Scaling Electrification Solutions

Getting to Zero Forum

zLab Workshop Summary

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Executive Summary

This report summarizes discussions and key findings generated during the zLab workshop that explored approaches to scaling electrification solutions on October 9, 2019, during the annual Getting to Zero

Forum in Oakland, CA. Hosted by Rocky Mountain Institute (RMI) and New Buildings Institute (NBI), this inaugural change lab was designed to innovate and accelerate the transformation of the built environment. This session ran concurrent with two other change labs, one focused on building energy performance standard policies and the other on the value of grid-interactive efficient buildings to building owners.[1]

More than 70 million US homes and businesses burn natural gas, oil, or propane on-site, generating over 10 percent of the country's greenhouse gas emissions (not including methane leaks).[2] Thus, building electrification is a key strategy for decarbonization. This zLab group focused on three critical issues:

- Getting consumers to demand electric heat pumps and other electric appliances from their contractors
- Expanding contractor capacity to deliver electrification solutions
- Making low-power solutions available and "retrofit ready"

After addressing the barriers to each issue, the group came up with five basic solution sets to tackle the three issues:

1. Utility rates pay for heat pumps: The utility company would pay for a basic heat pump installation. The cost of the heat-pump and installation would then just be built into a special rate paid by those customers participating in this program. A contractor would install a high efficiency heat pump with demand response capability in a home, allowing for responsive controls for the utility. The customer would have the option of paying an incremental cost for a higher efficiency heat pump. Thus, the customer gets the heat pump for a lower cost and has lower monthly bill payments. This might not be a permanent rate but could last a specific amount of time (e.g., 10 years) and then ramp down. In addition to increasing consumer demand, favorable rate structures could drive contractor capacity.

2. Work with health professionals to expand awareness of health benefits and increase value switching to electric appliances: To increase consumer demand for electric appliances, the group focused on health issues related to gas cooking. Coordinating with health professionals to share those health risks and viable alternatives can greatly expand the pool of trusted sources providing this information. It also bypasses lack of messaging in the installer field. A program to replace gas stoves could succeed by working with air pollution agencies, public health agencies, other health providers, low-income housing agencies, insurance companies, hospitals, and environmental justice organizations.

3. Increase contractor capacity through workforce development: Contractor capacity can be increased through standardized trainings for heat pump installations, and by creating industry apprenticeships and training materials. To increase recruitment and shift the focus from current practices, programs can consider rebranding the profession away from HVAC or furnace installer or technician.

4. Offer contractor incentives: Contractor incentives could include training incentives (e.g., the contractor can be a government-preferred contractor after having gone through the training) and performance-

[1] See https://gettingtozeroforum.org/zlabs/ for more details
[2] US Environmental Protection Agency, Inventory of US Greenhouse Gas Emissions and Sinks 1990–2015, 2016

based incentives (the cost of the training can be refunded after selling a certain number of units). Utilities and manufacturers can create funding sources for contractors prioritizing heat pumps.

5. Develop low-power specifications for utilities and manufacturers: It is crucial to develop specifications for electric appliances that are low-power, retrofit-ready, and would not require a house to invest in an electrical panel upgrade. Then utility companies and manufacturers could develop and/or import these appliances. The group developed basic specifications for HVAC systems, water heaters, stoves, and fireplaces.

RMI would like to thank all those who set aside time to create solutions for this workshop. The participants included: *Sean Armstrong (Redwood Energy), Sneha Ayyagari (Rocky Mountain Institute), Diane Bailey (Menlo Spark), Scott Blunk (Sacramento Municipal Utility District), Jacob Corvidae (Rocky Mountain Institute), Jeff Deason (Lawrence Berkeley National Laboratory), Pierre DelForge (Natural Resources Defense Council), Ralph DiNola (New Buildings Institute), Bryan Early (California Energy Commission), Jim Edelson (New Buildings Institute), Peter Eglinton (Efficiency Vermont), Dave Farnsworth (Regulatory Assistance Project), Steve Gelb (Emerald Cities), Stephanie Greene (Rocky Mountain Institute), Yihan Hao (Rocky Mountain Institute), Rachel Kuykendall (Sonoma Clean Power), Micah Lang (City of Vancouver), Trieu Mai (National Renewable Energy Laboratory), Amanda Myers (Energy Innovation), Steven Nadel (American Council for an Energy-Efficient Economy), Roch Naleway (Portland Electric), Elena Olmedo (Natural Resources Defense Council), Jenny Park (Resource Media), Laura Tajima (Building Electrification Initiative), Peter Turnbull, Zachary Zill (New York State Energy Research and Development Authority)*

