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HVAC Safety-Enforcement Policy - Mitsubishi Comments

Additional submitted attachment is included below.

Mitsubishi Electric Comments on HVAC System Compliance:

Impacts on Public Safety, Elimination of Fraud Schemes and Improved Energy Efficiency through Enforcement of Existing CEC Code, HERS and Permit Requirements

Executive Summary

The California Contractor State License Board (CSLB) currently estimates that 95% of the furnace replacements in the state are completed without permits. With few exceptions, most HVAC contractors present the option to install without permits to their clients as a money-saving advantage, when in fact it spares the contractor the inconvenience of oversight, and frees them to avoid several quality control standards. This widespread avoidance of HERS testing negatively impacts indoor air quality (IAQ), public safety and energy efficiency. Contractors who avoid compliance do so to avoid current system design requirements as well as HERS testing requirements including: system sizing, duct sizing, duct leakage testing, air-flow verification (temperature balancing), fan watt-draw, static pressure testing, filtration requirements and refrigerant charge verification. Consequently, 80% or more of the replacement systems, are oversized relative to home size and loads, as well as oversized relative to the existing ducts which are generally undersized if installed prior to new design and installation standards taking effect. Generally, the existing undersized ducts and duct leakage which averages 30% in existing buildings, remain unaddressed. Consequently, air handlers all over the state are using kilo-Watt hours to pump 30% of the heated or conditioned air out of the building - a compounded loss of efficiency and one which negates advances in equipment technology and efficiency that have been achieved over the last decade.

Even worse, the depressurization of the building envelope that these conditions cause, inevitably result in significant particulate and bio-toxin infiltration which new research correlates with a number of chronic illnesses. Undersized ducts stress furnace heat exchangers increasing CO poisoning hazards and depriving customers of the longevity and reliability that the systems would normally provide. Given these conditions in existing buildings, the need for balanced fresh air ventilation and well-crafted HVAC systems is clearer than ever. However, these problems are fairly technical in nature and it is very difficult to educate the general public about these health impacts and their relationship to duct-leakage and quality installation. While many HVAC contractors have a high-level of professionalism, evolving technology and building science research highlights the need for continuing education for HVAC contractors on the numerous variables that impact public safety and efficiency. HVAC contractors, once licensed, are not required to take additional training by the CSLB or the CEC, and therefore many remain uniformed about the health impacts of substandard work. “New school” design and install methods that can greatly reduce distribution losses are not accepted as industry standards

even though there is a significant body of research by Chitwood and other HVAC researchers to the contrary. Neither are contractors motivated to comply with HERS testing requirements because they make the most money selling new furnaces and AC equipment without addressing the existing ducting system problems. Equipment replacement by itself is a high-profit item, while duct repairs are far less predictable and can involve access challenges and full days of working in attics with temperatures well over 100 degrees. A broader understanding of the health and efficiency impacts of duct leakage would perhaps motivate contractors to educate the client about why they need higher quality installations.

However, because there are many well-trained contractors that continue to do unpermitted work in order to avoid the cost overheads, inconvenience and oversight, it is clear that contractor training alone is not the solution. Enforcement alone is also not sufficient, because without training and a full understanding of the public health, comfort and efficiency issues contractors do not have a stake in delivering excellence, high-quality systems. In order to achieve 95% compliance in HVAC system repairs over the next 10 years, a balanced four-pronged approach is needed that institutes: 1) Mandatory penalties for permit and HERS violators as well as better funding and guidelines for building departments for improved enforcement; 2) Better coordination between the CEC and the CSLB on enforcement related issues, 3) Contractor training on "new school" HVAC methodologies, health and efficiency issues, and 4) Simplified permit processes including statewide on-line permit applications that can be completed in 10-minutes, better inspection scheduling processes and inspector convenience calls to minimize contractor down-time.

Defining the Compliance Problem

On average, existing homes have 30% duct leakage (CEC and LBL data), and many pre-2000 homes have 50% or more duct leakage. It is well documented by LBL research that traditional nylon reinforced "duct tape" is not suitable for ducting and the building code has required the use of UL181 tapes since the mid-2000s (see Anything But Duct Tape). However, most hardware stores and even the largest "big box" stores sell the non-compliant tapes in their HVAC supply sections without any warning as to the suitability or durability of the non-conforming tapes. The National Comfort Institute (NCI) has confirmed that furnaces that even high-efficiency HVAC equipment performs at an average of 57% efficiency due to lack of contractor training and a failure to provide a minimum standard of installation quality.

