

Rewiring Energy Efficiency Programs to Better Support Electrification

Leslie Nelson, UC Davis Energy Graduate Group

Ana Sophia Mifsud, RMI

ABSTRACT

Utility energy efficiency programs have been built on the foundation that energy efficiency is a least cost resource – meaning utility investment in energy savings through efficiency is more cost-effective than investment in additional electricity supply. These programs have been successful across the nation, saving customers money on utility bills and avoiding unnecessary investments in carbon intensive electricity generation. As states and utilities commit to a decarbonized future, many are looking to their energy efficiency programs as a tool to increase the adoption of emissions-saving technologies. Electrification measures, such as heat pumps or induction cooktops, are a key tool for decarbonization of buildings. One fundamental challenge of pursuing electrification in the energy efficiency program framework is that electrification technologies are not necessarily a least cost resource to the utility. In fact, in some buildings they can increase electricity consumption which could hypothetically lead to utility investment in more electricity supply capacity.

We conducted interviews of implementers and administrators of residential heat pump programs across the country. This paper summarizes regulatory best practices for successful heat pump programs as well as how the energy efficiency program framework can be modified to better support electrification measures. Although utilizing energy efficiency programs can be an effective and fast way to support building electrification measures, the limitations of the framework may lead some states or utilities to seek a new framework built specifically to support electrification.

Introduction

The first utility energy efficiency programs arose in the 1970s, and they saw large growth in spending in the mid-2000s as states began adopting “energy efficiency resource standards” (EERS). EERS are quantitative, long-term energy savings targets for utilities (Gold, Gilleo, and Berg 2019). These standards require utilities to procure electricity or natural gas savings, typically equal to a percentage of the utility’s projected load growth. As of 2020, 27 states have enacted EERS (Berg et al. 2020). Energy efficiency has been critical to utility resource planning for decades. In 2003, California’s loading order policy directed energy demands to be met by energy efficiency and demand response first before new generation is considered (State of California 2003). The Energy Independence and Security Act (EISA) of 2007, Section 532(a) states that “each electric utility shall integrate energy efficiency resources into utility, State, and regional plans; and adopt policies establishing cost-effective energy efficiency as a priority resource.”

“Resource Acquisition” energy efficiency programs were built to procure energy efficiency savings as a least-cost alternative to additional energy supply investments, such as the build out of more generation (Krause and Eto 1988). Energy efficiency programs deliver a

levelized electricity resource cost of \$0.031/kWh on average, with new programs costing about one-third the cost of community solar photovoltaic and about 50% less than a new natural gas combined cycle plant (Molina and Relf 2018). Programs are designed to influence utility customers to install efficient equipment through means of financial incentives, rebates and financing, education, and technical assistance. The savings generated by these activities are validated through evaluation, measurement, and verification (EM&V), and regulators often offer utilities performance incentives to meet or exceed energy savings goals. In 2020, the total impact of ratepayer-funded energy efficiency programs was a savings of about 286 million MWh, which is approximately 7.69% of 2020 electricity consumption (BNEF 2022).

As climate change intensifies, focus is shifting from securing the lowest cost energy to decarbonization of the energy sector. As of early 2022, SEPA reports that 81% of U.S. customer accounts are served by a utility or a utility owned by a parent company with a carbon-reduction target, and 69% of U.S. customer accounts are served by a utility or a utility owned by a parent company with a 100% carbon-reduction target (SEPA 2022). In addition to decarbonizing electricity supply, direct emissions from the combustion of fossil fuels in buildings must also be decarbonized. Direct emissions from the combustion of fossil fuels in buildings are responsible for about 9% of global energy and process related CO₂ emissions (IEA 2021). These emissions can be greatly reduced or eliminated by electrifying fossil fuel appliances in buildings. Replacing a gas furnace with a heat pump, for example, will reduce carbon emissions in 46 of 48 states, or 99% of U.S. households (McKenna, Shah, and Silberg 2020).

Despite climate benefits, electrification technologies have had slow market uptake. Typical barriers to electrification of buildings include high upfront cost, lack of knowledge of equipment, and lack of qualified contractors. Energy efficiency programs have mastered tackling these types of barriers and accelerating market adoption of equipment. With the already established structure of efficiency programs to address these barriers, utilities have been including electrification measures – such as heat pumps and induction cooktops – in energy efficiency programs. There are many benefits to following the proven structure of these programs, but a key challenge is that energy efficiency program success is typically measured by reductions in energy use, not GHG emissions. In this paper, we use existing heat pump programs to examine how the energy efficiency program framework can be leveraged to support building electrification, and the limitations of that framework.

