

DOCKETED	
Docket Number:	21-IEPR-06
Project Title:	Building Decarbonization and Energy Efficiency
TN #:	239848
Document Title:	NRDC, BEI, Earthjustice, RMI, Sierra Club, SMUD IEPR Comments on HVAC Quality Installation
Description:	N/A
Filer:	System
Organization:	NRDC, BEI, Earthjustice, RMI, Sierra Club, SMUD/Pierre Delforge
Submitter Role:	Public
Submission Date:	9/24/2021 6:04:02 PM
Docketed Date:	9/24/2021

Comment Received From: Pierre Delforge

Submitted On: 9/24/2021

Docket Number: 21-IEPR-06

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on HVAC Quality Installation**

Additional submitted attachment is included below.



NRDC, Building Electrification Institute, Earthjustice, RMI, Sierra Club California, Sacramento Municipal Utility District comments on the 9/10/2021 HVAC Quality Installation IEPR Workshop

September 24, 2021

On behalf of the Natural Resources Defense Council (NRDC), Building Electrification Institute Earthjustice, RMI, Sierra Club California, Sacramento Municipal Utility District (the Signatories), who are advocating for equitable building decarbonization and clean air policies to mitigate the climate crisis, we respectfully submit the following comments on Heating, Ventilation, Air Conditioning (HVAC) Quality Installation following the California Energy Commission's (CEC) 9/10/2021 Integrated Energy Policy Report (IEPR) workshop.

Summary

Poor HVAC installation quality is one of the biggest opportunities for energy, greenhouse gas (GHG), nitrogen oxides (NOx) emissions, and energy cost savings in existing buildings, and one of the main barriers to cost-effective decarbonization of the building stock. Solving this issue requires making compliance to quality installation standards easier, faster, and cheaper, and better enforcing them.

The Signatories recommend strengthening quality installation standards, developing statewide systems to reduce the barriers to quality installation, reviewing contractor licensing rules and aligning them with California's building decarbonization needs, and investing in tools that help local governments better enforcement installation standards.

The barriers to quality installation are well understood, and there are effective solutions already in use by some local governments. California needs to prioritize investing in the tools and solutions needed in order to decarbonize its building stock in line with its climate goals.

HVAC Installation Quality Issues and Impacts

Heating, ventilation and cooling combined are the largest energy use and source of greenhouse gas (GHG) emissions in both residential and commercial buildings.¹ Unfortunately, HVAC systems typically operate very inefficiently, wasting 30 to 50 percent of the energy they consume due to installation issues including:

- 1) Leaky duct systems: the average duct system leakage rate in California buildings is approximately 30 percent (duct leakage refers to conditioned air that leaks through holes and gaps in HVAC ducts into unconditioned attic or crawl spaces);
- 2) Undersized duct systems that make blowers work much harder and therefore use much higher energy to deliver air, and also exacerbate leakage;
- 3) Oversized furnaces, air conditioners, and heat pumps that cycle on/off frequently, which significantly impacts system efficiency;
- 4) Incorrectly installed equipment that doesn't operate at their rated efficiency, due to issues such as refrigerant leaks in air conditioners and heat pumps.

Energy and Cost Impacts - HVAC quality installation issues are responsible for a huge amount of energy waste, GHG emissions, and unnecessary costs to bill payers. To put it in perspective, there are approximately 100,000 new housing units built in California every year, and these new units are quite efficient thanks to California's building energy code. In contrast, there are one million HVAC changeouts in California every year, quality installation can save 30 to 40 percent of HVAC energy use² from current practice, and existing homes typically use a lot more energy than new ones. The energy, emissions, and cost saving potential from HVAC changeout is therefore two orders of magnitude higher than savings from new construction codes. This doesn't diminish the importance of new construction codes that are critical in order to build right from the start, transform the market for clean and efficient HVAC equipment, and pave the way for cost-effective and scalable retrofits in existing buildings, but it highlights that solving the HVAC quality installation issue is essential to decarbonizing existing buildings and achieving the state's climate goals.

