It Was Water, Water Everywhere: What Did Efficiency Programs Learn from the Last, Great Flood?

Robyn King and Lara Bonn, VEIC
Suzanne Elowson, VEIC (Efficiency Vermont)

ABSTRACT

Vermont has had two 100-year floods in the past 12 years. The first time, with Tropical Storm Irene in 2011, an energy efficiency program sprang into action to support the restoration of residences and businesses statewide with significant incentives to build back—with future resilience in mind. This paper investigates what the state did differently, 12 years later with the Great Flood of 2023, an equally devastating storm that occurred in July—and what the state kept the same, in terms of its recovery response. The efficiency program pivoted its initiatives and measures in response to the devastation Irene brought to customers—especially those living near rivers. The program worked with regulators and FEMA to restore the customers' flooded living spaces, rebuild community life, and increase energy resilience against future such events. The authors describe which of the 2011 energy upgrades withstood the 2023 flood and which community engagement efforts worked best for accelerating recovery. The paper also addresses how braiding funding sources and program requirements spurred innovation following both catastrophic events—and expedited project completion. The authors explain how flood energy resilience considerations and designs could permanently influence future program investments. Experience from 2023 flood recovery has helped inform energy efficiency programs and services for future weather-related catastrophes and effectively assisting the most vulnerable customers.

Introduction

Incorporating energy efficiency, renewables, and energy resilience measures into public and private building stock can lead to better outcomes for communities in the wake of natural hazards. Similarly, there is consensus that communities across the country and the world will face the manifestations of climate change, necessitating planned improvements to the built and natural environments. Despite this shared knowledge among many leading organizations and governments, there remain significant barriers to widespread deployment of efficiency as a part of emergency response.

The Federal Emergency Management Agency (FEMA) has the responsibility to assist people before, during, and after disasters occur (FEMA 2021). While FEMA might be the most well-known disaster response agency, over 30 federal agencies have recovery programs (United States Government Accountability Office 2022). On the state level, hazard mitigation and other emergency operating plans often define roles for organizations that aid communities during and after an event (FEMA 2024a). While FEMA and related agencies have incredible impact on helping individuals recover, their assistance may be limited to what existed prior to the event (FEMA 2019), and their energy efficiency–oriented programs primarily apply to institutional buildings (FEMA 2024b) (Lee 2018). This can leave opportunity on the table for energy efficiency and resilience measures at the individual or business level, since these could appear to add additional cost if impacted individuals did not have them in place before the event (FEMA

2023).[1] Energy resilience, however, is a crucial component of long-term disaster response; it describes the ability to maintain access to energy resources in spite of disruptions. More broad definitions of resilience tend to include themes of reducing vulnerability and re-establishing baseline conditions quickly which could apply to the built environment, natural environment, or individuals.

Energy solutions–focused organizations could play a seminal role in disaster recovery—not only to replace critical systems that often have an efficiency component, but also to ensure longevity and resilience of buildings and their occupants. This paper focuses on a specific case study within the context of the State of Vermont and its statewide energy efficiency utility, Efficiency Vermont, in its response to two 100-year floods that occurred within the past 12 years, Tropical Storm Irene and the Great Flood of 2023. During and after both events, Efficiency Vermont found opportunities to support residents and businesses by leveraging its strengths: its existing infrastructure and its partnerships with myriad actors all working toward a collective solution. While Efficiency Vermont is still in the midst of recovery efforts related to the Great Flood of 2023, the organization is already synthesizing lessons learned to inform future disaster responses. Energy efficiency programs' thoughtful implementation of disaster recovery procedures can strengthen community climate resilience in a lasting and holistic way.

The Vermont Context

Background

The Brave Little State or Green Mountain State has a number of characteristics that make it especially susceptible to damaging climatic events, but also equally capable of positive and resilient response.[2] Known for being the second least populous state in the country (Barewicz et al. 2023), Vermont also has a high proportion of older residents, with 21.6% being in the category of persons 65 and older (United States Census Bureau 2023). It has seen modest population growth in the past decade (Vermont Futures Project 2023), with some more recent transplants during the pandemic (Anderson and Wertlieb 2022) and others having moved for safety reasons, especially in the face of the anticipated impacts of climate change (D'Auria 2023). The State of Vermont recognizes a number of populations within its borders that it defines as frontline communities[3], "groups of people who are directly affected by climate change and inequity in society at higher rates than people who have more power in society" (Vermont Agency of Administration 2021).