Case Study: Heat Pump Programs

Heat pumps can be used to replace or reduce fossil fuel or electric resistance space heating in homes. They are a very efficient electric heating solution that can be used to electrify the largest source of emissions in residential homes – the gas, propane, or oil-fired heating system (Leung 2018). Utility energy efficiency programs (referred to as utility programs) across the U.S. have been incentivizing and facilitating market acceleration of heat pumps to increase consumer adoption. We interviewed program administrators and implementers from Association for Energy Affordability (AEA), Center for Energy and Environment's (CEE) Minnesota Air Source Heat Pump (ASHP) Collaborative, Efficiency Maine, Efficiency Vermont, New York State Energy Research and Development Authority (NYSERDA), Northwest Energy Efficiency Alliance (NEEA), Sacramento Municipal Utility District (SMUD), and VEIC to learn more about strategies employed. These programs were selected because they were known to have heat

pump program success, unique strategies, and/or they operate in cold climates. The scope of study included single family and multifamily home installations and multiple heat pump technologies – ducted and ductless, air-source and geothermal. A summary of the best practices for heat pump program implementation is provided below in Table 1.

Table 1: List of all best practices gathered from interviews and research

Category	Best Practice
Regulatory	Allow programs to pursue fuel switching measures and provide appropriate regulatory metrics for fuel switching
	Consider innovative frameworks, such as market transformation attribution, for program design and evaluation
	Consider supporting statewide programs to share resources and research
	Require goals for number of installations or program spending for low-income customers
Financial	Provide meaningful incentives to overcome upfront costs
	Only incentivize high performing equipment, such as cold-climate heat pumps in colder regions
	Identify market segments to target for program marketing and engagement
	Provide higher incentives and financing for low-income or otherwise qualifying customers
	Consider partnering with other programs to stack incentives or identify additional incentive funding mechanisms
	Explore electric rate structures such as off-peak rates, electric heating rates, and dual fuel rates
Supply Chain	Develop strong relationships with market actors and integrate feedback loops into programs
	Provide midstream incentives
	Work with supply chain actors to encourage competitive pricing
Education	Develop marketing materials to educate consumers on energy and non-energy benefits of heat pumps
	Support contractor training and maintain a qualified contractor list
	Ensure contractors are trained to size equipment properly and size the equipment for the full heating load
	Ensure contractors are trained to properly set controls on dual fuel systems so that heat pumps usage is optimal

The financial, supply chain, and education barriers to consumer adoption of heat pumps are similar to those of other efficient appliances supported through utility programs. Heat pumps have a high upfront cost of equipment, consumers lack knowledge of the equipment or its energy benefits, contractors are not trained or familiar with installation of the equipment, supply chain market actors do not have motivation to stock and supply equipment, etc. This paper focuses on

the regulatory barriers that utility programs face in the implementation of electrification programs. To support electrification, utility programs must usually employ some work-arounds that go beyond business-as-usual energy efficiency practices. Leading programs are going beyond initial work-arounds to create comprehensive program frameworks that enable electrification at scale. Best practices gathered from these leading programs are detailed below.

Allow programs to pursue fuel switching measures

First and foremost, to enable electrification programs, fuel switching measures should be explicitly allowed by program regulators. For this discussion, fuel switching measures are defined as measures replacing a heating or cooling technology or appliance with one driven by a different energy source, such as replacing a natural gas furnace with an electric air source heat pump.¹ Because state EERS are specific to electricity or natural gas savings, utility programs typically include energy savings goals for specific fuels, such as kilowatt-hours for electricity and therms for natural gas. These goals are useful for programs that improve efficiency of equipment of the same fuel but can lead to conflict when pursuing efficiency programs where one fuel is changed out for another. For example, the replacement of a natural gas furnace with an air source heat pump would lead to natural gas savings from removing the furnace, but negative electricity savings from installing a heat pump. To maximize a utility electrification program, a regulatory structure must be developed to allow this type of measure. The first step to developing this structure is allowing fuel switching programs.

