet condition. Ray W. Herrick Laboratories, The School of Mechanical Engineering, Purdue University. West Lafayette, IN. Note that the range of data being larger that that reported in Appendix I (Mowris 2015) shows the curve of reduced Sensible EER from reduced evaporator coil airflow.	Noted
Evaporator Coil Cleaning	John Proctor, P.E., Independent Consultant		Note that the Mowris data do not agree with the Shen, Braun, and Groll data for Sensible EER at the 10% evaporator coil deficiency level. The Mowris data suggests 8% sensible EER reduction while the Shen, Braun, and Groll data suggest only 4%. Without the full range of data and confirmation by other researchers where possible, the real problems are hidden. This is part of problem number 1. **The programs allow the contractors to make airflow changes that are too small to achieve significant savings.** If the savings exist they are lost in the noise. As such they cannot be cost effective for anyone other than the contractors.	Agreed we did not look at other studies directly for the analysis. The study referenced in the comments and others should be compiled into a revised workpaper. Agreed that there should be a guideline for minimum fault level to merit measure installation.

RCA	John Proctor, P.E., Independent Consultant		The evaluation makes a big deal out of whether the manufacturer's charge level as set by weight or checked by another measurement is the correct charge level. The manufacturer sets the charge level by weight to some internal criteria (preserve the compressor, high efficiencies in particular tests, etc.). The amount of refrigerant by weight is the "proper" amount of refrigerant for a new **PACKAGE UNIT** installed as tested in the lab (evaporator and condenser coil airflows for example). At the same time they recognize that it is impractical for a technician to weigh out the charge as part of normal or even "Quality" maintenance. Therefore they supply other criteria to determine if the amount of refrigerant is "close enough". Their criteria are not designed to find units that require sufficient changes in the refrigerant levels based on available efficiency change of potential energy savings. As such their criteria may not be (and are not) the criteria that should be applied in a utility program. This returns us to problem number 1. **The programs allow the contractors to make refrigerant charge changes that are too small to achieve significant savings.**	Agreed that small changes should not be made as stated above. FDD diagnostics are still not very accurate as described by HVAC 5 and other researchers.
RCA	John Proctor, P.E., Independent Consultant		The evaluation contends that the proper amount of charge in the unit is the same regardless of whether the airflows are as designed or not. They support this position based on questionable data from prior evaluations by the same evaluators. They maintain that "Laboratory tests published in the last few years showed the diagnostic tests to be unreliable" page 39. It is not true that ALL DIAGNOSTIC TESTS ARE UNRELIABLE. In some cases these investigators misapplied the diagnostic tests and have never addressed these deficiencies. (DNV GL, HVAC Impact Evaluation FINAL Report WO32 HVAC – Volume 1: Report, Jan. 28, 2015. http://www.calmac.org/publications/FINAL_HVAC_Impact_Evaluation_WO32_Report_28Jan2015_Volume1_ReportES.pdf).	The reliability of diagnostic testing is an emerging issue. Agreed, not all tests are unreliable, but still think weighing the charge is the best evaluation methodology.
RCA	John Proctor, P.E., Independent Consultant		It is important that such statements be corrected so as to not spread incorrect or partially incorrect information to policy makers.	Agreed. Reviewed language and removed broad statements about FDD reliability.

RCA	John Proctor, P.E., Independent Consultant		**Now to Problem 1.** The utility programs have largely implemented the manufacturers' diagnostic tests or other proprietary tests. In the case of split air conditioners these tests are designed to ensure proper installation of the units (although the specifications do not mean the contractors necessarily follow them). In the case of package units the tests are made available to the contractors for rapid checks of the units. In both cases the tolerance limits are too narrow for utility programs that are designed to improve the efficiency, save energy, and reduce peak. The airflow and refrigerant diagnoses acceptance parameters need to be adjusted to: 1) only authorize rebates for adjustments if the original parameter measurement is in the range that an adjustment will achieve significant savings, and 2) That rebates be paid for adjustments that are large enough to achieve sufficient savings. The programs have consistently failed to follow these principles As a result the programs' wasted efforts on minor (or fake) changes in duct leakage, refrigerant charge, evaporator airflow, and condenser coil "cleaning" have doomed the programs to the trash bin. There are available energy savings in all these measures, but they lie with the units that are significantly out specification, not the average unit in California	We generally agree and will investigate further in the next round (2015)

Evaporator Coil Cleaning	Modera, UC Davis		the treatment of maintenance procedures to address blockage of evaporator coils was brought to my attention. On reviewing that section of the report, it seems that the report concludes that blocking evaporator coils has no impact on energy efficiency, and therefore should be assumed to not provide any energy savings. In brief, I do not agree with this conclusion. The reasons for my lack of agreement are as follows: 1. Total EER is generally not the appropriate metric for evaluating energy savings in California, as the sensible heat ratio of cooling loads in California buildings is generally very high (with the exception of a few applications such as indoor swimming pools, gyms and fresh food sections of grocery stores). Thus, the appropriate metric for cooling energy use in California is the Sensible EER. In this very report (on page 141 of 178) it is shown that a 10% decrease in evaporator flow results in a 10% drop in Sensible EER, which is a significant impact (and represents a savings potential associated with cleaning an evaporator coil so as to increase air flow).	Updating the analysis