The vast majority of furnace replacements are done without permits in California and 95% of them are performed without testing the existing ducts for leaks or verifying that minimum airflow requirements are met. Since most duct leakage in existing systems is on the supply side of the ducting system, the duct leakage effectively results in 300 to 400cfm of conditioned air being actively pumped out of the home, usually into the attic, before the heated or cooled air

ever reaches the registers. Because most people usually close doors and windows to save energy, this supply-side duct leakage results in depressurization of the home. If 400cfm is blown out of the building shell, then there is a corresponding 400cfm of outside air intrusion generally entering the home through light switches, plumbing holes under sinks and around baseboards. The energy loss is only half the story behind this depressurization phenomenon. In homes with crawlspaces, an average of 40% of the outside air intrusion enters the home through the crawlspace, typically bringing with it mold spores and other bio-toxins. In homes with moisture in the crawlspace, water vapor from the crawlspace is being actively drawn into the house due to duct leakage. The worst case scenario is high duct leakage in a wet crawlspace. Warm dry air is pumped into the wet crawlspace that is pressurized, while the house is depressurized. In these homes the windows and walls can be covered with condensation within minutes of the air-handler being turned on – and mold grows quickly in such an environment.

In homes without crawlspaces, all of the infiltration air comes in through holes at the tops of walls, bringing with it fiberglass or cellulose particulates. About half the attics in the state have rodent or other animal infestation issues bringing with them a host of bio-toxin related illnesses. According to recent peer-reviewed research by Dr. Richie Shumaker, 24% of the general population carries a gene that pre-disposes people to Chronic Inflammatory Response Syndrome (CIRS). According to his research, bio-toxin infiltration is correlated with many forms of inflammatory response including asthma, bronchitis, flu symptoms, edema, hives, arthritis, heart disorders and neurological disorders (see survivingmold.com). There is a great deal of new data on "sick home syndrome" and the EPA estimates that indoor air quality is up to 10 times worse than outdoor air quality. So it is clear that these health issues are pervasive and that duct leakage combined with under-sized ducting is one of the key variables that exacerbates these health and safety issues. Clearly, most air handlers using electricity to actively blow conditioned air out of the building with significant efficiency losses AND this contributes to a widespread health and safety issues that are causing significant illness to a much broader segment of the population than previously understood*[1]

Building science research and HVAC system testing clearly correlates undersized ducts with inadequate airflow through heat exchangers and associated heat exchanger failures. Manufacturers specify airflow and static pressure requirements in their literature specifically to avoid undue stress to heat exchangers and possible catastrophic failures. These specifications are often ignored despite code requirements to verify them. Many HVAC contractors do not check static pressure and do not own the equipment to properly commission systems either by verifying watt-draw as an indicator of static pressure or measuring static pressure itself. Reduced air flows causes pre-mature equipment failure, increased risk of CO poisoning. Carbon monoxide (CO) is the number one cause of poisoning death in the United States.

Building depressurization can also result in radon gas infiltration. Radon is a common naturally occurring carcinogenic gas that seeps at slow rates from underground shale formations. It is prevalent in many counties across California and in some counties effects up to 20% of the residences. It is regarded as the number two cause of lung cancer nationally by the CDC. Based on building science principles it is clear that depressurization due to duct leakage significantly increases the risk of radon infiltration and lung cancer, but there is currently no research that specifically correlates the rate of radon related cancers and duct leakage.

Repairs to duct leakage and proper system sizing and design at the time of furnace replacement can increase average system efficiency by over 30% because it reduces Watt-hour fan losses as well eliminating the lost BTUs. Another 15% increase in efficiency would result from compliance on other HERS verification measures including air-flow verification and refrigerant charge verification. In short, HERS compliance and stricter enforcement by the CEC and local jurisdictions would eliminate all of the system losses that National Comfort Institute (NCI) studies have confirmed to be 44% nationally and can exceed that number due to synergies and additional efficiencies gained through optimized system design. Given all of these known variables, compliance with existing CEC code requirements and commissioning standards would greatly increase HVAC system efficiency across the state. This could easily be achieved over the next ten years or less. Without this compliance program, all of the incremental changes in equipment efficiency and the technological advancement by manufacturers across the industry will be completely negated. Without compliance through better training and enforcement, all of our efforts to transition the State of California to a zero energy economy will be fruitless.