Because interest in the pursuit of fuel switching measures has been relatively recent, state regulations and guidance on fuel switching has been evolving rapidly. All the program implementers and administrators interviewed worked in states (California, Maine, Minnesota, Vermont, and New York) that explicitly allow fuel switching in utility programs (Berg, Cooper, and Cortez 2020). Some states that have no explicit policy on fuel switching have been able to support some electrification measures in a limited capacity. Michigan, for example, has no policy on fuel switching but approved a pilot heat pump program for homes and businesses served with unregulated fuels such as propane (MPSC 2020). When approving the program, the Michigan Public Service Commission stated that “measures that increase overall electricity consumption—regardless of a reduction in total million British thermal units energy usage or other benefits—are not suitable for full-scale electric [Energy Waste Reduction] EWR program implementation” and reiterate that the statutory charge of EWR programs is to save kWh and defer investment in new power plants (MPSC 2020). With this guidance, the implementation of heat pump programs is severely limited.

Though possible to run programs without clear approval and guidance around fuel switching measures, having a policy that explicitly allows fuel switching and provides appropriate pathways for utilities to pursue electrification programs is critical for large scale program implementation. Some states that explicitly allow fuel switching in utility programs have included certain tests to determine which fuel switching projects can receive ratepayer

¹ In this paper, fuel switching is in reference to the replacement of any fuel, including regulated fuels like electricity or natural gas, as well as unregulated fuels like propane or fuel oil. We note that California regulators refer to fuel replacements with two regulated fuels as “fuel substitution” and replacements with one unregulated fuel as “fuel switching.”

funded support. These tests can include criteria such as requiring that a measure provides a net reduction in source energy use, a net reduction in fuel-neutral customer energy costs, a net reduction in lifetime carbon emissions, no increase in coincident peak electricity demand, etc. (Minnesota Legislature 2021; CPUC 2019). Though well intentioned, these tests have the potential to cause additional administrative burden and dissuade utilities from pursuing fuel switching programs. For example, the California “Three-Prong Test” that was created in 1992 to ensure fuel switching measures truly reduce energy and benefit the environment had unclear requirements and a confusing structure that essentially precluded fuel switching programs until the test was updated in 2019 (Borgeson 2019).

Due to the challenges in implementation of such tests, tests being too restrictive, and additional administrative burden, it is a best practice for regulators to not include fuel switching tests for utility programs. If a test must be included, it should include a distinction between renewable and fossil source energy when calculating energy usage reductions, use long term marginal emissions methodology, set the cost tests at the portfolio level, include gas infrastructure costs in cost effectiveness, include the cost of carbon emissions including calculation of methane emissions leakage (using the 20 year metric), and include the cost of health impacts from the indoor and outdoor air pollution caused by combustion appliances.

Beyond simply allowing fuel switching in efficiency programs, regulators should also provide program regulatory frameworks that appropriately recognize the benefits of fuel switching technologies. Regulatory frameworks include goals, funding, and success metrics to support a program.

Develop goals that align with electrification benefits

Establishing goals that support electrification, and not simply energy savings, can align programs for success. The core reason for electrifying buildings is not to reduce energy usage, but to reduce GHG emissions. Running electrification programs under the premise of working toward electricity or natural gas savings misses the mark. Setting program goals in terms of total energy savings better aligns with electrification, but still falls short of the fundamental goal of emissions reductions. Program success metrics are typically tied to goals, so setting the right goals that recognize the value of electrification is critical to program design. Some example goals that recognize the benefits of electrification may include:

- Renewable heating and cooling equipment installation goals
- Fossil fuel equipment retrofit savings goals
- Net-zero or GHG emissions reductions goals
- State heat pump installation goals

These goals can be set through the state legislature, state sustainability plans, utility sustainability plans, or other avenues. Colorado has passed legislation that requires investor-owned utilities to file beneficial electrification plans, which supports the City of Denver’s Renewable Heating and Cooling Plan (State of Colorado 2021). Depending on who sets the goals, different organizations may be charged with promulgating those goals - such as state energy efficiency program implementers or utilities. Legislation in Maine focused on reducing oil dependence charges Efficiency Maine Trust and other state entities to prioritize alternative

fuels for heating and transportation (Maine Legislature 2011). Goals specific to electrification can be combined with other EERS or savings goals that programs are charged to meet. For example, New York has a statewide goal of 185 TBtu customer-level energy reduction by 2025, with a subsidiary goal of at least 5 TBtu in reduction through heat pumps (NYPSC 2018). A more explicit goal to support electrification is setting equipment installation goals such as Maine’s statewide goal of adding 100,000 new heat pumps by 2025 (Maine Legislature 2019). Further, setting goals around total GHG emissions in a region and not simply emissions or impacts of a certain fuel can provide a path to replacing unregulated fuels like propane and fuel oil that have high GHG emissions. Heat pump programs or other electrification programs can also be leveraged to provide non-pipeline alternatives to defer or avoid natural gas capital projects, and therefore can align well with natural gas infrastructure goals or planning.