Evaporator Coil Cleaning	Modera, UC Davis		The data presented on page 38 only look at total EER, and are difficult to compare with published data on the impact of reducing evaporator air flow, or even with the data on page 141. One problem is that the X-axis is "%blocked" rather than "% flow reduction". "%blocked" is not a precise measure of the parameter of interest which is "% flow reduction". As an example, 50% blockage will have a very different impact on an undersized coil versus an oversized coil, and the blockage could have no impact on coil flowrate for certain types of indoor fans (e.g. those that speed up to maintain flow independent of pressure). Another way to say this is that the impact of 50% blockage on flow is much smaller if the coil does not represent the predominant flow resistance. This is one example of the second problem, which is that the data presented are not complete enough to draw any reliable conclusions. Another example is that the conditions of the air entering the evaporator are not specified. The reason this is important is that the impact of reducing evaporator coil flow depends upon the conditions under which that area restriction occurs. For example, if you start with dry-coil operation at the design flow rate, reducing flow will at some point result in wet-coil operation, at which point the sensible capacity will be reduced in favor of latent heat removal, which is in many cases not required in California. The main point is that the appropriateness of the data presented (and therefore the conclusions drawn) is impossible to verify without more complete information. This is a key tenant of the scientific method, which is presumably the standard by which this report should be judged.	Updating the analysis

Disaggregated Methodology	Shayne Holderby, Honeywell		Section 1.1 States that the evaluation team addressed high impact measure groups. Our understanding of this is DNV-GL only monitored the specific measure for savings as opposed to the system. HSGS and other groups including the WHPA, ASHRAE, ACCA and all of the IOU's have all commented on earlier evaluations that in order to determine actual savings you must consider the impact of all measures performed on the savings of the unit. We think it is necessary to determine the impact on all measures on the overall efficiency improvement of a unit in order to accurately determine savings. In each case where this issue is discussed with DNV-GL they continue to claim that they can estimate actual savings by a combination of lab testing and field testing. We feel this approach has not worked on multiple reviews for the following reasons: a. In each evaluation DNV-GL has not been able to achieve the statistically insignificant number of units claimed to be needed to perform an assessment and has instead used statistical calculations to try and estimate the impact of not performing the required field inspections. b. Lab studies conducted in a controlled environment by DNV-GLs own comments have provided inconsistent measurement of savings. If the savings cannot be determined with repeatable accuracy in the lab, how accurate can they be in determining the conditions in the field? c. Since the method chosen by DNV-GL requires so many variables in the lab environment and then compared to field measurements they have limited the number of tests to what are claimed to be the 5 most "relevant" measures. Without consideration as to the impact of the other 17 measures (non-incentivized) performed in the field they cannot possibly accurately predict actual energy savings of either the measures tested or the overall efficiency improvements created by the other measures.	We could only evaluate aggregated measures for the only program that claimed such measures: SCE. Because of the way PGE claimed savings it made the most sense to evaluate them on a measure basis.

Coil Cleaning	Shayne Holderby, Honeywell		Table 1 does not provide a realization rate for Coil Cleaning, maybe because PG&E was no longer claiming the incentive, however all the data for this activity was recorded and available to DNV-GL during their evaluation period? a. In all testing performed by DNV-GL the IOU and the implementers have informed the evaluator that all data for testing is contained in the implementers data record. In every study DNV-GL has claimed to not be able to locate the information but at no time has DNV-GL made any inquiries to any party to help find the relevant data.	We provided ex post savings based on new data from PG&E for coil cleaning.
RCA	Shayne Holderby, Honeywell	1.3.2	1.3.2 "A random sample of 25 single-compressor and 11 dual-compressor packaged rooftop air conditioners from project year 2013 was used for the assessment." Based on the size of the actual installed based (over 9000 units) this is well below a statistically significant number of evaluated units. a. Since DNV-GL has continually provided fewer units than they claimed would be required to determine energy savings and efficiency improvements; how are they able to make recommendations on actual energy savings without a significantly large margin for error?	The precision for the RCA measure is 47% at 90% confidence. This is statistically significant.
Economizers	Shayne Holderby, Honeywell	1.3.3	1.3.3 "DNV GL developed installation rates based upon the results of field inspections of a random sample of 123 units at 45 sites" That is for all three utilities to test Economizer savings. Again far below a statistically significant threshold. a. Comments made during the report review indicated that they inspected a significant number of Analog Economizers to determine functionality and savings estimates. In at least the PG&E CQM program replaced economizers must be DIGITAL (ADEC), if they were inspecting units with analog units they were only checking on repaired systems vs replaced systems (assuming the units checked were even enrolled in an IOU program).	We investigated multiple measures within the economizer measure group. Our investigation included economizer repair and economizer replacement measures as well as controls repair and controls replacement.

Thermostat	Shayne Holderby, Honeywell	1.3.4	1.3.4 "DNV GL developed installation rates based upon the results of field inspections of a random sample of 56 units at 11 sites." Testing for T-Stat installations, again way below a statistically significant number and also not providing IOU specific data so no idea if they were actually inspecting units where t-stats had been reprogrammed, replaced or not changed.	The thermostats that we inspected had been reprogrammed or replaced through the program.
Specify sampled units	Shayne Holderby, Honeywell	2.1	2.1 "Robert Mowris & Associates, Inc. (RMA) and two independent subcontractors helped DNV GL achieve these objectives by reviewing program data and collecting new primary data that support defensible ex post savings estimates." a. In previous reports from these evaluators we requested significantly more data on what was checked and where the systems were checked. Instead of providing more data to help IOUs evaluate the claimed results the latest report includes virtually no field specific information to allow for review of results. b. Based on previous claims of units where incentives were claimed for repairs and equipment was not functioning (WO32 report), followed up by our Quality Control staff inspections it was determined that several units inspected for specific measures did not have those measures performed or where statements were made about non-functionality it was clear from pictures provided that the ADEC actually showed test passed (functional). No such documentation has been provided with the most recent evaluation limiting our ability to	Data provided as Appendix
Coil Cleaning	Shayne Holderby, Honeywell	3.1	3.1 "Condenser and evaporator coil cleaning data is non-existent for the QM programs, but cleaning data is available for the tune up programs." The preceding statement is false. All data for Condenser and evaporator data is present in the contractor portal for every unit brought to baseline.	PGE CQM coil cleaning claims have been located.

