2019 Building Electrification & EV Infrastructure Reach Code Initiative Frequently Asked Questions

Updated: December 17, 2019

1 Benefits of Electrification

1. What are the safety and health benefits of building electrification?

Research indicates that natural gas is a major fire risk in the event of earthquake. The link between earthquakes and natural gas triggered fires is documented in the State's 2002 study: https://ssc.ca.gov/forms_pubs/cssc_2002-03_natural_gas_safety.pdf

Natural gas use in the home is linked with asthma and other health risks:

- EPA identifies indoor air quality as a significant health risk and gas appliances are listed as a point of concern: https://www.epa.gov/indoor-air-quality-iaq/inside-story-guide-indoor-air-quality
- 2019 meta research links gas stoves and asthmhttps://heetma.org/gas-cooking-and-asthma/
- 2008 Johns Hopkins study linking gas stoves and asthma https://www.sciencedaily.com/releases/2008/10/081013131530.htm
- Lawrence Berkeley Labs, California Energy Commission and others have also produced similar studies
- Carbon monoxide from fuel use has been long deemed a risk. Enough that CO sensors are required in homes that burn fossil fuels: https://www.creia.org/california-carbon-monoxide-law-takes-effect

2. What are the benefits of electric vehicles?

Drivers of electric vehicles identify EVs as more fun to drive in general because they are quicker, smoother and quieter than gas cars. In addition, EV drivers typically save $1,000 to $1,500 per year in reduced "fuel" and maintenance costs. And of course, they dramatically reduce pollution.

2 Municipal Staff, Public Process, Affordable Housing

3. What is the impact to staff? Do Reach Codes add additional staffing burden as presented or if all electric?

A reach code for an all-electric requirement is very easy to permit and inspect. If exceptions are included (such as stoves), the level of effort is likely to be minor. For electric vehicle charging, the level of effort is likely equivalent to State code. The code model for "all-electric preferred" which has a mixed-fuel track does have some additional complexity for permitting and inspection of mixed-fuel homes.

4. Uniformity

Uniformity across jurisdictions is desirable and PCE, SVCE and regional partners are encouraging consistency. However, all-electric is simple and inaction locks in future cost (retrofits, rates) and risk (fire). Some variation across municipal codes is not unusual.

5. What kind of public process was held to develop the model codes?

Over 10 events were held with the full spectrum of stakeholders (city employees, building officials and developers, public and advocates) with over 350 attendees in total (non-unique). In addition, many dedicated meetings have been held with building officials, developers and affordable housing organizations.

6. What are the impacts to affordable housing projects? Have we spoken with any of those developers?

In most cases, all-electric buildings cost less to build. To assist with ensuring optimal design and cost-effectiveness, PCE is planning training and technical assistance for new construction. However, electric vehicle charging reach codes would require more EV charging which *would* cost more than State code levels. To address this issue, PCE and SVCE's EV infrastructure incentive program to launch in 2020 will include an explicit element for new construction of affordable housing. The intention of those incentives is to address most or all of the cost of EV infrastructure in affordable housing.

Multiple discussions have been held with affordable housing providers including a workshop held by the Housing Leadership Council in August and an in-depth meeting with MidPeninsula Housing senior staff in September. This was followed by multiple technical email exchanges. The two major points of concern related to lack of familiarity on the part of contractors (which will be addressed with training and technical support) and the cost of EV charging (which will be addressed with incentives). MidPen has already received recognition from Silicon Valley Clean Energy for its 66 unit all-electric affordable housing project in Sunnyvale, Edwina Benner Plaza: https://www.svcleanenergy.org/edwina-benner-plaza/

3 Resilience, Grid Readiness, and PG&E

7. Doesn't having gas appliances offer more resilience?

Natural gas appliances in general do not support resilience as most modern gas equipment depends on electricity to operate. In emergencies gas is also shut-off.

8. Does the code disallow propane, diesel generators or natural gas pipe fed generators?

The proposed code does not disallow propane, diesel generators or natural gas pipe fed generators. The reach code focuses on space/water heating, cooking, and clothes drying.

