HVAC Permitting: A Study to Inform IOU HVAC Programs

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1. Executive Summary

California's evolving and complex energy regulatory environment and diverse climates make it challenging for investor owned utilities (IOUs) to implement heating, ventilation and air conditioning (HVAC) incentive programs uniformly across service territories. A major concern for IOUs is whether replacement HVAC systems that are incentivized under such programs are obtaining permits by the local code enforcement agencies as required by law. Energy code requirements are specific to the geographic location of an HVAC system (climate zone or CZ) and conditions set by the existence of supportive hardware for the system (e.g., new or replaced ducting), and are up to the discretion of local building regulatory agencies to enforce. These factors make it difficult for IOUs to implement programs with uniform standards and requirements are permitted. This report focuses on complete HVAC system replacements, referred to as a "change-out" throughout.¹

Pacific Gas and Electric Company (PG&E) asked DNV GL to answer two primary questions. The first was to estimate the proportion of change-outs that applied for a mechanical permit as required by local building code. The second was to find out to what extent energy efficiency performance differs for three energy-related metrics (duct leakage, airflow, and system sizing) in residential change-outs that did and did not receive a permit.

The answers provided in this evaluation are meant to inform the 2013-2104 pilot HVAC Residential Code Compliance Program (referred to as Code Compliance, throughout) and provide feedback for the residential HVAC Quality Installation (QI) Program, which has been in existence since 2010. The two programs focus on different issues related to HVAC change-outs, but have a common goal of improved system performance that leads to reduced electric energy and power consumption. They also share an assumption that is tested in this study; that getting a permit, which activates energy code requirements, will result in optimal HVAC unit performance.

The QI program assumptions use only a subset of the mechanical change-out requirements set by the Standards and do not take into account local jurisdiction differences. This allows for

¹ There are two types of HVAC replacements defined by the 2008 California Energy Commission (CEC) Title 24, Part 6 Energy Code Standards (Standards): (1) a new or replacement spaceconditioning system, and (2) an altered space-conditioning system. The Standards define it as a space conditioning system that is altered by the installation or replacement of the air handler and outdoor condensing unit of a split system air conditioner or heat pump. http://www.energy.ca.gov/2008publications/CEC-400-2008-001/CEC-400-2008-001-CMF.PDF

uniform program delivery across the IOUs, but it is a considerable limitation of this study, which used data from its recent evaluation. This study also used sampling methods from multiple data sources, so the findings aren't statistically rigorous enough to extrapolate to the entire state. The findings are only intended to inform QI and Code Compliance program implementers.

The Code Compliance program began in the 2013-2014 program cycle and is still in its infancy, but IOUs expect the incentive to be available the third quarter of 2014. The program has collected preliminary data to develop a baseline of permit rates pulled from a few local building departments that are served by the program. The baseline data will eventually serve as a measure of change due to program intervention, but currently is intended to provide a reference point to inform program planners on the frequency of permitting by providing statewide estimates across several code enforcement agencies. The data does not establish an absolute baseline given the statistical rigor applied and potential biases that may exist in one or more of the secondary data sources used. The program is further defined in Section 3.1.1 of this report.

The activities in this study included searching for evidence of mechanical permits in a sample of 350 commercial- and residential-change-outs at 109 local code enforcement agencies (referred to as building departments or BDs throughout the report). The sample contained both program incentivized and non-incentivized equipment. Throughout this report, non-incentivized equipment is defined as HVAC change-outs that did not receive an IOU-sponsored incentive and incentivized equipment as incentivized change-outs. A sub-sample of sites was also used to test QI program assumptions for the three program measures—duct leakage, airflow, and system sizing.

The on-site sample in this report was derived from DNV GL's previous evaluation, measurement, and verification (EM&V) of the 2010-2012 QI program for the California Public Utility Commission (CPUC), the government entity that approves energy savings. In that study, consultants conducted field tests on a sample of participant homes and compared it with a closely matching sample of non-participant homes. The non-participant sample was used to test the QI assumptions for the three program measures.

This study also leveraged secondary data from a variety of sources including program tracking data, market saturation studies, and impact evaluations. A brief and list description of the secondary data sources, including CPUC work orders (WO) used in this report is as follows:

- **HVAC Market Effects Study (CPUC W054):** Telephone surveys identified recent HVAC replacement installations among residential and commercial customers.
- California Lighting and Appliance Saturation Study (referred to as CLASS): Telephone calls with follow-up on-site inspections identified replacement installations among residential customers.

- **Commercial Saturation Study (CPUC WO24 referred to as CSS):** Telephone calls with follow-up on-site inspections identified replacement installations among commercial customers.
- Upstream Commercial Incentive Program Tracking Data (referred to as Upstream): The participants were HVAC distributors, no contact with customers who received new equipment. The study leveraged tracking data of high efficiency HVAC installations at commercial businesses for program years 2010-2012.
- Quality Installation Residential Rebate Program Impact Evaluation (CPUC WO32 referred to as QI):² No participant contact. Telephone calls with non-participants followed by on-site inspections identified replacement installations among residential customers whose HVAC systems had characteristics of the participant population for program years 2010-2012.