Economizers	Shayne Holderby, Honeywell	3.1	3.1 "Economizer: The economizer information was inconsistently populated across the programs, and was not useful to the measure evaluation. In particular, the pre-implementation and post implementation changeover set point data was unpopulated and could not be used to validate the assumptions in the models used to develop ex ante savings". Obviously incorrect as the question must be answered for the incentive for this measure to even populate in the Implementers portal. An example is provided below of the required questions and responses.	There may have been a problem with the data that we were provided
Thermostat	Shayne Holderby, Honeywell	Table 4	Table 4 Target Sample indicates a total of 15 sites out of a potential 800 were selected to represent the entire program for PG&E C-QM. Further on in the documentation it becomes clear that DNV-GL actually used only 3 sites to make the determination for all units enrolled in the program.	There were eleven sites overall completed in the sample from PGE's CQM program: 8 Economizer and 3 RCA. As stated in the research plan, results for all programs were combined for
Coil Cleaning	Shayne Holderby, Honeywell	3.3.1	3.3.1 States "DNV GL planned to complete inspection of 45 HVAC units on ride-along visits with implementation technicians focusing on the coil cleaning measures. A total of 28 units across five sites were successfully inspected due to logistical limitations. Site inspections were focused in the southern California area because most of the coil cleaning was done in SDG&E territory." Obviously not reflective of PG&E C-QM, this statement conflicts with other statements regarding the sites chosen and inspected. In addition in this instance DNV-GL did provide the unit sticker numbers for a total of 5 units and we tracked the review to a single site located in the worst possible area for Coil Cleaning verifications. Bakersfield, CA. is listed as the "worst possible" site because it is high wind, dust area where even well maintained systems will show some degree of contamination in a very short period. It is certainly not reflective of the average rooftop location of the other 7000 enrolled units in the C-QM program.	Coil cleaning was not evaluated for PGE CQM because no claims were made.

Coil Cleaning	Shayne Holderby, Honeywell	Table 6	Table 6 identifies that only 5 sites in PG&E territory were actually visited as a ride-along. HSGS believes this sample is not statistically significant. No indication of what four of the five sites visited were so again the ability to review and comment on the specific conditions found at the "test" sites is withheld from the IOU and implementer in reviewing the reports findings.	The focus of the ride along effort was to evaluate coil cleaning measures. PGE CQM program coil cleaning was not targeted in this study because no coil cleaning claims were made.
Coil Cleaning	Shayne Holderby, Honeywell	4.1.4	4.1.4 Ride along data provided by DNV-GL indicates they visited sites where coils had not been cleaned in 18 and 36 months prior to the site visit. That does not match our program requirements. In addition based on the sticker numbers an evaluation of coil cleaning was claimed from the visit of 1 site in our program. All sticker numbers belong to <Site Name and Contractor Name Redacted>	Correct, one site was visited in PGE territory. PGE CQM program coil cleaning was not targeted in this study because no coil cleaning claims were made.
Coil Cleaning	Shayne Holderby, Honeywell	Table 11	Table 11 Based on the findings PG&E C-QM units were closest to the most optimal energy efficiency state prior to the coil cleaning evaluation. PG&E units showed the smallest change in discharge pressure and EER between pre and post cleaning state indicating the units were already clean. The report seems to indicate this as a negative as it gave a higher rating to SDG&E sites where the greatest difference between pre and post cleaning was present. Not sure of the confusion but the change from pre to post cleaning would indicate sites in SDG&E were actually in worse shape (dirty) when visited than those in PG&E territory.	When the coil is already clean there is smaller savings from cleaning it again than when the coil starts out dirty.
Coil Cleaning	Shayne Holderby, Honeywell	Table 11	Table 11 HSGS confirmed units were cleaned no more than 11 months prior and as little as 7 months prior to the site visit by DNV-GL based on data in the contractor portal and inspection reports. a. Again since DNV-GL did not request to review the information prior we are unsure how the evaluator made the determination as to the time between the last cleaning and the test visit.	These must be the Bakersfield units that you are referring to. They were removed from the data since coils had been cleaned through the 13-14 program. Exact date of cleaning was unknown.
Coil Cleaning	Shayne Holderby, Honeywell	Table 13	Table 13 Currently PG&E C-QM gets no savings from coil cleaning because it was removed as an incentive back in 2013. Regardless of incentive payment the report was supposed to focus on savings achieved. We do not understand how DNV-GL made the determination to exclude all savings attributed to coil cleaning from the PG&E review.	claims. No savings were claimed by PGE CQM for the coil cleaning measure, either singly or as part of another measure. We have gone back to provide ex post savings to PGE CQM coil cleaning based on additional data provided. The data do show