9. How reliable is the electric grid as compared to natural gas?

The natural gas grid and electric grid both go down on occasion. In fact, during California's primary natural disaster events, wildfires and earthquakes, utilities are supposed to turn the gas off. If 100% reliability is a goal for your home or project, electrification with battery and solar backup via microgrid is the way to get there.

10. Is the electricity on the grid "clean"?

PCE base service is 80% GHG free today and SVCE is 100% GHG free.

11. Will electrification require expensive transformers and distribution grid upgrades?

Depending on the building size and the amount of EV charging some additional secondary transformers may be required. For all-electric buildings those costs are within the overall cost-effectiveness of electrification. EV charging does represent an added cost but those costs are small relative to overall construction costs and substantially less than retrofitting.

Additional distribution grid transformers are rare and most or all of the costs are typically the responsibility of PG&E. If there are costs to the property, these are costs are usually more than offset from the savings of all-electric construction.

The model code for EVs allows for significant use of Level 1 charging and load management to minimize service and transformer costs.

12. PG&E load calculations for EVs require concurrent calculation:

The model EV code gives precedence to the National Electrical Code which allows for load management (NEC 625.42) reducing the actual load. PG&E has confirmed that they will use specific load design in their calculations (not a fixed calculation based on number of spaces):

> Per PG&E: *We calculate loads based on the information provided by the applicant on the improvement plans, single line diagram and charger equipment specifications. Load balancing equipment can be considered and when it's used, we'll use the current limiting amperage to*

determine the load for L1, L2 and L3 (DCFC). Please note, for non-residential installations the applicant will be required to provide the charger equipment specifications/cut sheets.

13. PG&E Deficit Billing:

If a service upgrade is required, PG&E may be eligible for recouping certain costs if the costs are above an allowance based on past and forecasted use within 3 years. If utilization does not meet forecast, then certain costs may be recoverable. Because of the lag time between construction and when EVs will show up that could place a building in a "deficit billing" situation. There are several considerations:

a. Designing for efficiency is very important
b. Load management significantly reduces this risk
c. PCE is actively offering vehicle incentives (including for low income used vehicles) and marketing and would be happy to partner with builders for custom marketing at its properties to encourage EV adoption
d. If a deficit billing condition arises, the builder has 2 options: "lump sum" payments OR on-bill. On-bill may be attractive to amortize the costs and have beneficiaries of the installations cover the costs.
e. PCE is also planning to engage the CPUC regarding service upgrade costs to bring them more in line with other parts of California (other utilities costs are lower)

14. PG&E timeframes for distribution grid actions is slow

Turnaround times associated with PG&E and new construction are not expected to be materially different between all-electric or mixed fuel construction. Also upgrades to the distribution grid due to EV charging installations (more load than electric buildings), is rare at this point – about 3% according to our data from the CPUC. This may rise somewhat with reach codes and PG&E response times have clearly been adversely impacted by the bankruptcy. This is likely affecting both electrical and natural gas service response times. PG&E has committed to support electrification and is openly supporting all-electric reach codes due to concern about stranded natural gas assets and rising costs of maintaining the natural gas system.

4 Cost Effectiveness Studies

15. Are the state-wide cost-effectiveness studies based on IOU utility rates or PCE/SVCE's?

Currently, the study is based on specific IOU utility rates.

16. For tenant/landlord situations, who is paying for the measures vs. who receives the benefits?

It depends on the metering situation and rental agreement between tenant and landlord.

17. Are the models adjusted for upstream fugitive emissions? Do they account for Renewable Portfolio Standard requirements? Is there a consideration for hydrofluorocarbons (HFC's) in GHG emission saving analysis?

The GHG emission factors do account for future Renewable Portfolio Standard requirements. However, the GHG emissions factors do not reflect current emissions rates which may be ahead of the RPS requirements, do not include fugitive emissions, and do not include emissions associated with HFCs.