The secondary data sources are defined in 4.1 (Table 2: Data Source Matrix), the primary data collection methodology defined in Section 4.1, and the results are defined in Section 4.3.

1.1 Permit Rates

The rate of permitting was derived from the frequency of known HVAC change-outs that obtained permits. The identification process of HVAC change-outs is described in detail in Section 4.

DNV GL consultants searched for evidence of commercial and residential mechanical permits for 350 HVAC unit change-outs from 109 of the 530 local departments responsible for building codes throughout California. The residential and commercial data sources contained samples of permits for unitary HVAC installations (package and split systems) from 2010 to 2012. Incentivized equipment is defined as those change-outs that did receive an IOU-sponsored incentive and non-incentivized equipment change-outs that did not.

The first piece of information obtained was the frequency of permitting. The following permit rates were found by category:

- Non-Participant Residential 38 percent (there was no participant residential sample because HVAC programs have permitting requirements)
- Non-Participant Commercial 13 percent
- Upstream Participant Commercial 32 percent (SCE service territory)
- Upstream Participant Commercial 26 percent (PG&E service territory)

² DNV GL, Quality Installation (QI) Residential Rebate Program Impact Evaluation, in process

Approximately 8 percent of the commercial sample was excluded and filed as inconclusive due to lack of sufficient permit record detail.

Common expectations for permit rates for HVAC change-outs are in the range of 10-30 percent³, and in general, permit rates among non-incentivized equipment were in line with these expectations. The Upstream program tracking data, which provided a substantial source of data for this study, did not track permit rates. However, it was anticipated that permit rates would be greater because the equipment sold exceeded code efficiency requirements and therefore buyers would be more likely to obtain permits for greater efficiency equipment.

1.2 Permitting Effect on QI Baseline Assumptions

Program administrators estimate energy savings for measures using assumptions and calculations, which are found in a document commonly referred to as a workpaper. Program administrators submit their workpapers to the CPUC for approval.⁴

The CPUC QI impact evaluation assessed workpaper baseline assumptions through site tests and inspections. This study adds to that body of knowledge by providing data for each site on whether a permit was on record at the local BD for the change-out. The results of this study are relative to the QI workpaper baseline assumptions for duct leakage, minimum airflow, and system sizing.

The core of data collection efforts for this study was matching the addresses of all recent changeouts with permit records from the appropriate jurisdiction. In addition to permit verification data, consultants sought measurement data to compare to workpaper assumptions. Consultants had limited success acquiring data from Home Energy Rating System (HERS) registry companies due to privacy policies intended to protect customers and contractors. The QI impact evaluation study conducted on-site visits of 50 residential sites that were non-incentivized equipment in QI programs. This sample was used to test the QI baseline assumptions for the three program measures in this study.

1.2.1 Duct Leakage

The QI program requirement for duct leakage states that leakage must be below 15 percent of nominal airflow. Duct leakage test results from a previous impact evaluation study of the

³ G. William Pennington, *"Underground Economy: Contractors Failure to Pull Permits for Residential HVAC Replacements"* Testimony to the Little Hoover Commission, 27 March 2014 pg.1-17

⁴ The process of developing workpapers can be found on the CPUC website under non-DEER workpaper values for energy efficiency measures:

http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/exantereiew.htm

program found that in the non-participant sample, many sites had duct leakage in excess of 15 percent, but on average duct leakage was lower than the QI program assumption, which was 24 percent.

1.2.2 System Airflow

The QI program requirement for system airflow is a minimum of 400 cubic feet per minute (CFM) per ton of cooling capacity. Data from the QI program evaluation showed that many non-participant sites had lower airflow, 298 CFM/ton to 315 CFM/ton, than the QI program assumption of 350 CFM/ton. The range of airflow distributions are reported in Table 5.

1.2.3 System Sizing

The QI workpaper assumes program incentivized equipment are sized properly and nonincentivized equipment are oversized on average by 20 percent. System sizing calculations provide an estimate of the amount of heating and cooling needed for a building. The Air Conditioning Contractors of America (ACCA) Manual J calculator A was used to estimate cooling loads in this study.⁵ Consultants collected data relevant to the calculation at a sample of buildings and used the data to develop the ACCA Manual J-based system-sizing model for all QI residential non-incentivized equipment. The calculated size was then compared to the installed tonnage to determine the amount of over- or under-sizing. On average, the QI residential nonincentivized equipment systems were oversized by 13 percent.

⁵ ACAA Manual J Calculator Website - http://www.acca.org/technical-manual/manual-j/