RCA	Shayne Holderby, Honeywell	Table 27	Table 27 values are not supported by the testing data. DNV-GL appears to have combined results from both ACP and C-QM (Table 23) even though both programs provided sufficient independent data? Table 18 appears to indicate that C-QM had the least Post Treatment charge offset from expected but the Table 27 evaluation indicates poor Ex Post Realization rates. Since no specific unit data is provided for this testing we have no ability to verify or understand the findings.	As stated in the research plan, all RCA data was combined to arrive at savings since no one single program had sufficient data on its own. ACP and CQM data were only combined in coming up with the over/undercharge distribution, and 80% of the data used was from CQM. The data will be provided in an appendix. Program-specific realization rates
Specify sampled units	Shayne Holderby, Honeywell		During the previous W032 report it was noted several discrepancies between reportedly tested sites and the findings of those sites. It appears according to Table 31 DNV-GL has reverted from using identifiable information to DNV-GL site labels which we cannot verify, inspect or determine if any of a dozen different conditions apply to the inspected unit: a. Is the unit even eligible in the program b. Was the unit even enrolled, because it's on the roof and sticker is present does not mean its enrolled. Customers refuse to allow corrections and the unit could have been made ineligible. c. Was the testing of the economizer operation conducted properly, we have no way to test and verify. d. Making the identification of units not readily available leads to no benefit in determining both energy savings and corrective actions needed. e. Since we also conduct and record QC evaluations for many baseline installations we could use our data to determine if a site had a working economizer rather quickly if the proper test data was provided for review.	Sticker numbers will be included in the data provided in the appendix.

Calibration Process	SCE	1.3.1 – Coil Cleaning measure group results (6)	"Using the laboratory relationships for condenser coil cleaning, with ambient temperature and relative discharge pressure data points from the site visits we calculated the improvement in system efficiency and cooling capacity as a result of condenser coil cleaning. The revised efficiency and capacity were used to develop simulation input parameters to calculate the ex post savings estimates "Was there any calibration process applied to this? Calibration process and methods should be detailed/clarified. Were determined "condenser coil cleaning relationships" applicable for all territories (CZs)?	Yes, the relationships were applicable to all climate zones. No calibration process was necessary as the simulation was not used on specific buildings, but on prototype models.
Evaporator Coil Cleaning	SCE	Section 1.3.1 (6)	While the laboratory results show impact from condenser coil cleaning, they showed negligible impacts of treating evaporator coil blockage, and currently no impacts from cleaning evaporator coils are supportable based on the laboratory data. This statement seems to contradict the impact on Sensible EER* as shown in Figure 2, Appendix I (page I-3), The graph shows an 8% decline in EER*with a 10% decline in Evaporator Airflow. Given the hot and dry climates of California, this decreased in efficiency should result in measurable savings and should not be ignored.	Evaporator coil cleaning data analyzed and included in report. Evaporator coil cleaning savings are now non-zero.
Calibration Process	SCE	1.3.2 - Refrigerant charge adjustment measure group results (Page 6)	"These data were linked to laboratory research results (developed in a related laboratory study) that established the relationship between various charge conditions to EER, sensible and total cooling capacity. Revised EER and capacity from the analysis were then run through the appropriate DEER prototype simulation models to calculate ex post savings from the observed ex post parameters "Not clear what level of calibration and/or validation was included in this process if any. Need to detail/clarify calibration process and methods utilized for field/lab data and projected EERs. What was the process/methods for normalizing/accounting for different outdoor conditions?	No calibration process was necessary as the simulation was not used on specific buildings, but on prototype models. Normalization for different outdoor conditions is necessary when calibrating to actual billing data. Not applicable here.
Economizers	SCE	1.3.3, p.7	Combined program results on economizer installation rate at 56% - SCE @ 82%, much improved since last evaluation. Attributable to Economizer training?	Unknown if training is the reason for the improvement.

Evaluation Methods	SCE	1.3.3 Economizer repair measure group results (Page 7)	"During the inspections, functional testing of the economizers was performed to determine if the economizers were operating properly. A site-level installation rate was then calculated as the number of properly functioning economizers divided by the number of economizers tested. "Need to define/describe criteria for determining a "properly" working economizer. Need to define/describe functional tests and functional test procedures utilized/developed for evaluating economizer operation.	The economizer procedure is detailed in the appendix.
Evaluation Methods	SCE	1.3.4 Thermostat adjustment measure group results (Page 7)	"The thermostat adjustment measure group saves energy by adjusting the occupied and unoccupied thermostat set point schedules to reduce the required cooling and heating energy." Thermostat measures are highly dependent on climate conditions (CZ), building types, and human behavior with a high degree of variant from building to building, occupancy type to occupancy type, from site to site, etc. Buildings in CZ with higher "cooling degree" requirements and/or significant temperature fluctuations throughout the day and season variations may be more prompt to comply with thermostat and equipment operating control type of measures and associated measure implementation requirements. Describe reasoning, testing and functional testing procedures and characterization utilized for evaluating this type of measures.	Climate and building type variations are handled by the simulations.
RCA	SCE	1.4 Conclusions and recommendations (Page 9)	"RCA: A critical piece of information was the amount of charge added or removed from the units by the program for sampled units with savings claims" As part of this evaluation, were there any specific recommendations on current methods and/or procedures used by Utilities for evaluating and determining Refrigerant charge?	Lab report and the WO32 report has specific findings and recommendations on diagnostic procedures. This report did not focus on diagnostic procedure because they are covered elsewhere.