18. **What geographical regions do the cost effectiveness results apply to?**

    The statewide IOU study covers all geographical regions in California. This initiative focuses on San Mateo county (CEC climate zone 3) and Santa Clara county (CEC climate zone 4). The most up-to-date draft of cost effectiveness study can be found at: http://localenergycodes.com/content/2019-local-energy-ordinances/

19. **Does the PV sizing in analysis result in over production?**

    For most scenarios, no. The residential code allows for a slight over generation for all-electric homes with battery storage.

20. **Was there a sensitivity analysis performed on cost benefit?**

    The studies were performed with a set of assumptions that the consultant teams assumed would be most realistic. Sensitivity analysis has not yet been performed.

21. **Why are different compliance margins found to be cost effective between residential and nonresidential buildings?**

    The variance in compliance margins depends on occupancy type of the building and location (climate zone). These two determinants impact the energy consumption of the building, the state building code requirements, and subsequently the extent that additional energy efficiency measures are cost effective.

22. **Is it truly cheaper to build all-electric? How reliable is electric equipment compared to natural gas?**

    The studies have found that for the major building end-uses all-electric appliances have a negligible impact on installation costs as compared to gas appliances. Building all-electric has substantial cost savings for avoided natural gas infrastructure. These studies posted on our website examine the upfront costs, maintenance costs, and operational costs of all-electric designs and support these conclusions:
    i. Residential Building Electrification in California
    ii. 2019 Residential New Construction Cost-effectiveness Study
    iii. 2019 Nonresidential New Construction Cost-effectiveness Study

23. **For the reach code path "Option 3: Electrically Heated Building", How will the maintenance cost of a residential house be over the house life expectancy? Will it be more expensive in utility bills without solar panel installations?**

Generally speaking, yes an all-electric building operational cost improves dramatically with a) more efficient HVAC/DHW systems and b) more solar PV. Refer to the cost infographic on our website for detailed information on a single family home.

24. What are the baseline PV sizing requirements for low-rise residential buildings as per 2019 Title 24 code?

The PV system offsets the electricity usage of a mixed-fuel home. An all-electric home is required to have a baseline PV system size equivalent to a similar mixed-fuel home.

5 Building Technologies

25. Don't people prefer gas stoves?

Yes, many people prefer gas stoves. However, most people are unfamiliar with induction stoves which offer superior speed, cool and safe surfaces while cooking, and better indoor air quality. For 2018 Consumer Reports' top cooktops were electric and induction stoves were the top two.

26. Does all-electric heating use a lot of energy and can it work in our cool climate?

All-electric heat pumps are highly efficient and effective in weather far colder than ours. DOE studies show heat pump space heaters as highly efficient at as little as 5 degrees Fahrenheit. California Energy Commissions cost effectiveness studies also show high efficiency.

27. Is equipment not available?

Heat pumps and induction stoves have a long-established history and are widely adopted in other states. Also, numerous California institutions and agencies have committed to all-electric buildings which will aid scaling the know-how in California. Training is a need PCE and SVCE will be addressing.

28. Central water heating: Aren't central heat pump water heaters are infeasible/unavailable?

There are multiple design options for multi-family buildings including central heat-pump water heaters (HPWH) with larger tanks, central HPWH's in parallel, distributed HPWHs within each unit, or distributed HPWHs serving multiple units. Central HPWH it is absolutely an option with dozens of case studies and several practitioners, particularly in affordable housing. The following guide provides case studies, design insights and products: https://peninsulareachcodes.org/wp-content/uploads/2019/10/AZeroEmissionsAll-ElectricMultifamilyConstructionGuide_RedwoodEnergy.pdf

29. Can a heat pump water heater match the performance of a gas system?

Yes, a heat pump water heater can equal the performance of a gas equivalent. For example, Rheem's 55 gallon unit can deliver 70 gallons of hot water in the first hour, enough for about four showers. For comparison, Rheem's gas equivalent delivers 79 gallons in the first hour. When

selecting any hot water heater, no matter the fuel, make sure it is the right size for your use type. A home with a big family or a vacation home might need a larger 80 gallon tank.