Establish funding mechanisms to support electrification

To accomplish goals, a consistent funding source(s) must be identified to support programs. Almost all interviewed program implementers shared that high incentives are critical for heat pump program success, which means programs must be well funded. System benefits charges are intended to fund public benefit programs and could support electrification programs if regulators grant approval. System benefits charges allocated toward a resource acquisition program could be supplemented by other funding sources to bolster program budgets and enable successful heat pump programs. Some examples of other funding sources include:

- Carbon market revenues
- Taxes on fossil fuels
- Renewable energy portfolio standards
- Forward capacity market funds

MassCEC and NYSERDA have dedicated funding for renewable thermal market transformation from renewable portfolio charges and RGGI revenues (VEIC 2018). Maine funds heat pump programs through a systems benefits charge, RGGI, forward capacity market funds, and contracts with Maine utilities (VEIC 2018). Similar to goals, the nature of the funding source may lend itself toward a particular organization implementing programs, such as a state agency.

Track program success with appropriate electrification metrics

Heat pump measures can be included in utility programs charged with claiming kWh or therm savings, but the savings claims are limited. Air source heat pump initiatives such as those run by Efficiency Maine, Energize Connecticut, Mass Save, National Grid Rhode Island, and New York utilities, have been able to claim “market opportunity” electricity savings, which are the electricity savings associated with installing a higher efficiency ASHP above the baseline efficiency ASHP (VEIC 2018). There is also potential to claim natural gas “early retirement” savings when inefficient natural gas equipment is replaced before the end of its useful life. Though these methods provide a pathway to claim electricity and natural gas savings, the savings are small and do not recognize the core benefit of electrification, the GHG emissions reductions from fuel switching. Under the traditional resource acquisition model that requires a certain

amount of energy savings be delivered per dollar invested, fewer savings claimed can limit the amount of funding available for incentives and program implementation. In a study of heat pump programs in the Northeast, VEIC (2018) found that programs that only counted market opportunity electric savings had much lower incentives than programs that measured success against renewable heating and cooling goals and/or fossil fuel retrofit savings. Utility program structures that base program funding on savings generated and that only claim market opportunity or early retirement savings are limited. Some program success metrics beyond kWh or therm savings are:

- Btu savings
- CO₂ savings or avoided carbon dioxide emissions
- Number of installations
- Market transformation

A regulatory framework for utility programs that better recognizes the impacts of fuel switching technologies is setting fuel neutral goals such as heat energy metrics like British thermal units (Btus). New York has established Btu metrics in programs. Btu savings fit most closely to the classical utility program framework, but the metric breaks down when considered in the context of resource acquisition. A reduction in Btus across multiple fuels does not necessarily lead to a reduction in the need for additional investment in resources of one fuel or another. Installing a heat pump, for example, leads to overall Btu savings from a small increase in Btus from electricity and a large decrease in Btus from natural gas. Overall Btus remove the detail of the fuel so the metric does not support resource planning for specific fuels. Further, Btus are somewhat related but do not directly relate to the electrification goal of GHG reductions.

A metric that more closely aligns electrification programs with emissions goals is reduction in CO₂ equivalents. SMUD has adopted a metric of avoided carbon dioxide emissions to align efficiency programs with organizational goals (Wang and Menonna 2020). For CO₂ equivalents, regulators should use lifetime marginal emissions instead of annual marginal emissions, as the carbon intensity of grid electricity is rapidly changing.

Including a program metric that is number of installations of equipment is an explicit way to ensure market growth of electrification equipment, and track toward total installation goals. This metric can be paired with utility program savings goals as a means of ensuring that the proper amount of emphasis is given to electrification programs within the program portfolio. Maine utilizes the typical energy savings goals but pairs it with a statewide goal of adding 100,000 new heat pumps by 2025 (Maine Legislature 2019).

To address many of the barriers to greater market adoption of heat pumps, interventions beyond financial incentives are needed. Market transformation efforts such as workforce training, marketing, and demonstration projects are often needed for fast and comprehensive market adoption. These market transformation activities can be included in utility energy efficiency programs, but the traditional resource acquisition model that requires a certain amount of energy savings be delivered per dollar invested can limit the amount of funding available to pursue market transformation efforts. Further, the resource acquisition model only gives energy savings credit on a per-unit replacement basis and does not give credit for whole market advancement that leads to energy efficient technologies becoming the norm. It is a best practice

for regulators to develop frameworks that support market transformation activities and recognize their impact.