Record Review and Recommendations	SCE	1.4 / 8-9	Many of the recommendations from the records review are already implemented within the SCE CQM program:-Collect discharge pressure and outdoor temperature before and after coil cleaning.-'Collect both the existing ("test-in") and modified ("test-out") economizer changeover set point. The program additionally collects information around each and every component in the economizer section, asking the technician to specifically address each component's status and to enter recommendations for repair, replacement, cleaning, or adjustment of each of these components.-Collect existing ("test-in") and modified ("test-out") thermostat set point.-Collect existing ("test-in") and modified ("test-out") supply fan control fan state.	In some cases these data fields were sparsely populated. We recommend additional QC of the data.
Record Review and Recommendations	SCE	1.4 / 9	"Requiring the implementers to submit a photograph of the economizer open and closed for each claimed economizer would necessitate the implementer putting the economizer through its paces after installing the measure and increase the number of economizers left in working order."SCE CQM already collects alternate documentation in the form of written technician verification which highlights economizer component condition before and after any repairs are performed. Photos alone would not provide such clear verification nor would they augment verification due to realistic issues with complex rooftop lighting conditions and unit identification (do the dampers	SCE economizers performed quite a bit better than those in other programs. The strategies seem effective.
Economizers	SCE	1.4, p. 9	"Repaired" economizers that did not operate – for SCE at 82%, were inoperable systems primarily analog or digital? Economizer training had not previously been required for the program unless participant was applying for an ADEC incentive – gap has been addressed. Economizer training is now mandatory for technicians performing work in CQM. It includes: analog, digital, dcv/vfd.	[illegible] economizers was 82%, which means that 18% were non-operational. We are investigating the breakdown of analog vs digital controllers in our economizer sample and the breakdown for failed vs working
Participation Records Key Findings	SCE	3.1 / 20	"Only the PGE Commercial QM and SDG&E Direct Install program implementers recorded pre and post-implementation thermostat set point temperatures." (p.20)The SCE CQM program does collect pre and post-implementation thermostat set point temperatures and fan setting.	Those fields were poorly populated in the SCE data.

Feedback/ recommendations on measure implementation methods – Economizer Repair	SCE	1.4 Conclusions and recommendations (Page 9)	"Economizer repair: We found many economizers "repaired" through the programs that did not operate"As part of this evaluation, were there any specific comments and/or recommendations on functional and/or functional test procedures that IOUs shall include to improve evaluation of this measure?	The specific procedures can be found in the appendix. Furthermore, the WHPA is releasing an economizer document that addresses these issues.
Evaluation Methods – Interactive effects	SCE	2.4 Field M&V approach (Page 18)	"Thus, data were collected on observed operational parameters and conditions such as the amount of refrigerant, pressures, temperatures, and set points. We collected data on the settings, quantities, and other parameters that go into savings calculations, which allowed the team to use either an engineering model, a prototypical building simulation model or a combination of the two to generate total savings…"Where interactive effects among measures evaluated? Describe reasoning and/or basis for excluding interactive effects? If evaluated, for which measures are interactive effects expected to significantly affect measure impacts? Similarly, for which measures are interactive effects expected NOT to significantly affect	The measure level analysis was motivated in part because of how measures were tracked by other IOUs. There are limitation of the measure approach (interactive effects not considered), but unit pre/post kWh analysis was very difficult last round and needed an extremely large sample because of large CV.
Evaluation Methods – Economizer failure	SCE	2.4 Field M&V approach (Page 18)	"…if the economizer is not operational, the unit energy consumption will be increased, but how much will depend on the building and location of the unit. Once we know the average frequency of failed economizers, this effect can be modeled across the population of units taking into account building type and climate zone."As part of this evaluation, was economizer (damper) failure position evaluated? From sampled population of systems what was the economizer (damper) failure rate at 100% open, 75% open, 50%, 25% open, and % fully closed? Was reasoning/diagnostic for damper and/or damper actuator failure evaluated? Broken linkage, incorrect response to temperature signal, non-functional temperature sensor and/or damper actuator, incorrect	Final report to include more discussion of economizer failure. Unfortunately, the evaluation was not able to perform economizer simulations.
SCE QM measure Ex ante % of overall	SCE	Pg 19	The approach to SCE's quality maintenance measure (only 6.1% of overall evaluated ex ante savings)…" Table 2 shows QM is 11%, why is it stated as 6.1% here?	Typo. Should be 11%

Sample Design	SCE	3.2 / 23	In Table 5, "Achieved Model Parameter Dataset Size" was larger than the Planned Model Parameter Dataset Size yet achieved a larger +/- 56% precision at 90% Confidence Level. Why wasn't a greater precision achieved with the larger-than-planned dataset size?	Because of larger than planned coefficient of variation (CV)
Evaluation Methods - RCA	SCE	3.3.1 Implementation ride-along visits (Page 23)	"During the ride-along visits, DNV GL first corrected the refrigerant charge and installed clean filters, then collected data on the change in compressor suction and discharge pressure as well as the static air pressure and airflow across the evaporator coil to assess the system changes before and after evaporator and condenser coil cleaning."Where specific testing procedures and/or functional tests developed and/or adopted by DNV GL for RCA and/or other measures as part of this process? Are these included and overviewed in this report? How these procedures compare to those used by the Utility programs?	The RCA weigh-out procedure is described in the appendix, but is not necessarily recommended for use within utility programs
Implementation ride-along visits	SCE	3.3.1 / 24	Why did none of the five planned SCE CQM ride-along visits occur indicated by Table 6?	Delays in some aspects of the study caused a timing issue and the remaining ride alongs were not fielded in favor of completing
Economizers	SCE	3.3.2 Post-performance site visits (Page 24)	"Determining the economizer functionality, control sequence, and changeover set point"Where functional test procedures developed and/or adopted by DNV GL for economizer measures as part of this process? Are these included and overviewed in this report? How these compare to those used by the utility programs?	The specific procedures can be found in the appendix. Furthermore, the WHPA is releasing an economizer document that addresses these issues.
Laboratory data	SCE	Pg 29-30	• Were the relative discharge pressure increases done with psia or psig?• What relative discharge pressure increases would have caused tripping of high pressure switches for each HVAC system?• Were cardboard blockages applied to multiple condenser faces?• Were there observations of airflow direction changes with high condenser blockages?	Relative discharge pressure increases were done with psig. Unknown what pressure would have tripped high pressure switch. Yes, cardboard blockage was applied to multiple condenser faces. No observation of airflow direction change noted.
Coil Cleaning	SCE	Pg 30-31	Why were the equation fits for coil blockages done using only data from non-txv systems?	All the field data were from Non-TXV systems