30. Will the heat pump water heater need to be supplemented by electric resistance?

Heat pump water heaters are typically designed with hybrid heating capability, including a backup electric resistance coil. This enables the heat pump to work when its bitterly cold, and also helps the heat pump replenish its hot water supply more quickly. In most cases, particularly in mild California climates, the electric resistance coil is idle.

31. Can the central heat pump water heater distribute adequate water supply temperature to multiple units simultaneously?

Yes, when designed appropriately. Many entities are supporting specific design guideline development, expected to be publicly available in early 2020. The Zero Emissions All-Electric Multifamily Construction Guide outlines demonstration projects and common implementation.

32. With the rapid change in technologies, how soon will these all-electric technologies become irrelevant?

Most electrification technologies have been around for over a century. They will likely become slightly more efficient over time, but the current options available will be relevant for the life of the system.

33. How does the induction cooking compare to the current more favorable gas cooking?

Induction cooking has more specific temperature control, is much safer, easier to clean, and can vary heat settings faster than gas. They are also more efficient, as demonstrated by this study on Residential Cooktop Performance and Energy Comparison.

34. How do the costs for electric space heating and water heating compare to that of natural gas-based options?

The answer largely depends on the product chosen, climate, and occupant behavior. Generally, energy costs can be treated as similar. This is because while electricity is more expensive than gas per Btu, heat pumps are more efficient. Capital costs for new construction are lower because a building owner can avoid the high cost of a new gas meter.

35. Are natural gas systems more efficient than all-electric?

In every case, all-electric systems operate more efficiently than natural gas systems.

36. What if the new building does not have air conditioner? Are there any other requirements to later convert from a gas heater to electric heat pump?

The latest model code includes requiring electrical capacity minimums for gas-based space heating.

6 Electric Vehicles, Charging & Parking

37. EV demand: EV demand is perceived to be low raising questions about whether the proposed EV infrastructure is needed.

The model EV reach code is intended to ensure buildings built today will be ready for EV adoption to occur within the 40+ year life of the building – and incorporate that readiness at construction so as to avoid the very substantially greater costs of retrofits. For our region, EV sales will likely be the majority of vehicle sales in the next 5-6 years so the EV expansion will be well within the life of the buildings.

Data supporting that projection includes that at the end of 2018 EV purchases in San Mateo County were approximately 18% of new vehicles sold and based on a PCE county-wide survey in January 2019 over 35% of residents report they are "very likely" to adopt an EV as their next vehicle. It is anticipated that at the end of 2019 sales will be above 20% in the County and in some nearby jurisdictions sales are well above 30%. Automakers are rapidly moving to address that increase in demand. Every major automaker has announced major expansions of EVs (ex: GM: 20 new electric vehicles by 2023; Volkswagen: 50 fully electric models by 2025; Ford: 40 electrified models by the end of 2022). Global purchases of vehicles are expected to be over 50% EV by 2040 but in California it will be much faster.

38. Can you explain different types of EV?

PEV - Plug-in Electric Vehicle, which includes both PHEV and BEV as subsets
PHEV - Plug-in Hybrid Electric vehicle, which includes a conventional combustion engine.
BEV - Battery electric vehicle, which does not include a conventional combustion engine.

39. Why does the EV model code include use of low-power Level 1 charging?

"Level 1" charging identifies charging on a standard 110/120 volt plug. This is lower power than Level 2 charging which is the equivalent of a dryer outlet (or DC Fast Charging which is very high-power charging such as a Tesla Supercharger or EVgo station). Most installed EV charging stations are Level 2 however, in practice, many – possibly even a majority of EV drivers charge at home using Level 1.

Level 2 charging provides faster charging, important for longer range driving but Level 1 provides 30-40 miles of charge overnight. This level of charging provides sufficient charging for both Plug-in Hybrids which make up 40% of market and it is also sufficient for average daily driving which is under 30 miles a day. It is also substantially less expensive to deploy and, especially at large scales, minimizes the number of transformers and size of service panels to support. Finally, Level 1 outlets provide a practical option for people who may wish to own electric bikes, scooters or motorcycles.