In addition to these efficiency gains through compliance with existing code requirements, there are additional "new school" HVAC design opportunities that can nearly double these efficiency improvements. This "new school" of system design, developed by Rick Chitwood who has worked as an energy analyst and HVAC system researcher for CEC for several decades, can reduce duct system losses by shortening ducts, placing registers closer to the center of the house, using bar-type supply grills without dampers, building longer supply plenums with damper control of every room at the furnace, increasing duct insulation values and reducing system resistance to flow (static pressure) by oversizing return ducts and return grills. Where possible, deeply burying ducts under an R-50 or R-60 blanket of blown insulation in the attic increases the effective duct wall R-value to R-30 or higher. Any mechanicals that may need service can be marked with flags hung from the attic ceiling and accessed with service gang planks and platforms. These repairs when integrated into duct replacement work can cut BTU losses in half. Rick Chitwood and his protégés, McFarland, Perunko and Healey have done the most cutting edge HVAC system design work in the State, and have demonstrated many times over that a ton of cooling per 1000sf of living space is more than adequate if the ducting is fully optimized. Most HVAC contractors have never learned about these design variables and will

insist on 400sf per ton, hanging ducts from the ceiling of the attic to make them accessible, even though this results in significant heat loss through the duct wall. Although these methods are not currently code requirements, they well understood and scientifically verified. Even though these efficiencies are not theoretical, and are well-documented, the prevalent thinking among HVAC contractors is to stubbornly adhere to "old school" tenants, and most insist that the new school thinking is "wrong" and that short-duct design compromises comfort or air mixing, despite research to the contrary. These methods applied to older homes also increase comfort and return on investment for the homeowner, generally between 18% and 25% depending on climate zone and current system condition.

Although no opinion surveys have been conducted among HVAC contractors about what percentage embrace "new school" design, it is clear that the majority remain firmly entrenched and resist new approaches despite all evidence to the contrary. This contractor resistance to change testifies to the need for industry wide contractor training, not only on compliance with current permit and HERS requirements, but also on system design, computer modeling and optimization, all of which increase value to the consumer assuring them the comfort, air-quality and efficiency they deserve with little to no additional cost. Anything less than a quality install with a permit and independent HERS testing is in fact a disservice to the home-owner. At the recent CEC workshop on compliance, a contractor's union representative said that additional training "is not necessary – we don't need to swallow and elephant". Clearly, we do.

More stringent rules and enforcement of permit requirements requiring proper duct sizing and conformance with minimum leakage requirements would be a win-win situation for the State and consumers and would actually increase total gross sales for HVAC contractors as well. Duct repairs are often not sold by HVAC contractors because furnace replacement without changing duct work is generally more profitable. Under current California law, replacement of any major component of an HVAC system including a furnace, air handler, coil, condenser or more than 40' of ducting replaced, requires a permit from local building departments and a third-party HERS inspection. If existing ducts leak more than 15% they must be tightened to below the 15% leakage rate. This standard is relaxed to accommodate the inconvenience of tightening ducts during a furnace replacement, but it is too lax. The CEC should seriously consider an 8% to 10% standard. If some or all ducts need to be replaced, this is less costly and safer for the residents than letting the problem go unaddressed. If the duct testing equipment is already hooked up, there is no better time to address the problem. Contractors need to own their own duct testing equipment and test systems at the outset of the job and not count on HERS raters to find the problem after the fact. HERS raters still need to verify after the repair work is done. HERS testing usually includes air flow measurements, fan-watt draw, refrigerant charge verification and duct leakage testing. These tests are performed to assure a minimum standard of HVAC system performance.

HVAC Contractor Fraud in the State of California

The Contractors State License Board (CSLB) recognizes widespread fraud schemes perpetuated by HVAC contractors that use false "red tags", a false report of CO leakage to shut down an operational furnace during cold weather. This tactic is in fact a con used to force the sale of a new furnace when the client is most vulnerable- during cold weather. There are documented cases of this fraud occurring across the state and the CSLB has issued warnings to consumers regarding this "false red-tag" fraud but has little power or budget to make the problem widely known or mitigate against it. Even large HVAC contractors with contracts to sell through large box stores have been caught in such fraud schemes -with little consequence. Typically, the victims are elderly who are more fearful of being left in their homes in the cold, and who are more easily manipulated into signing inflated contracts without taking the time to get competitive bids. Clearly, there are laws already on the books to protect citizens from such fraud schemes but greater enforcement is required and government agencies from the city to the state level are underfunded to provide that protection.