Laboratory data	SCE	4.1.3 / 31	"The accuracy of the laboratory testing instrumentation is 4% so relative impacts for most levels of blockage are within the margin of error of the individual tests. Even without considering the instrumentation error band, the results showed minimal efficiency and total capacity impacts from reducing evaporator coil blockage. Because of this, we decided that evaporator coil cleaning has savings that are too small to be measured. Also, note the workpaper estimates are not supported by the latest lab test data even at the maximum blockage rate."The disposition UES values for evaporator coil cleaning assume 6.25% of refrigerant charge adjustment savings, which could be within the 4% instrumentation error. Again, the cardboard cover methodology does not appropriately test the negative impact on coil heat transfer as accumulated dust and debris would which decreases the impact the instrumentation could have detected.	The evaporation coil cleaning section has been re-written and data re-analyzed. Measurement error is in fact lower than 4% for the laboratory measurements.
Evaporator Coil Cleaning	SCE	Pg 31-32	There isn't enough detail made available about the evaporator coil blockage lab data to draw meaningful conclusions. Use of a non-uniform method like directly blocking a coil with cardboard, and only reporting % area blocked is problematic. Completely blocking off a surface forces air to move around through the unblocked portions, with increased velocity, which changes how the coil surfaces are utilized for heat transfer. The fault severity is also not clear. % area blockage doesn't tell exactly how much airflow is being restricted, which is the dominant effect of fouling. ASHRAE SPC207 FDD test method group consensus is that a uniform method is best for implementing this kind of fault, such as restricting the return air or supply air, and tracking using measured airflow. (http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=2306&context=iracc).	The graphs have been changed to show airflow reduction instead of coil blockage.

Evaporator Coil Cleaning	SCE	Pg 31	Why are savings considered too small? Previous disposition was that it made up 25% of RCA UES. LBNL study shows that evaporator coil fouling can double the pressure drop (constant flow) within 7.5 years of accumulation in a residential system (see link below): http://epb.lbl.gov/publications/pdf/lbnl-49757.pdfThis is likely worse/ accelerated for commercial applications, especially if kitchen conditions/grease contribute to fouling. SCE lab tests saw maximum evaporator airflow reduction faults air-side-calculated efficiency reductions of 17%, 20%, & 26% at 80F, 95F, and 115F OD conditions, respectively (see link below):http://www.etcc-ca.com/reports/evaluating-effects-common-faults-commercial-packaged-rooftop-unit	Evaporator coil cleaning data analyzed and included in report. Evaporator coil cleaning savings are now non-zero.
Coil Cleaning	SCE	Pg 33	"all units whose metering device could be determined during field data collection were non-TXV units" How many were able to be determined vs those that couldn't? Why couldn't it be determined in those cases? Why does this trend not match with implementers' data in Tables 21, 22, and 23, which show significant #'s of TXV systems?	be determined and all were non-TXV. It does not match implementers data because the sample was very small. We don't expect large differences in coil cleaning savings from one metering device to the other, more important is to match
Laboratory data	SCE	4.1.3 / 27	The laboratory test conditions do not seem to reflect a realistic standard for preventative maintenance – cardboard blocking of condenser coils does not accurately recreate the roof top design conditions where all of the condenser fins are coated with dirt/grime/grease as the heat transfer gradually declines. The same applies to the evaporator coil lab testing, which could have benefited from a testing methodology that appropriately affected heat transfer degradation.	procedure does not fully replicate real world coil fouling conditions in a laboratory. Report edited to acknowledge this limitation and that other studies have yet to develop a procedure to replicate dirty coils or to quantify typical level of dirtiness/change in heat transfer. That said, for condensers the field measured change in compressor discharge pressure captures all the effects and when replicated in the lab should produce reasonable impacts on compressor power with some uncaptured effects on capacity. For the evaporator coil because the field measurements show

Thermostat	SCE	4.4.3 / 62	Regarding Table 35 "Thermostat field verification results":Why weren't all of units claimed to have the measure installed at the sites inspected? There were reasons given why only 11 of the 15 sites could be visited but no reasoning provided for why not all the units on the site were inspected (ex: "Quality Maintenance" claimed 70 units in the ex ante tracking, only 17 units were inspected, 3 found to properly install the measure).	IPMVP within-site sampling techniques were used to determine how many units were inspected at each site. It is not cost-effective to inspect each unit at a site.
Thermostat	SCE	4.4.3 / 62	It appears that there was not adequate field verification to support the particularly low state-wide installation rate for this measure, let alone for the SCE CQM program which was not part of the field verification sampling. Due to the nonexistent sample size, the installation rate for this measure should be handled the same as the Supply Fan Control installation rate for SCE CQM, which was assumed 100% installation rate.	Agreed, not adequate field data. Thermostat measure ex ante savings are passed through.
Thermostat	SCE	4.4.3.3 / 63	"As previously mentioned, the tracking data does not report thermostat measures for the SCE QM program. Of the 5,823 HVAC units in SCE implementer data, there are 2,778 thermostat adjustments. New and existing thermostat types are provided. However, it is not possible to assess if these units qualify with implementer data as the revised set point temperature field is sparsely populated. The implementer data provides no information to corroborate or refute the installation rate found on-site."Thermostat set points for both the existing thermostat and replaced thermostat are required data collection fields, meaning they are not allowed to be "sparsely populated". No SCE CQM sites were included in the on-site sampling for this measure and thus cannot adequately evaluate the installation rate for this measure, similarly to the Supply Fan Control measure.	17 thermostats at 6 SCE sites were inspected in this evaluation and only 3 of them met the criteria for the installed thermostat measure. The implementer data provided to us by SCE was sparsely populated. Perhaps there was additional data that was not provided.