40. How are the electric vehicle charging spaces shared between tenants in multifamily buildings?

The model codes require that each parking space in a multifamily building be provided with EV infrastructure, even parking spaces that are unassigned to specific dwelling units.

41. What are the typical costs of EVSE (Electric Vehicle Supply Equipment)?

Residential chargers - $400-$1200 per outlet
Nonresidential chargers - $1000-$5000 per outlet

42. Will a very aggressive deployment of EV readiness may put a sudden load to the electric grid?

Significant effort is going into planning at the infrastructure level, and smart charging capability at the EV charging station to ensure this is not an issue. Utilities are planning and preparing for increased levels of EV deployment.

43. Do EV charging stations also count as parking spaces? If not, are cities required to separately meet minimum parking space requirements as well as minimum number of EV charging stations?

This initiative's intent is that an EV charging station would replace a parking space, i.e., the total number of parking spaces would remain the same even with EV reach code requirements. Our understanding is that the municipalities interpret whether an EV charging station is equivalent to a parking space. Local ordinance adoption processes should ensure that local planning and zoning interpretations do not inadvertently result in an increase in the total number of parking spaces required as a result of EV reach code adoption.

44. Parking Stall Size: Will Requiring EV spaces make projects unviable?

9' x 18' is common in CA muni codes and so are larger spaces (10'x20'). As an example, Burlingame space size requirements appear to be 9' x 20' (same width, and longer than CalGreen @ 9' x 18') with an allowance for 8.5' x 18' in special circumstances. However, Burlingame has zones allowing for 8.5' x17'. https://qcode.us/codes/burlingame/view.php?topic=25-25_70-25_70_020

To maximize flexibility the November 2019 update to the EV model code removed reference to space sizes to leave space sizing up to the local jurisdiction.

7 Model Code Ordinance

Note: responses below related to mixed-fuel buildings apply to the PCE/SVCE all-electric "preferred" model building code. However, the project is also supporting many municipalities opting for the "Menlo Park model" which is all-electric "required with limited exceptions"

45. Do the local governments work with public utilities on developing the ordinance?

Local governments must receive approval from the California Energy Commission before adopting local building energy ordinances. (All other ordinance types must be submitted to the Building

Standards Commission). This initiative supports local governments in developing ordinances that are ready for CEC application and promote regional consistency.

46. How will the code be implemented against current standard practices?

The Statewide Utility study researched design approaches that are market ready as well as cost effective. The model codes as part of this initiative will support a flexible design approach with multiple compliance pathways.

47. Can we directly adopt the San Francisco EV ordinance?

Yes, cities can adopt EV ordinances they feel are best for their community, subject to the constraints of their own local ordinance development process. This initiative is building upon and enhancing other EV ordinances to recommend model codes.

48. How do we apply the cost effectiveness study to develop a prescriptive approach for model ordinance?

The cost effectiveness studies determined the maximum performance level that can be achieved cost effectively through a certain set of measures. The intent was to identify a market ready performance threshold, while allowing for it to be achieved in a variety of ways. Local jurisdictions can choose to allow for an alternative prescriptive compliance path that requires this set of measures.

49. Can reach codes promote better air quality in addition to energy efficiency?

Indoor air quality impacts are not explicitly studied, though many studies have shown that avoiding indoor natural gas combustion can result in better air quality, such as:

- Results of the California Healthy Homes Indoor Air Quality Study of 2011-2013: Impact of Natural Gas Appliances on Air Pollutant Concentrations. By Nasim A. Mullen, Jina Li, Marion L. Russell, Michael Spears, Brennan D. Less, Brett C. Singer
- Energy Research and Development Division FINAL PROJECT REPORT Air Quality Implications of
- an Energy Scenario for California Using High Levels of Electrification. By EPRI, prepared for California Energy Commission
- A Longitudinal Study of Indoor Nitrogen Dioxide Levels and Respiratory Symptoms in Inner-City Children with Asthma. By Nadia N. Hansel et al.

50. Are retrofits being considered in the electrification reach code?

Retrofits are not considered for the current scope of this initiative, except for electric-ready measures.