NEEA has been successful in developing market transformation evaluation frameworks. Their model includes understanding the market, existing barriers, and potential leverage points (Moran, Leritz, and Littlehales 2018). A market transformation program may claim near term savings, but the larger objective is to measure progress of the entire market as the program accelerates technology adoption. Guidehouse (formerly Navigant Consulting, Inc.) facilitated a Market Transformation Summit in February 2019 that identified cold climate heat pumps as a candidate technology to leverage existing resource acquisition incentive-based programs and add momentum by including market transformation activities (Davis, Harris, and Violette 2019). Because the barriers to heat pump market adoption require market interventions beyond financial incentives, regulators should allow market transformation program evaluation to recognize the impact of program activities beyond near term energy savings. This program structure includes defining a baseline market adoption curve, deploying market interventions, and then tracking market growth over time (Moran, Leritz, and Littlehales 2018).

The New York State Clean Heat program includes incentives from New York electric utilities and market development initiatives, such as workforce development and consumer education, from NYSERDA. This framework funds market transformation efforts without the budget being dependent on the amount of energy savings the utility program can claim.

Consider supporting statewide programs to share resources and research

Organizing heat pump programs and activities at the statewide level has great potential for pooling resources and amplifying efforts in areas such as manufacturer engagement, workforce training, consumer education, and technical support. Conducting these activities at a level higher than the utility or program implementer reduces duplicate efforts across the state, provides more consistency across programs, simplifies market actor engagement, and supports smaller utilities that may be resource constrained.

Regulators should consider if a statewide program should run all activities related to heat pump program design and implementation or if some activities should be reserved for local utilities. The regulator should examine if local regions have differing needs such as different climates, percentage of low-income customers, primary language spoken, etc. and therefore may not be best served from a uniform program across the state. Certain activities, such as engaging contractors and supplying incentives might be more effective if conducted by a local group. The regulator should also consider if the utility or other local organization may have a better relationship with consumers or better means to target and access consumers.

The model of having a statewide body conduct broader market development activities and local utilities conduct specific implementation activities has been seen in the Minnesota ASHP Collaborative and New York State Clean Heat program. The statewide organizations should also facilitate knowledge-sharing among the incentive programs, whether that be developing a joint management committee with statewide and local stakeholders or working with each utility to facilitate uniform design of incentive programs. Other programs, such as Efficiency Maine and Efficiency Vermont, have had success with statewide implementation of programs due to the consistency across the market.

Suggestions for Program Development and Evaluation

Utility energy efficiency programs have built an industry with expertise in accelerating market adoption of efficient equipment. This knowledge should be leveraged to support electrification, but the incumbent program regulatory framework - the goals, funding, and success metrics – should be adjusted to meet the needs of electrification. The foundation that energy efficiency programs provide a least cost resource to utilities cracks when fuel switching is considered. There are instances where a cracked foundation can be given enough additional support to be successful. For example, the NYS Clean Heat program is a utility program providing incentives and claiming savings, but also has statewide market transformation support from NYSERDA. There are overall Btu savings goals as well as Btu goals specifically to be met by heat pump installations. Through all these elements, the program has the ability to advance electrification on a large scale.

Though there are many work-arounds and modifications required to effectively include electrification measures in utility energy efficiency programs, a key benefit of leveraging the utility framework is that it is already built. Existing energy efficiency programs have proven success, and the regulatory structure has been built and implemented. These programs also have established relationships with market actors and trade allies and know how to engage customers. Depending on the state, electrification programs might be most quickly implemented by utilizing the utility program framework with some modifications. This has been the route taken by the heat pump programs interviewed for this paper. Other states that do not yet have heat pump programs might have more rigid structures and policies that preclude electrification in energy efficiency programs, such as Michigan's insistence on reducing electricity usage regardless of Btu savings. These states might need to step outside the energy efficiency program framework and develop new goals, funding, and success metrics for electrification programs.

If the utility's hands are tied too tightly by energy efficiency programs, they may need to seek a new class of programs for electrification. Those electrification programs can follow a similar structure to energy efficiency programs, with the main difference being goals of GHG savings instead of kWh or therm savings. If the modifications to energy efficiency programs are easier and faster than developing new electrification programs, then utilizing the program structure that is already built may be the best route. The first step is acknowledging how far the energy efficiency program framework can take an electrification measure based on the available tweaks and modifications and the state's specific regulatory framework. As more programs are developed and tested there is additional potential to determine the best path forward.

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