The California Energy Commission has been given authority to uphold energy code requirements and the CSLB has authority to uphold contractor law. Clearly there is overlap between these jurisdictions and greater cooperation and collaboration is required to make these agencies more effective. Also, clear guidelines must be issued to local city and county building departments regarding a uniform system of fines and penalties as well as guidelines. Building inspectors should be given a mandate by the CEC and CSLB to cold call upon every house that has an HVAC truck parked in front of it with ducting all over the front lawn and demand a permit. Traffic cops hand out tickets every day to people parking without a permit, and this is a primary revenue stream for the entire police department. Empowerment is key. The solution clearly requires greater coordination between CSLB, the CEC, and local jurisdictions to implement an enforcement plan that will both crack down on these health and efficiency violations as well as put revenue into enforcement coffers to pay for expanded enforcement. Higher fines and penalties could also be used to fund training for both contractors and building departments.

The health impacts of these fraudulent business practices warrant corrective action including the following: 1) A consistent state-wide schedule of fines, and penalties; 2) Public service announcements regarding HVAC testing and the health implications of circumventing permits and inspections; 3) Contractor and inspector training programs. The public deserves protection from fraudulent business practices, improved indoor air quality as well as the benefit of improved system efficiencies that produce higher returns on investment.

In addition to contractor fraud, there are accounts of HERS testing fraud. In some smaller counties as many as 15% of the HERS test results submitted to the on-line registries is

fraudulent. By some accounts, as much as 70% of the HERS test results submitted to CalCerts in more populated counties are fraudulent. These accounts are based on anecdotal evidence, but investigation of some HERS raters is ongoing and there is reason to believe a significant degree of fraud in the HERS verification system is occurring. Obviously, this is a critical problem to curtail if the state is to achieve higher rates of compliance and HVAC system efficiency. Incidences of fraud by HERS raters should be treated as a criminal offense, and the CEC should collaborate with the CSLB to investigate these cases and permanently bar HERS raters who are caught engaging in a pattern of misconduct from ever working in the field in the future.

Simplification and Standardization of Permit Application Processes

Every contractor in the field will complain that permit applications take too much time to file, they slow down work flow and inspectors rarely show up within a predictable window of time, leading to a great deal of frustration, lost time, and unnecessary and unpredictable costs to both contractors and their clients. For the most part, they are right. The system is in desperate need of standardization and simplification. The duplication of paper in the CF1R through CF3R is mindlessly time consuming. Is it really necessary to have a CF1R that is pages long? If there are schematic drawings and load calculations, is it necessary at all? If there are plans, a permit and compliance with Manual D and J, isn't a final HERS verification sufficient? Most building inspectors don't read all of the fine print on all 20 pages of these documents. It's clearly a case of bureaucratic quagmire. No wonder contractors dodge the paperwork like bullets. Permit applications for new systems as well as system replacements and repairs need to be drastically simplified and made to be more user friendly with a standardized one-page on-line filing. This could be centralized through a single web portal that is statewide, but automatically forwards the application to local building departments. This would centralize the database and spare all of the building departments the task of building their own online application process and forms.

Building departments should be required to keep a tighter scheduling process with clear windows of time during which inspectors will reliably show up to meet contractors. Courtesy calling by inspectors to alert contractors a half hour before arrival at the jobsite should be a statewide standard and required by the CEC. It takes relatively little effort for an inspector to call a contractor when they are half an hour away, especially if that 3-minute call is saving the contractor hundreds of dollars in down time. The customer service provided by building departments and the convenience they build into that service, is key to removing barriers to compliance on a statewide level.

Summary of Compliance Objectives and Benefits:

1) **Prevent "red-tag" fraud,** especially against the most vulnerable elderly victims by requiring gas company verification of CO hazards in the home and making false red-tags that are

unverified by gas company personnel punishable by mandatory jail time and suspension of license. Contractors should not have the right or the power to disconnect someone's furnace in the middle of winter without