51. How will the ADU's be addressed?

Inclusion of ADUs is at the discretion of cities. Some are including ADUs in all-electric requirements, some are not.

52. How will mixed-use buildings comply?

The compliance margin percentage will be calculated as a weighted-average of the individual building results.

53. How will high-rise multifamily buildings comply?

Cost effectiveness results for high-rise multi-family building will be available in late 2019. It's likely that a compliance pathway will be available for all-electric, and a model code can be applied. In the meantime, current cost effectiveness studies have demonstrated compliance pathways for low-rise multifamily and hotel buildings, both of which are similar to high-rise multifamily buildings.

54. What building types are covered under the reach code?

Cost effectiveness studies were performed on single family, low-rise multifamily, hotel, office, and retail prototypes. At a minimum, most buildings falling under these size ranges comply with the reach code buildings. This initiative's model code applies the cost effectiveness findings to an expanded set of building types.

55. How do the proposed model reach codes affect the implementation/plan-check process? (applies only to the "electric preferred" model code. The "electric required" Menlo Park model is substantially simpler)

For Performance Path - Plan check would utilize the usual compliance outputs (the CF1R report for residential, or PRF-01 for nonresidential) to review the fuel type: "Natural gas" or "All-electric," and the characteristics of the water heating and HVAC systems and whether they are gas or all-electric. Based on this information, plan check will know what compliance margins the Proposed Design will need to show compared to the 2019 code compliant Standard Design, and verify that those compliance margins are achieved.

For Prescriptive Path – Plan check would need to review the plumbing drawings for the locations of natural gas piping, and which appliances are served by a natural gas pipe (if any). Plan check will then cross-reference the energy efficiency characteristics of the home as compared to the standard prescriptive requirements in Title 24 Part 6 as part of usual procedures. However, if there is natural gas piping, there will be short list of additional efficiency measures that plan check must review in addition to those required with Part 6.

Mandatory – Plan check will review the electrical drawings to ensure that adequate electrical capacity is supplied to space heating, water heating, cooking, and clothes drying end-uses.

56. Can you please advise the Energy Design Rating (EDR) equivalent to compliance margin requirement?

The proposed reach code language refers to EDR reductions from the 2019 code compliant baseline design. It is challenging to develop an exact relationship between an EDR reduction and a compliance margin because EDR includes whole-building energy use, while a compliance margin includes only a limited set of end-uses (not including solar PV or battery, for example). The full range of compliance margins and associated EDRs are available in the residential cost effectiveness study, but as an example an efficiency-only EDR reduction of 1 is approximately equivalent to a 5% compliance margin.

57. Please clarify the exclusion for "heavy industry and process loads" from the nonresidential portion i.e. does the nonresidential category cover warehouse or any other industrial uses?

The energy code only lightly regulates industrial processes. The reach code doesn't cover any research into how these industrial processes could be made more efficient. Common building systems (e.g., envelope, HVAC, etc..) that must already comply with Title 24 must comply at a reach level, and the industrial processes (which are NOT part of the compliance margin) are not affected.

58. Does 2019 Title 24 Part 6 require residential buildings to be all-electric? Will the reach code?

Neither will make all-electric construction a mandatory requirement. All-electric construction will be one of the compliance pathways.

59. Can a reach code still require PV?

Yes, cost effectiveness justification is provided for both Residential and Non-Residential buildings. We are including this in the model code.

60. Do the model codes prohibit co-generation or other types district thermal systems?
The intent of the model codes is to apply to new construction appliances serving specific building end-uses including space and water heating, cooking, and laundry.

Cogeneration represents an energy generation technology and is not an appliance serving one of the end-uses covered by the PCE/SVCE model codes.

The model codes would apply to new construction buildings that connect to the existing district thermal (a.k.a central plant) system and install on-site "booster" appliances to provide supplemental space or water heating (for example), but would not apply for new buildings that only use a heat exchanger and pumps to connect to a district thermal system and do not use any booster systems. Existing district thermal systems are not impacted by the reach code.