

The Need to Address Existing Buildings

This brief discusses findings that emerged through a series of interviews held in the spring of 2021, and a virtual workshop held in June 2021, in which over 115 stakeholder participants discussed Pathways to Carbon Neutrality in California.

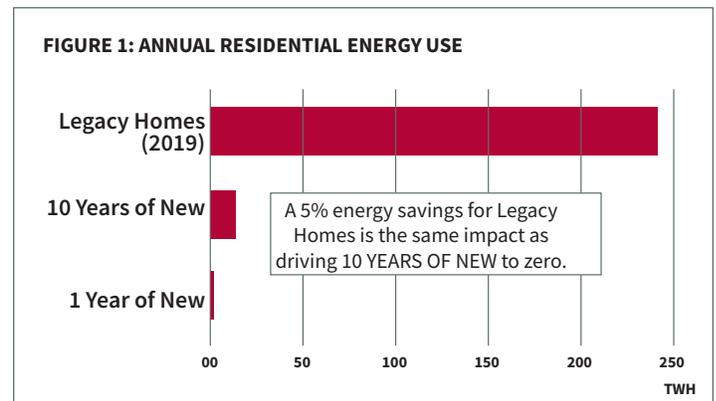
California can't build its way out of this – Existing buildings must be retrofitted.

Buildings represent 13.7% of California GHG emissions. California is setting high standards for new buildings with codes and regulations specifying energy efficiency, requiring photovoltaic systems, and starting to discourage or forbid fossil fuel appliances for space heating, hot water, and cooking. The state is on the way to eliminating carbon emissions from new buildings. However, new buildings are less of a problem than existing buildings.

OVER THE LAST FIVE YEARS, California has added about 85,000 units per year of housing.¹ Ten years of construction at this rate will yield around 850,000 new homes. In contrast, California has around 14 million existing homes, which is 15 times greater than ten years of new home growth. Buildings are long-lived, so almost all existing homes will still be in use in 2045.

LEGACY HOMES MUST BE RETROFITTED

Using simple averages for energy consumption, Figure 1 shows residential energy use for legacy homes and for new construction (10 years growth, and also 1 year). Notice that energy use for 10 years of new homes is a small fraction of energy use for existing homes. To put these numbers in perspective, a mere 5% reduction in energy use from legacy homes would be the same as driving energy use from new homes to zero.



There are two ways to reduce the carbon impact of existing buildings. One is to reduce the need for heating and cooling by improving the thermal envelope. The other is to convert fossil-fuel appliances to electric (furnaces and hot water heaters to heat pumps; gas stoves to induction). This brief discusses challenges to retrofitting existing buildings. (Although this document focuses on residential buildings, the issues are similar for commercial buildings.)

¹ US Census data: <https://www.census.gov/programs-surveys/popest/technical-documentation/research/evaluation-estimates/2020-evaluation-estimates/2010s-totals-housing-units.html>

Challenges for Retrofitting Millions of Existing Buildings

RETROFITTING ELECTRIC APPLIANCES IS HARD

The conversion to electric appliances is not as simple swapping out old with new. There is a one-time need to upgrade wiring and cap legacy gas lines. Wiring upgrades can trigger mandates to upgrade portions of the building's electrical system to modern codes, and perhaps necessitate an increase in electrical service capacity. Compared to a like-for-like swap, these improvements entail more sophisticated planning, more complex permits, a more elaborate inspection, and more sophisticated installers, leading to increased cost and time.

PROACTIVE REPLACEMENT IS BENEFICIAL

When an existing furnace, hot water heater, or stove fails, replacement is a matter of some urgency, and a prompt, like-for-like swap is routine. Residents without heat or hot water may be reluctant to accept the delays required by converting gas to electric. Therefore, participants noted that conversion should be done proactively, not at time of failure.

How can millions of building owners be induced to replace fossil-fuel appliances prior to failure?

AVAILABILITY OF TRAINED LABOR

Participants noted that a substantial increase in the number of electricians, already in short supply, will be critically important for the residential conversion to electricity. Conversion will also sometimes require skills in plumbing and construction. **Is there opportunity to create streamlined certification for technicians who install heat pumps?**

PREPARATION OF BUILDING DEPARTMENT OFFICIALS

Participants identified an issue that local building departments may not always be familiar with relatively new technology such as heat pumps. For reasons of public safety, they can only approve installations that they understand. **Is there opportunity to educate local officials on installation of heat pumps and induction stoves?**

SUPPLY OF ELECTRIC APPLIANCES

Participants indicated that it is difficult to source electric heat pumps because currently there is only a small market with few manufacturers, limited models, and large commercial heat pumps are simply not being manufactured. **Can heat pump supply and R&D be incentivized?**

THE NEED FOR SCALE

Retrofits need to be done to millions of buildings in only a couple of decades. Existing programs are on a house-by-house basis.

Can programs be designed to achieve large economies of scale and scope?

DESIGN OF SUBSIDIES AND INCENTIVES

Participants indicated that subsidy and incentive programs are fragmented across many agencies and can be hard to navigate.

Can programs be designed to require minimal initiative by residents/owners?

SOCIAL JUSTICE

Participants point out that low-income residents often lack the wherewithal to undertake retrofits. **How can low-income residences be retrofitted?**

SPLIT INCENTIVES

Participants identified that for energy efficiency improvements, the property owner pays the cost yet the tenant reaps the benefits of lower utility bills. **How can this split-incentive problem be addressed?**

UTILITY COST

The cost for space heating and hot water is higher with electricity than with fossil fuels. **How can the increased utility costs of electrification be addressed, especially for low-income people?**

FINANCING ENERGY EFFICIENCY

Participants point out that some energy efficiency projects for older homes, especially those in low-income areas, have a short payback period, yet the work is often not done. **Can programs rapidly implement financially-attractive energy-efficiency improvements at scale?**

CAPITAL EXPENSE

Electric conversion can be expensive, even for the "willing and able". **Can attractive, scalable financing options be devised, especially for people less knowledgeable about the complexities?**

DISTRIBUTION SYSTEM

In some areas, the electricity distribution system might need upgrades to handle increased demand resulting from the conversion from fossil fuel to electric appliances. **Can distribution upgrades be coordinated with residential electrical conversion?**

Ambitious Undertaking

Participants noted that to convert millions of buildings from fossil fuels to electric heat, hot water, and cooking in 24 years is a very ambitious, perhaps unprecedented undertaking. One participant proposed a "moonshot" for the massive amount of retrofitting that is required. **Are vendors, workforce, financing mechanisms, and public opinion prepared for the actions required? Is there opportunity to rethink the philosophy of programs, subsidies, regulation, etc. to undertake successfully the ambitious scale of work in the time available?**