2) **Reduce non-compliance from 95% to 5% in ten years** by creating a schedule of fines and penalties that provide sufficient deterrence to increase compliance.
3) **Reduce carbon-monoxide (CO) poisoning hazards** in homes by enforcing current code requirements for system duct sizing and air-flow verification on all gas furnaces. Strict verification of combustion ventilation area (CVA) calculations by building inspectors and draft testing of appliances that are susceptible to back-drafting such as gas water heaters located in laundry rooms, should also be performed to minimize CO poisoning hazards as required by current code.
4) **Reduce duct leakage statewide from an average of 30% to an average of 6% in five years.** Additionally, conformance with current code which requires heating and cooling load calculations would result in proper system sizing and will reduce NOX, SOX and GHG gas emissions from building HVAC systems by more than 22% and by as much as 30% due to synergistic efficiency gains.
5) **Furnace or air handler replacement currently requires HERS testing for duct leakage of existing ducts.** This law in effect requires HVAC contractors to own duct leak test equipment as this is more cost-effective than contracting HERS raters for this work prior to final testing. Only a fraction of the HVAC contractors own this equipment currently. Enforcement would make use of these tools and improved duct sealing methods the norm.
6) **HVAC Efficiency Optimization:** The code currently requires that all furnace replacements be performed with room by room load calculations (heating and cooling load calcs) that result in appropriate duct sizing relative to equipment capacity and which deliver the correct cfm and BTUs required to each room of the house to balance temperatures within 2-3 degrees. The most common customer complaint about existing HVAC systems is in fact uneven heating and cooling across different zones of the home, and most homeowners are surprised to hear that there is a process and method to achieve the desired "temperature balancing". This is necessary to both assure comfort to the client and to prevent under-sized ducts or oversized air handlers that can cause health and efficiency issues. Better compliance with code requirements clearly has multiple benefits to the customer.
7) **The CEC and CSLB should consider incentives to encourage contractor education on building science issues related to HVAC and additional certifications such as NATE or NCI.** In reality, compliance will not be achieved on a statewide basis unless CEC requires continuing education for HVAC contractors and their crew foremen on new-school design and installation practices. Once trained, contractors and their crew leads are far more likely to have a stake in the quality and health of the systems they deliver to their customers. Without this knowledge, enforcement will be resisted and perceived as an unnecessary intrusion into their business practices. It is likely that a survey of industry practices and attitudes would reveal a low level of HVAC contractor awareness about indoor air quality impacts and other HVAC related health hazards. It is somewhat clear from the resistance to new-school thinking that contractor licensing requirements alone are insufficient to assure

the protection of public health and efficiency of systems installed. It is also clear from the prevailing patterns of unpermitted furnace replacements, and the widespread practice of oversizing furnaces, that it can no longer be assumed that HVAC contractors know how to calculate the correct size of equipment and ducts as currently required by law. Current licensing requirements for HVAC contractors do not require "continuing education" or additional certifications, so it is possible for a contractor to hold a license for twenty or thirty years and never have to read a page or learn anything about new installation practices. New-school thinking on systems integration is resisted by resilient conventions that severely compromise quality. For this reason, the CEC should consider HVAC licensees and their foremen be required to complete continuing education classes and additional certifications over the coming five years. Penalties and fines collected can be used to offset some of the cost of these trainings.

8) **Software and system design training for HVAC contractors:** System design in conformance with the building code is unreliable without the use of software that performs room by room calculations and includes floor plan and ducting diagrams. This software is expensive, (approx. $1000) and some of the proceeds from penalties and fines can be allocated to offer software rebates to contractors who sign up for advanced certification training and software design training earlier in the training program cycle.
9) **All furnace replacements should be completed with a 5-point safety check of carbon monoxide hazards:** to include "back-drafting" hazards at water heaters which can be affected by forced air systems and especially if water heaters have passive (not fan assisted) exhaust and are subject to vacuum like effects from adjacent forced air return grills or devices with fans such as range hoods or dryers.
10) **Assurance of indoor air quality as it pertains to mold and dehumidification:** HVAC contractors should take note of mold growth in any system and be well versed in the potential health impacts and correct any systems that could contribute to mold growth. If musty odors or mold are detected in bath rooms or basements bio-toxin testing should be required along with a list of local service providers and BPI-certified consultants (Building Performance Institute). Exhaust fans with humidistat controls should be installed in bathrooms where mold growth is probable or evident. Central system ducting with evidence of mold growth should be replaced and cause of mold growth rectified.
11) **Fine particulate filtration systems must be HERS certified for airflow verification.** High-MERV filtration can inadvertently cause air flow restriction and result in heat exchanger failure and CO poisoning if additional measures are not taken. All high filtration systems must have static pressure testing with and without filters in place to verify overall airflow and filter impacts on durability and operational safety of the equipment.
12) **No Ducts in Crawl Space:** Current code and compliance credit structure offers greater compliance credit to ducts in crawlspaces, but ignores potential health impacts of this system configuration which are numerous: Duct leakage in the crawlspace pressurizes the crawlspace at the same time it depressurizes the living space which can drive bio-toxins into the interior with considerable potential health impacts. Crawlspaces are also often damp and ducts leaking warm air will pick up water vapor from the crawlspace and promote mold

growth in the home. These effects are exacerbated if the crawl space has a dirt floor and rodents are present or if they penetrate the ducting system, a common problem in older homes. Also about 5% to 20% of homes nationally have radon gas in the crawlspace, known to be the second leading cause of lung cancer in the US. No rebates should be offered for this type of duct installation due to potential indoor air quality impacts resulting from duct leakage in crawl spaces which drive toxins, vapor and particulates into the living space. In all cases where there are existing ducts in the crawl space, other HVAC solutions should be employed and contractor education programs should include a thorough investigation of the existing research regarding these important health impacts.