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Barriers to electrification

While building electrification is a promising pathway to decarbonization, there are several barriers to adoption. Figure 1 highlights some of the key barriers that the zLab group sought to address:

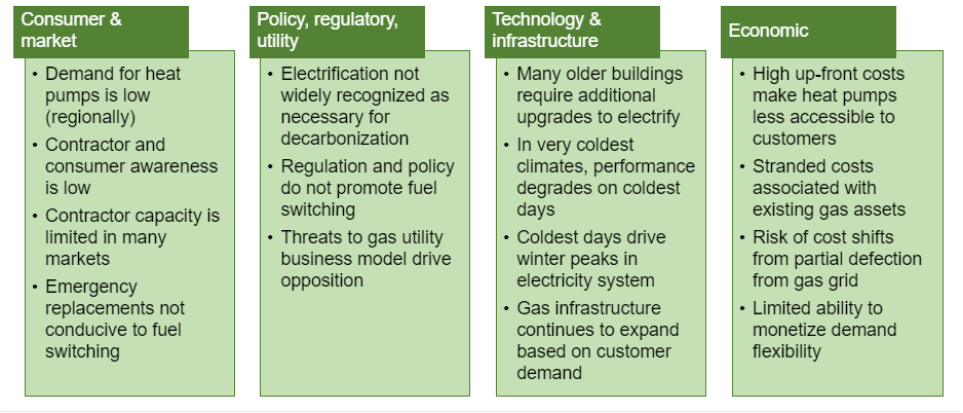


Figure 1: Barriers to Building Electrification

The group further analyzed barriers to building contractor capacity and increasing adoption of heat pumps:

Challenges to stimulating customer demand include:

1. Lack of consumer familiarity
2. Bias towards status quo appliances
3. Higher upfront cost and barriers to customer access
4. Electric technology upfront cost and ongoing lowering cost of gas
5. Appliance cost differential
6. Lack of several product options

Challenges to developing a contractor base include:

1. Lack of installation training
2. Lack of adequate equipment and materials
3. Risk of callbacks with new technology
4. Lack of training on trouble-shooting appliances
5. Trades nearing retirement

Solutions and Related Commitments

1. Utility rates pay for heat pumps

Proposed Solutions

Through a demand response program, the utility would serve as a platform through which contractors receive incentives and consumers can get installations of highly efficient heat pumps at lower costs as shown in Figure 2:

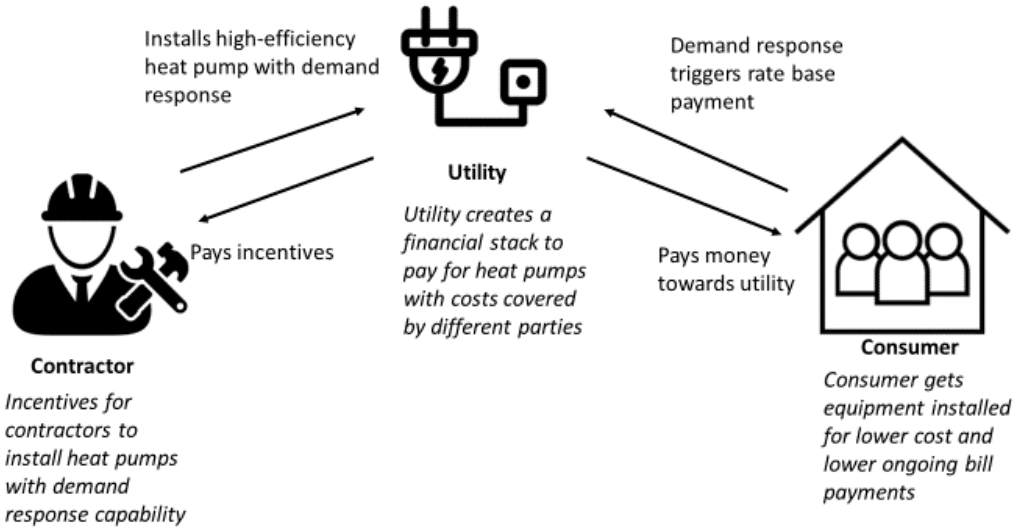


Figure 2: Utility Demand Response Program Helps Pay for Contractor Incentives

The utility could fund this program through a value stack that accounts for the potential energy and carbon benefits of heat pump installations as shown in Figure 3:

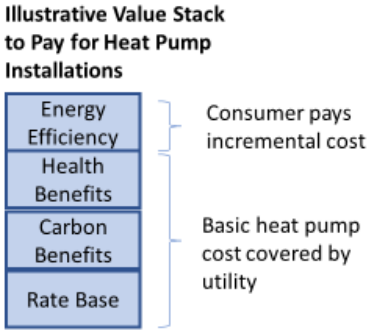


Figure 3: Value stack for utility heat pump programs

Though designed as a customer demand item, this would clearly drive contractor capacity as well presumably by directly employing contractors through the utility or at least creating qualified contractor

partnerships. Other solutions that were discussed include a rate discount for all electric homes or a higher rate for duel fuel homes.

Preliminary research shows that implementing this type of program could result in overall rate reductions (and therefore significant financial benefits) if avoided pipeline installations, carbon credits, and health benefits are monetized and factored in to the new rate. Even in scenarios where these factors are not considered, the customers may no effect increase in rates as a result of this program, though further research is required based on a precise program design.

Additional considerations

- How does one keep rates affordable while rate-basing costs?
- How does one inspire third parties to support rate basing?
- How would a cost model work without markets with demand response, cap and trade, or RGGI?
- How can social and environmental benefits such as health be monetized in a rate structure?
- Would this bypass fuel-switching prohibitions by not using efficiency program incentives?
- Would this be do-able now in any states without new rulings from the legislature or public utility commission?
- Could this model only be used by dual-fuel utilities, or could gas utilities rate-base this as an infrastructure improvement, even as the fuel billing switches to an electric utility?
- This approach could be piloted in places where distribution pipes are most costly for the utility to maintain.
- The saved costs of decommissioning distribution pipelines could be used to off-set and further lower the special rates.
- It's important that the rate for this is only rate-based among the pool of participating customers. That way if costs are more expensive than gas service, then it does not punish customers who are not able to participate. And if costs are less expensive than gas service, then it incentivizes people to join the program.

Related Commitments

- Provide heat pump demand response data from California to others
- Discuss rate structures with regulatory experts
- Demonstrate the cost-effectiveness of heat pumps with demand response
- Discuss rate structures with advocates and policymakers
- Steer these proposals into AB 3232 building decarbonization feasibility study process (running 2019 to the end of 2020)
- Participate in the rate review process to drive adoption of electrification rate

2. Work with health professionals to expand awareness of health benefits and increase value switching to electric appliances

Proposed Solution

The group suggested expanding the coalition by building awareness and momentum about the detrimental health impacts of gas stoves. This is particularly an issue in affordable housing. For example, cooking with natural gas can lead to up to 250% of EPA indoor air quality limits for NOx emissions in the ~200,000 units of New York City Housing Authority. Including health professions such as air pollution agencies, health care providers, low income housing advocates, hospitals, insurance companies, and environmental justice communities can help spur action on the city and state level.

Additional considerations

- How does one keep rates affordable while rate-basing costs?
- How does one inspire third parties to support rate basing?
- How would a cost model work without markets with demand response, cap and trade, or RGGI?
- How can social and environmental benefits such as health be monetized in a rate structure?
- Provide materials to make it easy for health practitioners to tell this story. Who pays for these to be printed?