Decarbonization Impacts - Poor HVAC installation practices also stand in the way of cost-effective electrification of existing buildings. Gas furnaces are routinely oversized relative to home heating needs in order to compensate for leaky and undersized ducts. Doing the same with a heat pump increases costs significantly. Heat pump equipment and installation costs increase with their capacity. Replacing

¹ <https://www.eia.gov/todayinenergy/detail.php?id=37433>

² Bill Pennington; California Energy Commission. (2021, September). IEPR Workshop: Quality Installation of Heating and Air Conditioning Equipment, pg. 2.

an 80,000 BTU (8-ton) furnace with a 60,000-BTU heat pump, or in some cases even two heat pumps, is much less cost-effective than installing a single 36,000-BTU heat pump combined with an air-tight and right-sized duct system, and low-hanging fruit energy efficiency measures such as envelope air sealing and burying attic ducts in insulation. This rightsizing and systems approach could be cost-competitive with typical practice, and it would reduce energy bills by 30 to 50 percent. The lower bills would also enable financing such as tariff-on-bill, allowing building owners to afford the expense of an often-unplanned HVAC changeout, and enabling the growth of an industry just like energy cost reductions from solar photovoltaic (PV) enabled leasing models and supported the growth of a new residential solar industry.

Health impacts – Poorly installed gas appliances can lead to incomplete combustion, carbon monoxide poisoning, and inadequate venting of combustion gases, resulting in polluted and sometimes toxic indoor air. In addition, air losses through leaky supply ducts result in depressurization of the conditioned space, causing make-up air to be pulled from attics and crawlspaces which can expose occupants to mold and rodent droppings and contribute to health issues. Duct leakage issues disproportionately impact low-income households who are more likely to have older and lower quality duct work.

A Multi-Faceted approach to HVAC Quality Installation

Solving this issue requires a two-prong approach that 1) makes it easier, faster, and cheaper to comply, to reduce the financial and business pressures to forego permitting; and 2) enforces permitting.

Enforcement of the mandatory measures required by the energy code, via permitting, is critical but is an uphill battle if we don't address the root causes of non-compliance. The paltry HVAC changeout permitting rates of **8 percent in residential³** and **13 to 32 percent in commercial⁴** are a clear indicator that the barriers to compliance are significant enough that almost the entire industry chooses to avoid permitting.

Enforcing permitting will not only save energy through ensuring quality installation, it will also remove a barrier to heat pump installations as most of those are currently done under incentive programs that require a permit, whereas most gas replacements are unpermitted. Permitting enforcement will level the playing field between gas furnaces and heat pumps and help stretch electrification program funds further.

³ DNV-GL; CPUC. (2017, September). HYPERLINK "http://www.calmac.org/publications/HVAC_WO6_FINAL_REPORT_Volume1_22Sept2017.pdf" Final Report: 2014-16 HVAC Permit and Code Compliance Market Assessment (Work Order 6) Volume I – Report, pg. 28.

⁴ DNV GL; PG&E. (2014). HVAC Permitting: A Study to Inform IOU HVAC Programs, pg. 7.

Removing the Barriers to Quality and Permitted HVAC Installations

Barriers to permitting include:

1. The **cost of permits**, several hundred dollars per piece of equipment, which adds up.
2. The **time delays** from going to the permit desk to pull a permit and then waiting for an inspector to show up onsite, costing installers valuable time that they could be spending earning money on a different job. They must charge these extra costs to the customer, which would make their bids uncompetitive relative to contractors that offer unpermitted work, creating a strong market pressure to forego permitting in order to win jobs and stay in business.
3. The **cost of implementing** the measures required to comply, such as duct testing, sealing, and in some cases partial or whole duct system replacement. While these costs are necessary, they will come down with volume and innovation, which are currently stymied by the lack of market scale.
4. **Contractor licensing rules:** some stakeholders commented that licensing rules may prevent HVAC contractors from doing themselves or even subcontracting systems work such as building envelope air sealing and insulation, that isn't considered "incidental" to HVAC changeouts. Only general contractors are allowed to perform this type of systems work that can make HVAC changeouts much more cost-effective and financeable. Or the homeowner needs to manage the different trades which is often unrealistic, especially in emergency situations and because few homeowners know what to do unless advised by their local HVAC contractor.