Implementation Strategies

HVAC Contractor & Supplier Outreach – Using the Carrot and the Stick:

1) Hold focus groups and stakeholder discussions with building department managers to develop cohesive strategy on enforcement and training programs including penalty structure, program marketing, training topics that are most needed and possible compliance incentives for contractors.
2) Identify and define "gross" health and safety violations, for example: 1) Oversizing furnaces with over 30% more air flow and capacity than existing ducts can handle and performed without a permit; 2) Furnace or air-handler replacement without removing and replacing asbestos-wrapped ducts; 3) Furnace or air-handler replacement without fixing ducts that leak more than 20%, 4) Furnace or air handler replacement without addressing rodent or fowl intrusion into ductwork, etc. For any of these "gross" violations, impose fines that are two times the value of the contract by September 1, 2019 or another specified date. Second violations would result in a fine that is four times the value of the contract. A third violation would result in a fine that is five times the value of the contract. These are just suggested fine structures, used as an example only, and the actual fines need to be discussed in round-table discussions with local jurisdictions, and imposed uniformly on a statewide basis.
3) Cases of known fraud or demonstrable patterns of fraud should be turned over to DA offices with mandatory charges pressed. Convictions for fraud should result in loss of license and whatever other penalties the court sees fit based on damages. Continued performance of HVAC contracts after license suspension should result in mandatory jail time. The small percentage of contractors engaged in these types of fraud schemes should be driven out of business, and penalties should be stiff enough to deter others from engaging in such schemes. All CO red tags (equipment shut-downs due to CO leaks) should be issued or verified by a gas company appliance specialist who is trained to test for CO and has scopes and equipment to inspect for cracks in heat exchangers. Any incidences of fraud, i.e. intentional misdiagnosis of systems or false "red tags" that are not verified by gas company representatives and that are used to manipulate home owners or motivate a fast sale of new equipment, would be punishable as a criminal offense resulting in permanent suspension of contractor's license. Fines and damages

should be payable by confiscation of HVAC contractor's equipment, including shop equipment, commercial vehicles, and shop real estate if owned by the contractor or contractor's company or corporation. Continued performance of HVAC contracts after license suspension or ongoing incidences of fraud should result in mandatory jail time.

4) Basic systems integration training for all HVAC contractors doing business within the state must begin by January 1, 2020, including training at energy centers on room by room load calculations, basic WrightSoft software training, equipment and duct sizing, advantages of short duct systems, safety issues related to duct leakage, duct leakage testing procedures, , indoor air quality, combustion safety issues, CVA & CO issues, and system commissioning including optimizing combustion efficiency, verification of BTUs delivered and HERS verifications. This basic training would be free throughout the year at the training centers, and given the volume of trainees that need to go through the program, it would be a further enticement to offer the trainings only once at a venue in each county to save contractors a trip across the state. This free training would culminate in a "CEC-Certification". However, this free training would exclude certification trainings (BPI NATE or NCI) which contractors would be offered separately by for hire trainers and which contractors would be required to pay for.
5) Incentives should be offered to early adopters who sign up for the basic training by September 2019 and complete training by February 28, 2020. Incentives would take the form of $200 -$300 discounts on WrightSoft design software or group discount coupons offered by NCI or NATE and negotiated in advance by CEC.
6) CEC should seriously consider additional HVAC certifications being mandatory for HVAC business owners by the end of 2020, and required for all their crew foremen by the end of 2021. Setting and aggressive training goal of 95% of the HVAC contractors in the state with advanced certifications by end of 2020 would significantly advance quality and efficiency in the state.
7) The program should provide for emergency furnace replacements without forgoing the option to integrate advanced energy upgrades and associated rebates.
8) Unlicensed contractors should be prevented from engaging in unfair competition with licensed contractors. Part of this effort should be focused on expanding CSLB's sting operations and budgets for such operations, allowing at least one sting team to operate within 100 miles of every address in the state. However, other more cost-effective methods of mitigating against unlicensed work should also be employed: Outreach to equipment suppliers that sell within a region (even those based elsewhere or across state lines) requiring that they sell only to licensed HVAC contractors is essential. A significant amount of unlicensed work is being performed and anecdotes abound about unlicensed contractors lining up to purchase equipment from suppliers after hours and on weekends. Licensed contractors can't effectively compete when substandard work is being performed by unlicensed and uninsured contractors are allowed to go unchecked. Signs posted behind the counters of supply houses should notify buyers that only license d contractors are allowed to purchase major equipment components and that unlicensed and unpermitted work will be severely punished. Such signs should underscore permit and HERS requirements. On-line distributors should similarly be required to ship equipment only to primary address used to register the contracting business with the CSLB and using credit cards issued to contractor businesses of the same name.