SCE CQM Program Savings by Measure	SCE	4.6.3 / 71	Regarding Table 42 "SCE QM program savings by measure": There is no clear explanation for why the ex post kW savings were so much lower than the realization rate for kWh savings and it is impossible to confirm either ex post savings calculations with the report information. A breakdown of the treatment frequencies according to building type, climate zone, and unit type would allow the ex post savings calculations to be reviewed.	Frequencies across the program are shown in Table 41. The same frequency was applied across all building types and climate zones. UES by building type and climate zone are shown in the appendix for RCA and Coil cleaning. The RR for economizers was 82% and for thermostats was 30% as described in the text. These values were applied to the May
SCE CQM Program Savings by Measure	SCE	4.6.3 / 71	Regarding Table 42 "SCE QM program savings by measure": There is a potential error in the table where it states that there were only 600 claims for "QM w/ Economizer" yet that measure package provided by far the highest savings. Gas heated units with economizers are by far the most prevalent unit type in the program but the numbers in the table indicate otherwise. The number of claims here tends to indicate that it refers to the number of units rather than measures. Again, more clarity around these values and calculations would allow the results to be confirmed, especially since the SCE CQM program was the only program to go through this methodology	Typo, Economizer with HP QM reversed with Economizer QM.
SCE Condenser Coil Cleaning Unit Energy Savings	SCE	Appendix Simulation Results / B-3 and B-4	Regarding the two tables for "SCE Condenser Coil Cleaning Unit Energy Savings":Both tables only have 4 of the 8 SCE climate zones represented by the Condenser Coil Cleaning simulation results while the Refrigerant Charge Adjustment simulation results for SCE (B-8) have 7 of the 8. Why were some of the climate zones simulated for Refrigerant Charge Adjustment but not the other, more prominent Condenser Coil Cleaning?	Simulations have been re-run and are now consistent across SCE climate zones.
SCE CQM Program Savings by Measure	SCE	Appendix C Evaluated QM Programs (C-14)	Regarding Table 5 "SCE commercial QM program activity (2013-14)":The table identifies 15,959 claims for HVAC Maintenance at only 115.9 kW, or 0.00726 kW per claim. A 48% ex post realization rate places the kW per claim at 0.00348 kW. How is it possible that these activities amount to less than 2% of the coil cleaning savings alone in other utilities?	Typos in Table 5 Appendix C. now corrected.
SCEAddendumcomAttach_2801.pdf	SCE	NO COMMENTS	NO COMMENTS in SCEAddendumcomAttach_2801.pdf	OK

the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	Remove incorrect data and add correct data and analysis discussed in these comments.	Data has been modified as we feel is appropriate.
the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	Add field measurements of evaporator airflow before and after replacing dirty filters and cleaning coils on 4 units (3 in PG&E and 1 in SDG&E) and airflow measurements for 24 units with clean filters before and after only cleaning dirty evaporator coils.	Evaporator coil cleaning data analyzed and included in report.
Comments on the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	Add corrected analysis of HVAC maintenance measures using the application sensible energy efficiency ratio (EER*s) based on laboratory test data. All figures providing total capacity or total EER (or EIR) and analyses based on these metrics (including DOE-2 simulations) should be removed from the HVAC03 report since these data provide misleading or incorrect results.	The data in the report represents what we think is the most accurate and best representation of the laboratory and field data gathered through HVAC-3 and HVAC-5 efforts.
Comments on the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	Add data and analysis of condenser and evaporator coil blockage EER*s impacts versus time for all field measurements using laboratory test data to evaluate EER*s impacts.	We don't believe there is sufficient data to support this analysis.

Comments on the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	Add corrected analysis of supply fan control and replace thermostat measures based on information provided in these comments.	Not adequate field data for thermostat and supply fan measures. Thermostat measure ex ante savings are passed through.
Comments on the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	If the HVAC03 report is corrected satisfactorily, please remove Appendix I based on one site visit in PG&E and replace with the partially completed RMA HVAC03 pilot study report based on 4 site visits in SDG&E and 1 site visit in PG&E including 35 refrigerant recoveries, 28 coil blockage, 24 economizer, and 15 replace thermostat measures.	We did not make all changes recommended by RMA. The RMA work on the pilot work of this project remains part of this document.
the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	In the future, require complete program databases prior to preparing research plans.	Noted
the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	Require deliverables of all reports for pilot studies prior to initiating field observations.	This recommendation will be taken going forward

the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	Require all EM&V studies to adhere to the AEA guidelines for data-based systematic inquiry, competence, integrity, respect, and responsibility for all stakeholders.	Noted
the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	Require higher quality data, analysis, and reports with greater transparency, oversight and accountability (i.e., field and laboratory test measurements must be available for review).	This recommendation will be taken going forward
the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	Field measurements must be initiated during program implementation and analytical methods need to be as simple as possible and no simpler.	Noted
the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	Conflicting errors and omissions in the HVAC03 report and previous WO32 EM&V report combined with misunderstanding how to use laboratory test data for evaluations indicate problems with laboratory tests being managed by CPUC EM&V contractors.	Laboratory test data informing prototype simulations for use by ex ante and ex post evaluation has always been the objective of ED and it is why ED approved funding of laboratory testing.