Vermont's built environment and industry makeup contribute to its vulnerability in the face of climate change, especially given the number of older buildings and industries that rely on

[1] For example, the National Flood Insurance Program, administered by FEMA, indicates that air conditioning, furnaces, refrigerators, cooking stoves, built-in appliances, and water heaters are covered under certain packages. Damage to the building caused by moisture, mildew, or mold and compliance with state and local regulations is not covered. In addition, there is a note that coverage can be limited in a basement (FEMA 2023).

[2] FEMA's National Risk Index defines community resilience as "the ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions." (Community Resilience | National Risk Index (fema.gov). Most Vermont Counties rate as "Very High" or "Relatively High" with regards to Community Resilience, with only one falling into the category of "Relatively Moderate" and one falling into the category of "Relatively Low" (Map | National Risk Index (fema.gov).

[3] Examples include rural communities, those at risk of displacement, senior citizens, non-native residents, low-income residents, people of color, and chronically ill or disabled people, to name a few (Vermont Agency of Administration 2021).

specific climatic conditions. Vermont has roughly 324,200 residential building units, of which about 24% are rentals and 16% are for seasonal or occasional use (Vermont Housing Finance Agency 2022a). About 73% of the housing stock is over 35 years old, and 25.5% of it was built before 1939 (Vermont Housing Finance Agency 2022b). The majority (56%) of households heat their homes with petroleum-based fuels and about 13% primarily use wood for heating (United States Energy Information Administration 2023). Vermont's leading industries are Leisure & Hospitality, Retail Trade, Manufacturing, Health Care and Social Assistance, Education, Professional and Technical Services, and Agriculture (Barewicz et al. 2023).

From a climate perspective, there are observed recurrences of specific types of disasters that lead to opportunity for more intentional planning and action. In the past 24 years, Vermont has had more than one federally declared disaster per year (State of Vermont 2024a), and each county in the state has experienced a flooding event dating back to 1996 (FEMA 2022). Between 2010 and 2019, FEMA designations show that Vermont received $9–30 million on average in assistance support from disaster declarations, the range representing whether or not the inclusion of Tropical Storm Irene factors in (Vermont Climate Council 2021, 28). Climate projections show that Vermont is likely to experience more extreme heat, heavy precipitation, and annual precipitation in the future, which can translate into more significant droughts and flooding events (Vermont Climate Council 2021).

Roughly 10,000 buildings within the state are currently sited in FEMA-designated Special Flood Hazard areas, some directly in high velocity floodways and others that are likely to suffer damage even if not within the higher risk zone (State of Vermont 2024b). In the most recent flooding, there were disproportionate impacts to affordable housing located in areas most susceptible to flooding (Duffort 2023a), and mobile home parks were more likely to be located in flood hazard zones than traditional single-family homes (Baker, Kahl, and Surwilo 2020). Vermont's development patterns have centered around waterways, leaving myriad businesses vulnerable to flooding events (Van Wie 2021). Additionally, agricultural operations, which are often located in low-lying areas, have been severely impacted by recent flooding events.

Emergency Planning

The State of Vermont maintains planning documents specifically related to hazard mitigation and protection of critical infrastructure during emergencies. The State Emergency Management Plan (SEMP), which addresses all potential hazards, is based on FEMA's National Preparedness Goal (Vermont Emergency Management 2019). The SEMP outlines the primary functional responsibilities of specific state agencies and partner organizations that traditionally handle human services in the wake of disasters (Vermont Emergency Management 2019). For example, the SEMP directs the Department of Public Service (PSD) to handle communications and energy, while other agencies and organizations are responsible for long-term recovery and basic human services (Vermont Emergency Management 2019).

Within the realm of energy planning, the PSD also maintains the Vermont Energy Assurance plan, which aims to address all hazards related to power outages (Vermont Public Service Department 2013). The Vermont Hazard Mitigation Plan, prepared by Vermont Emergency Management, names natural hazards most likely to occur in the state, as well as mitigation plans for risk reduction (Vermont Emergency Management 2023). Further, the state aims to develop a Resilience Implementation Strategy as directed by the Governor and State Treasurer, by 2025 (Vermont Agency of Natural Resources 2024).