NRDC supports the following policies suggested by various stakeholders:

- 1) **Online permitting and inspections:** The pandemic has accelerated the adoption of online permitting and remote inspection solutions, which can help reduce both permitting cost and time. A growing number of California cities, such as San Jose, are adopting them. The CEC should consider policies that assist and support local government adoption of such tools. We support the California Energy Alliance (CEA)'s recommendation that CEC develops a **statewide permitting system** that offers cities that don't have their own a standard, low-cost option for implementing online permitting. We also recommend that the Legislature appropriates funds to assist local governments in implementing their own online systems should they choose to do so, and that the CEC considers ways that the \$20 million in funding provided by [Assembly Bill 128](#) to support local governments in implementing streamlined and remote solar permitting be designed to enable fast turnarounds for other technologies . Similarly, the state should consider how technology can facilitate **inspection scheduling, remote/video inspections**, to further

reduce cost barriers to compliance, and after-hours inspections so homeowners can final their permits without missing work.

- 2) **Review contractor licensing rules** to ensure that they are aligned with the transformation of the building stock that we need to meet our climate goals, particularly that they allow HVAC contractors, with the appropriate training, to perform or subcontract key energy efficiency and related measures that enable a systems approach to building decarbonization, such as right-sized HVAC and duct systems as well as air sealing of the building shell.

Enforcing Quality Installation Standards

The California code already sets maximum duct leakage requirements and requires HERS testing on changeouts. While this adds cost and time to the process, it is an essential requirement to protect occupants from wasting their precious resources on heating unconditioned spaces, and from the induced health impacts. However, the enforcement of this policy through permitting is currently ineffective due to very low permitting rates.

The Signatories support the following policies to tighten and help improve compliance to HVAC quality installation standards:

- 1) **Require heating and cooling load calculations, proper duct sizing on HVAC changeouts, and verification that the system was installed according to design.** Load calculations (ACCA Manual J) and duct design (ACCA Manual D) are essential for contractor to right-size both the HVAC and the duct system, which is the foundation of both quality and cost-effective installations. This applies to both gas, AC, and heating, but is particularly true for heating with a heat pump. There are many online tool that support Manual J and Manual D installations, it is primarily a matter of training and equipping HVAC contractors with the tools and knowledge that is needed for modern HVAC systems.
- 2) **Develop a compliance reconciliation system** as proposed by CEA. The system would reconcile the number of HVAC units sold by distributors to contractors with the number of permits those same contractors pulled and closed out. This information would enable enforcement by state agencies such as CEC and CSLB. We recommend starting with basic functionality that may not cover all cases but support some level of enforcement and enhance it over time as we learn more about what works and what doesn't. This would be a much simpler approach than the serial number tracking that has been proposed and raised concerns by several parties.
- 3) The Legislature should require a **statewide Resale Inspection Program**, inspired from the City of Davis's program implemented in the 1970's. With near 100% compliance, this program is the closest thing we have to a silver bullet for solving the permitting issue. The program requires

that property owners get an inspection of the HVAC and water heating equipment on the property prior to reselling the property, allowing the City to check that it has been permitted. The Resale permit would be valid for a long enough period of time (e.g. 18 months) that it would not slow down the resale process. With enough lead time, support, contractor education, and grandfathering of older installations, cities could implement this in a way that provides a strong incentive for permitting in the near-term, while not requiring inspection until sometime down the road, e.g. 2030.

- 4) **Consumer, contractor, and building department staff education** on the value of permitting and on modern HVAC technologies, particularly high-efficiency heat pumps, will also help. Although education is unlikely to resolve this issue on its own, it is an important complement to the above policies.

Thank you for the opportunity to comment, we look forward to working with CEC and stakeholders to solve the HVAC quality installation issue and remove this major barrier to building decarbonization in California.

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