Comments on the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	The most important failures appear to be the EM&V studies and not HVAC maintenance programs which have received "false alarms" of unacceptably poor load impact evaluations for many years based on erroneous EM&V studies	adjustment programs have been proven by recent laboratory testing on fault diagnostics. The programs then evolved and challenges remain to estimate impacts on an ex ante and ex post basis. ED is encouraging new approaches to these programs and their evaluation under new policy directives. Therefore the programs and the
Comments on the HVAC03 Impact Evaluation Report of 2013-14 Commercial Quality Maintenance Programs	Robert Mowris & Associates, Inc.	1	For the sake of the customers, we recommend master HVAC technicians revisit 118 units where used refrigerant was put back into systems and recover the refrigerant, evacuate to 500 microns, and recharge with new refrigerant. We also recommend master HVAC technicians revisit all economizers tampered with by non-master technicians to check operation and ensure economizers are functional.	Not necessary. Our teams performed all work in a professional manner.
Laboratory data	Robert Mowris & Associates, Inc.	3	Correct laboratory testing instrumentation accuracy to 1%. Add the average uncertainty for laboratory tests of sensible capacity to 0.6% and EER*s to 0.8%.	Noted
Evaporator Coil Cleaning	Robert Mowris & Associates, Inc.	8	All coil blockage figures or tables should be replaced with figures showing airflow since coil blockage cannot be measured in the field. The HVAC03 report should include field measurements of evaporator blockage for 28 units and provide laboratory data for sensible capacity and EER*s. The load impact analysis should focus on the 4 units where airflow was measured before and after replacing dirty filters and cleaning dirty coils. The realization rate for evaporator coil cleaning should be 47% based on the EER*s impact of	Evaporator coil cleaning data analyzed and included in report. Evaporator coil cleaning savings are now non-zero.
Coil Cleaning	Robert Mowris & Associates, Inc.	11	Figure 11 should be replaced with a figure showing discharge pressure since coil blockage cannot be measured in the field and total capacity and EER should be replaced with sensible capacity and EER*s. The realization rate for condenser coil cleaning should be 16.2%. The savings are based on an EER*s impact of 2.1%.	Figure 11 already shows relative discharge pressure increase on the x-axis.

RCA	Robert Mowris & Associates, Inc.	15	The RCA realization rate should be 98.9% for all HVAC maintenance programs based on the 35 units with correct refrigerant recovery data. Used refrigerant was put back into 118 units without obtaining the owner's permission based on full disclosure of potential problems caused by putting used and contaminated refrigerant back into systems. For the sake of the customers, we recommend master HVAC technicians revisit these units to recover used refrigerant, evacuate to 500 microns, hold at or below 1000 microns, and recharge with new refrigerant.	We had permission to refill systems with old refrigerant
Field Measurements of Economizer Repair and Controller Performance	Robert Mowris & Associates, Inc.	16	Revise the economizer realization rates to 91.7% for all programs. Remove all discussion of other economizer observations and DOE-2 simulations which are irrelevant. Removing wires and changing minimum damper positions can cause economizer failure and is not a recommended test method. For the sake of the customers, we recommend master HVAC technicians revisit these units to check economizer operation and ensure the economizers are functional.	We believe our staff were competent and the methodology sound.
Thermostat	Robert Mowris & Associates, Inc.	17	Based on the 100% installation rate found by master HVAC technicians, the HVAC03 report installation rate appears unrealistically too low. Therefore, we recommend master HVAC technicians revisit these sites to ensure new thermostats were installed. If this cannot be double-checked, then we recommend an installation rate of 100% for replace thermostats.	We are confident in the ex post findings even though they are inconsistent with pilot findings.
Supply Fan Control	Robert Mowris & Associates, Inc.	18	Provide 100% realization rate for supply fan control based on insufficient statistical evidence to support realization rates less than 100%.	Agreed, not adequate field data. Supply Fan Control measure ex ante savings are passed through.

Field Measurements of Outdoor Air Fractions	Robert Mowris & Associates, Inc.	18	Remove any mention of OAF being measured at OAT less then 20F. The OAF measurements are not relevant to the report since no program claimed economizer perimeter sealing (EPS) savings or optimizing damper positions to reduce OAF. The discussion of OAF appears to be related to DOE-2 simulations which are opaque meaningless to the evaluation which focused on installation realization rates. Remove all discussions of irrelevant DOE-2 simulation modeling and results. Correct figures showing power measurements of units since no power measurements were performed under HVAC03.	Outside air fractions were not measured in the field.
American Evaluation Association (AEA) Guidelines	Robert Mowris & Associates, Inc.	20	If the HVAC03 report is not corrected satisfactorily, then please remove Appendix I from the report and any mention of master HVAC technicians and Robert Mowris & Associates, Inc. If the report is corrected satisfactorily, then please remove Appendix I based on 1 site visit in PG&E and replace with the partially completed RMA HVAC03 pilot study report based on 4 site visits in SDG&E and 1 site visit in PG&E including 35 refrigerant recoveries, 28 coil blockage, 24 economizer, and 15 replace thermostat measures.	We did not make all changes recommended by RMA. The RMA work on the pilot work of this project remains part of this document.