The Energy and Climate Action Landscape

Within the Executive Branch of Vermont's government, the PSD represents public interests regarding energy, telecommunications, water, and wastewater. The PSD has jurisdiction over "rates, quality of service, and overall management of Vermont's public utilities," which includes efficiency utilities as well as electric and gas utilities (Vermont Department of Public Service 2024). The State of Vermont has 17 electric distribution utilities, one transmission-only company that handles the bulk power system, and one natural gas distribution utility (Vermont Department of Public Service 2013). There are also three Energy Efficiency Utilities (EEUs), which deliver energy efficiency services related to both thermal and electric use to residential and business consumers throughout the state of Vermont. Outside of the City of Burlington and the area served by the natural gas distribution utility, Efficiency Vermont, which is operated by the Vermont-based nonprofit VEIC, functions as the statewide EEU for both thermal and electric efficiency.

As a regulated utility, Efficiency Vermont draws upon an energy efficiency charge for its funding for electric efficiency measures, with its thermal budget coming from participation in regional cap and trade programs as well as from the regional Independent System Operator (Vermont Public Utility Commission 2024). As Vermont does not have a deregulated energy market in the traditional sense, distribution utilities contribute toward state energy goals on the supply side, while EEUs such as Efficiency Vermont contribute on the demand side by providing financial support and other resources for building efficiency measures.[4] Efficiency Vermont, through administration of efficiency programs benefitting both residential and commercial customers, has saved 20.9 million MWhs of electrical energy, has saved 32.2 million MMBtu of thermal energy, and has eliminated 13 million tons of carbon dioxide emissions since its creation in 1999 (Efficiency Vermont 2024). Efficiency Vermont is a significant contributor to statewide energy goals and recognized co-benefits of energy efficiency.

In the past few decades, the State of Vermont has increasingly paid attention to setting goals, requirements, and targets related to energy and climate action, in recognition of the significant impacts that will accompany unmitigated climate change. Early efforts in the first decade of 2000 included goals for the number of buildings weatherized and the types of information that the state would track to monitor progress and impact of energy use reductions (Vermont Department of Public Service 1998) (Vermont Department of Public Service 2011). In the most recent state legislation, the Global Warming Solutions Act (GWSA) of 2020, Vermont set ambitious requirements for greenhouse gas (GHG) emissions reductions (Vermont Climate Council 2021).[5]

The Comprehensive Energy Plan, produced and maintained by the PSD, names pathways, strategies, and recommendations to meet GHG requirements, efficiency targets, and renewable energy goals (Vermont Department of Public Service 2023). The complementary Climate Action Plan names initiatives, programs, and strategies to equitably achieve the GHG reduction requirements as well as climate change mitigation tactics. The Climate Action Plan, through the involvement of its Just Transitions Subcommittee, recognizes the importance of emissions

[4] Efficiency Vermont provides myriad services that fall outside of building efficiency such as streetlighting support, wastewater system support, energy literacy, and energy planning to name a few.

[5] The Global Warming Solutions Act of 2020 mandates that Vermont reduce emissions of GHGs by: 1) 26% reduction from 2005 levels by 2025; 2) 40% reduction from 1990 levels by 2030; and 3) 80% reduction from 1990 levels by 2050.

reduction and mitigation strategies that provide equitable benefits to state residents (Vermont Climate Council 2021). The Climate Action Plan specifies that various state agencies and the Climate Council created by the GWSA must engage continuously with other organizations to achieve the outcomes necessary to meet state requirements. It also highlights the outcomes of the state's Greenhouse Gas Inventory to target the highest sources of emissions (Vermont Climate Council 2021).[6]

The Flooding Events and Efficiency Responses

Tropical Storm Irene

Not since the Great Vermont Flood of 1927 had the State of Vermont seen such widespread economic, social, and ecological devastation as it did during Tropical Storm Irene. On August 27th and 28th, 2011, intense rainfall of up to eight inches fell within a period of 12 hours on oversaturated terrain, eventually making its way into local waterways (Van Wie 2021). Over 50,000 households experienced power outages (Vermont Department of Public Service 2013), hundreds of homes and buildings were washed away, and over 2,000 roads were washed out (Van Wie 2021). Estimates place the total damage at over $730 million (Van Wie 2021), with over 300 businesses reporting impacts (Vermont Department of Public Service 2013). Six people lost their lives as a result of the flooding (Department of Public Service 2013). Part of the cause of the massive losses was longstanding development along floodways and river valleys and expansion of impervious surfaces (Van Wie 2021).