9) Although many stakeholders have suggested a statewide registry of equipment serial numbers, such a registry would be difficult to maintain and would involve gathering and cataloging millions of names, addresses and serial numbers. Managing and maintaining such a registry would be difficult and expensive unless it is merged with HERS certification. Once assembled, it is hard to imagine how enforcement agents would pour over such data to find violators. Enforcement measures should impose sufficient fines and deterrence to make such a registry unnecessary.
10) Equipment supply houses that host trainings and facilitate state mandated QC efforts can be rewarded by including them as "co-sponsors" of the training events on posters and outreach mailings. Allow suppliers/distributors to present their most efficient and lowest carbon footprint equipment at the trainings, so contractors are given an opportunity to "sell up to a quality standard" and promote low-emission furnace and heat pump technology. Manufacturers could be invited to co-sponsor the trainings, or include new school installation techniques in their own certified repair training.
11) Trainings would also be co-sponsored by the local and national contractor's associations that choose to collaborate and using their email lists. Local contractor organizations maintain data on contractor emails and are usually willing to support training efforts with mass-emails to their members. Building departments may similarly have access to email contact data and can assist in promoting training events with notifications at their service counters.
12) All HVAC suppliers and hardware stores should be advised that non-UL compliant duct tapes and sealants should not be sold in the same aisle as ducting materials. Duct tapes that are not UL certified should carry a warning that they are "not suitable for duct repairs - use only UL-certified products". Large box stores such as OSH, Lowes and Home Depot often do not even offer tapes that meet current code, and they should be required to carry UL181 tapes designed for both metal to metal and flex connections if they elect to supply HVAC repair materials. Homeowners attempting to do their own duct repairs are unaware that traditional tapes do not meet current code and UL requirements. (See LBL research "Anything But Duct Tape". The state should require that signs be posted advising buyers that all tapes used on ducting should be UL181 compliant with reference to specific tapes and their intended applications. Literature on proper duct repair methods should be distributed to home-owners in these stores with reference to additional information online.

2) City and County Jurisdiction Empowerment:

1) State law must direct CSLB to require stricter enforcement by city and county building departments. Enforcement policies should result in immediate positive cash flows for local jurisdictions and allow them to engage in higher-level inspector training on mechanical system requirements, plan-checking HVAC system load calculations, best practices, combustion safety, CVA and indoor air quality issues as well as visual inspection topics.
2) County-wide participation with a cohesive program would prevent negligent contractors from hiding out in pockets of un-enforced jurisdictions. A cohesive and concerted state-wide effort

would assure county-wide compliance as well as statewide compliance. Stakeholder meetings and ICC meetings should at some point also include representatives from local contractor associations and from wholesale supply houses. However, such discussions should not be a forum to voice objections to permit and HERS requirements, but for promoting compliance.

3) Eventually, a single website could be set up as a clearing house for all jurisdiction permits on a county-wide basis, permit payments and compliance data base for all jurisdictions within a given county, to be monitored and updated and maintained by the County Building Director or the Energy Directors Office. HERS compliance docs would still need to be uploaded to CalCerts or other participating HERS certification agencies. Permits for furnace and AC replacements should be a single page document filed on-line with a fee of around $150 or less.
4) All load calcs and design documentation could be available at the jobsite with extra copies for building departments to review after the install, so furnace replacement work is not slowed by the application process. If load calcs are found to be off by more than 10% after the fact, those contractors would be required to submit drawings and load calcs in advance in the future until they have developed a consistent track record for accuracy.
5) Calling for permits should be easy and painless. Inspections should be scheduled within a two hour window with the inspectors placing a convenience call 20 to 30 minutes in advance of arrival so that contractors are not losing half a day and thousands of dollars a year just waiting for inspectors.