Related Commitments

- Work in partnership with public health experts to establish a pilot program that links energy efficiency program to a discount on health insurance in participating buildings
- Develop materials and fact sheets on health and gas
- Expand Fossil Free Buildings Campaign to include medical professionals, advocates, and California Nurses Association
- Help steer the California Energy Commission towards considering public health when suggesting building policy
- Engage with the local health authority to start a conversation on indoor air quality and health
- Building support within state agencies to champion an integrated approach to electrification and health
- Support conversations between sustainability offices and public health offices in at least three cities
- Reach out to other cities that have incorporated and prioritized health issues into policy making around building electrification
- Work to get indoor air quality monitors in Sacramento lending library
- Contact three health NGOs to meet about the electrification and health nexus

3. Offer Contractor Incentives

Proposed Solutions

Utility and government incentives can help drive lower cost installations to the customer and stimulate demand for heat pump installations.

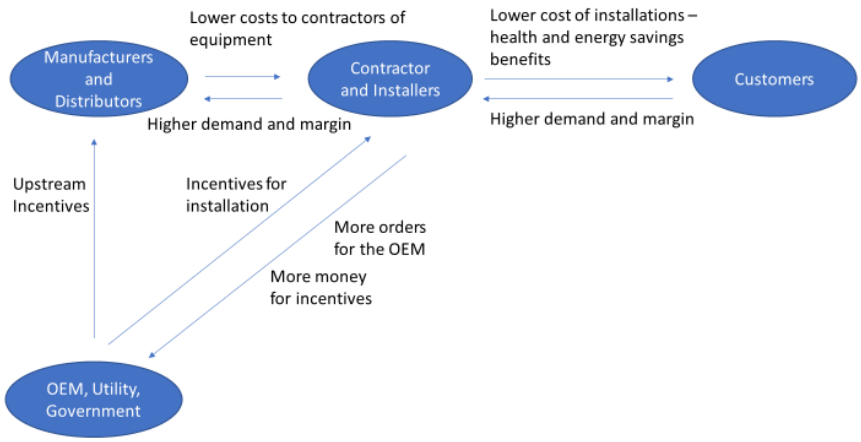


Figure 4: Contractor Incentive Flows

Additional considerations

- How might a ban on single-cycle ACs or back up electricity or gas work?
- How can one relate equipment rebates with consumers thinking of incentives for contracts?
- How can we enlist HVAC business owners as allies?
- How can labor unions be engaged in this process?
- How can electrification fit into existing licensing standards?
- How can one create a streamlined method to interface with utilities for service upgrade requirements?
- What is the intersection between permitting and contractor development and compliance?
- Would a model where the utility directly owned the system and provided heat as a service work?

Related Commitments

- Consider how to include contractor incentives in existing building decarb strategy such as AB 3232

4. Increase Supplier Capacity through Workforce Development

Proposed Solutions

- Design tools such as tax credits, utility rebates, and cap and trade that can be used to scale existing processes
- Create a central organization, clearinghouse or market maker to facilitate this process
- Overcome barriers which include lack of quality training for installer, having equipment and materials readily available, risk of callbacks with rapidly evolving new technology, lack of knowledge on trouble-shooting equipment, skilled tradespeople nearing retirement through targeted government and industry apprenticeship and vocational training programs
- Connect underemployed and low-income workers to HVAC training programs. Require "high road agreements" or hiring processes to ensure equitable hiring.
- Publish contractor case studies and results from incentive pilots to demonstrate sustainability
- Create playbook and contractor materials that can be applied across the country
- Create and expand a contractor base that is qualified and eager to install major electrification technologies including heat pumps and electric hot water heaters

Related Commitments

- Rebrand HVAC training programs as "Clean Energy Technician Training"
- Encourage local community choice aggregators to fund Green Workforce Development at community colleges
- Include workforce development policy as part of Electrification Readings to be shared with advocates and policymakers
- Convene stakeholder advisory group to develop common certification standards and to advocate for vocational training
    - Includes trade groups, manufacturers, contractors, policy officials, etc.)
- Will get a local group that does contractor training for renewables to add training on electrification
- Collaborate with local industry associations to develop a jobs and skills readiness transition strategy