3) CSLB: California State License Board Coordination on Enforcement

1) CSLB has government relations representatives to speak with local jurisdictions about statewide fraud and code violations and how to implement enforcement plans. Skype conferences or webinars should be used to streamline this process at countywide meetings of building officials so that uniform enforcement practices are implemented statewide.
2) CSLB in collaboration with the CEC should be able to provide a fine and penalty structure that would be uniform across all counties.
3) CSLB has issued a state-wide mandate to rein in HVAC fraud and non-compliance and has told their staff to report all cases of fraud to their investigations department, however, because these are criminal offenses they must be prosecuted by the local DA offices. There are indications that charges are not always pressed in these cases, and CEC can coordinate outreach to DA offices to promote awareness of the statewide HVAC fraud problems.
4) CSLB offers sting operations support for suspected gross violators, but also need funds from penalties collected to cover costs of expanded sting operations.

4) Community Outreach:

1) Outreach to the general public through news stories and public service announcements through local papers and TV stations.

2) Mailed notifications with literature on health concerns to neighborhoods known to have problematic homes, such as areas known for widespread use of asbestos insulation during the original development, or older developments where houses are known to have open wall cavity ducts or wood framed return plenums.
3) Ad placements for public education seminars or "Healthy Home Clinics" held at city and county libraries to advise the public about indoor air quality concerns, combustion safety issues, the importance of building permits, enforcement, patterns of HVAC contractor violations as well as energy efficiency.
4) One strategy that is known to increase participation in Healthy Home Clinics is on-line pre-registration. Even if they are free events, pre-registration makes people note the date and commit mentally to attendance. Public Service Announcements (PSAs) on local television and in local papers also boosts on-line registration for such events.
5) Advertising in print or on public service announcements for television an 800 number fraud hotline for all suspected HVAC fraud: 1) False-red tags to force new system sales; 2) Safety issues such as re-use of leaky asbestos ducts, etc.

Basic Principles Justifying Change:

1) Although there are codes in place to protect public from health and safety issues, enforcement and penalties are not currently sufficient to deter abuse of permit requirements and health and safety requirements, especially when it comes to furnace replacements and duct system repairs.
2) Law enforcement routinely issues citations for traffic violations to promote safe driving habits and impose fines that that increase relative to the severity of the violation, yet little is done about health concerns and violations by contractors in residences that have significant impacts on public health.
3) Traffic citations are in fact a major positive revenue stream for local law enforcement and this serves as a model for more stringent enforcement in regard to building code violations.
4) According to CSLB, there is nothing in current state law that prevents a building department from imposing fees on gross violations of public health and safety issues or in cases of fraud,
5) Without a statewide penalty mandate or guidance from the CSLB and the CEC, there is reluctance on the part of building departments to impose more stringent fines and penalties that could act as a deterrence to abusive practices. Small town politics and boards of supervisors are hesitant to impose rules on companies who operate in their jurisdictions. Many have close community ties. A statewide mandate is necessary to overcome the influence of local, small-town politics.
6) In 2015, the State Enforcement Director at the CSLB issued a directive to pass all incidences of fraud on to CSLB investigations. The department is well aware of widespread problems both in regard to fraud as well as substandard installations that result in health and safety hazards. Call CSLB: 916-255-4183.
7) A crack down on fraud and unhealthy, substandard work will be of course bad for negligent businesses and good for diligent businesses, but will not be bad for business as a whole. People will be paying slightly more for their systems but will benefit by avoiding the health, safety and efficiency problems that the old school installers leave them behind.

8) Jobs on a statewide basis are likely to increase overall over time rather than decrease, because more HERS raters will be needed to service an increase in compliant furnace, AC and HP system installs. This increase in HERS and inspection related jobs will be sustainable as the state moves to simultaneously adopt zero energy building codes in the residential sector.
9) Analysis is required to assess fiscal impacts. Local jurisdictions should have authority to raise permit fee rates if program costs exceed projections, or if revenue from fines prove insufficient. However, penalties on a statewide basis should be adjusted upwards if such shortfalls occur on a widespread basis as the enforcement program matures.

Resources and Footnotes:

1) California EPA published several studies in the last two years that conclude 25% of the US housing stock is causing symptoms in unsuspecting residents.
2) EPA and Carb agree that UV air cleaners commonly sold by HVAC companies are unhealthy: they do not remove bio-toxins as advertised, and release ROS, "free radical compounds" which can cause heart attacks and cancer. One
3) The California State License Board has a Public Relations Division and is willing to send representatives to discuss the widespread abuses and mitigation strategies with building departments and local politicians.