5. Develop low-power specifications for utilities and manufacturers:

Proposed solutions

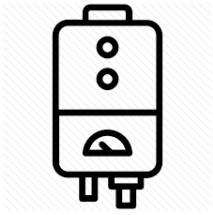
- The group aimed to empower cities and advocates to approach utilities and manufacturers with specifications needed for a variety of appliances that are low-power, “retrofit ready” and don’t require an electric panel upgrade. The goal of this process was to clarify needs and motivate utilities and manufacturers to develop, import, and support solutions.
- Because many of the necessary products are available internationally, *there is an urgent need for an accelerated import program* to:
    - Provide grants for UL Listing ($30k-$60k cost per product)
    - Provide grants for DOE Certification (cost of $10k-$30k per product)
    - Provide grants for field performance confirmation ($200k-$1M per product) for advanced/high-efficiency performance claims new to the U.S. market

Retrofit Panels for Low-Amp Households

- Low education requirement; Fail safe for 20+ years; Universal and simple
- Subpanel must have switch off to balance loads; balance smart tech with universal application
- Switchboard for critical loads (med equipment, light, cooking, pumps, elevators); Briefly Interruptible (Dryer, dish washer, fridge, HVAC, recreation) and Flexible with surplus (EVs, Preheat DHW tanks, tools with batteries)

Stoves

- 1400W at 120V to allow for plug-in use
- 30” wide
- Highly insulated oven to provide higher performance with less power
- Draft suggestion: 4 burners with internal load balancing



Central Domestic Hot Water (DHW)

- The ideal performance characteristics of a central domestic hot water Air Source Heat Pump version would be:
    - COP of 5.5+ at plant, allowing for 30%-50% loss from recirculation system and use of existing panels without a service upgrade
    - 240V
    - Design temp 5F/-15C
    - fits on an elevator
- Centralized wastewater heat pumps (e.g. Sharc) could potentially work in 20% of Vancouver buildings at a high Co-efficient of Performance (COP)

HVAC

- 120V
- 1400W or less
- COP 3+
- Inverter controlled
- When a PTHP, they need to be sleek with a small impact, both horizontal and upright configurations. Examples are Sakura and Innova brand PTHPs.
- Need operational turn-down to accommodate small multifamily and Passive House HVAC loads

Outdoor Fire Places:

- Often last gas end use to be cut from the design, but avoids $20k gas connection

- Alternatives utility utilize water vapor, LEDs
- Needs a waterproof “toaster” element
- Able to plug into existing 120V outdoor outlet, similar to a lawnmower, 1400W or less

Additional Considerations

- How much will electric vehicle chargers affect these specifications?
- How will EV ready code address panels?
- How will these products be advanced in cold climates?
- What are the cost differentials and what different services and value do they provide?
- How can HVAC systems be configured to use existing steam/hot water pipes?

Related Commitments

- Consider these specifications in research and analysis related to net zero energy buildings
- Liaise with colleagues and local stakeholders to help develop the panel and sub panel specifications
- Keep supporting Redwood Energy to produce technical guides
- Liaise on potential interface with these specs for SB 1477 Bill which would allow major retrofits to qualify
- Will help develop a guide for central heat pump water heaters
- Will help formalize these specs and send to manufacturers

Next steps

What will RMI do?

Scaling electrification strategy is an ongoing effort for RMI and many others. As a result of this workshop, we will integrate these ideas as appropriate into our workplans over the next year. We will also follow-up on the “related commitments” to support the advancement of these ideas. RMI looks forward to continuing the discussion. And we encourage everyone to join us at the 2021 Getting to Zero Forum, March 15–17, 2021.

What can you do?

First, continue telling the story, emphasizing the importance of electrification for creating healthy, safe, low-carbon buildings.

Second, reach out to relevant stakeholders you know to advance these ideas. These stakeholders can include health professionals, community colleges and other workforce training centers, utilities, regulators, manufacturers and contractors.

Finally, share what you’ve done and let others know (including RMI) how you’re advancing this work.