Within days of Tropical Storm Irene, Efficiency Vermont identified key strengths in operations to offer immediate support for impacted residents and businesses, while developing more robust plans for longer-term support. Working closely with the Governor's office and the PSD, Efficiency Vermont distributed information via a press release, website updates, and physical collateral. Over the first weekend after the storm and into the evenings, Efficiency Vermont increased business hours for technical phone consultations. The intent of this communication was to help impacted residents prioritize health and safety and to highlight existing rebates and service delivery channels that customers could use (for example, for appliances such as dehumidifiers). While offers for specific recovery efficiency measures had not yet been extended, there was an indication to impacted residents that they would be forthcoming.

The monetary and technical support package that Efficiency Vermont developed within the weeks after the storm was a product of field experience. In the days immediately following the flooding, Efficiency Vermont deployed technical staff to observe conditions in impacted towns, offering help and addressing gaps that the EEU could fill. In addition, Efficiency Vermont continued connections with state agencies, FEMA, weatherization agencies, the Vermont Fuel Dealers Association, local contractors, and key town coordinators. Since no additional budget was available, Efficiency Vermont layered this support on top of existing technologies it funded. There were some modifications to respond to unique customer needs, especially in the case of service delivery. Table 1 below details the final support package, not inclusive of technical services provided or outreach and engagement strategies.

Table 1: Measures supported by Efficiency Vermont in relation to Tropical Storm Irene

[6] 40% of the state's emissions come from transportation and 34% come from buildings.

Customer type	Technologies and Services	Standards & Eligibility*
Commercial	New Pellet Central Heating System; New Oil Heating System, with or without Hot Water Storage Tank; New Propane Heating System, with or without Hot Water Storage Tank; New Propane Hot Water Heater with Tank or on Demand; Efficient Brushless DC Motor on New Hot Air Furnace; Addition of Cold Start Control to New or Existing System; Addition of Outdoor/Indoor Reset Control; Building Assessments with Air Sealing measures; Appliances (Refrigerator, Washing Machine, Dehumidifier); Custom Commercial Rebates	Standard: Custom for Pellet Systems; AFUE 85% for Oil Heating Systems; AFUE 92% for Propane Systems; CEE Tier II or III; ENERGY STAR® Certified where applicable for appliances Eligibility: Equipment up to 250 mbh, funds to be used on equipment, materials, or work necessary for upgrade or replacement of property damage occurring between August 28 and August 31, 2011. Preparation work expected of removing damaged dry wall or mold in the case of envelope upgrades supported.
Residential	Same offerings as commercial(with the exception of custom rebates) in addition to: Free income-eligible services through Weatherization Assistance Program; Home Assessments with air sealing measures, additional health and safety insulation measure recommendations	Standard: Same standards as commercial; Residential codes where applicable Eligibility: Equipment up to 250 mbh, funds to be used on equipment, materials, or work necessary for upgrade or replacement of property damage occurring between August 28 and August 31, 2011. Preparation work expected of removing damaged dry wall or mold in the case of envelope upgrades supported.

Residential - Mobile and Manufactured Homes	Mobile and manufactured home replacement	Standard: Zero Energy Modular Eligibility: Replacement of destroyed home during the flooding event

Efficiency Vermont evaluated services and financial assistance offered by others and identified available funding sources. To pursue the measures named in Table 1, impacted residents and businesses needed to confirm that they were already working with FEMA for compensation for baseline replacements for building envelope and energy efficiency, and that they intended to supplement that funding to improve beyond the baseline. As indicated in Table 1, Efficiency Vermont partnered with local Weatherization Assistance Program providers, while also offering an analogous service for those who were not income-eligible for these services. Efficiency Vermont primarily drew upon its preexisting funding structure to provide these incentives to its customers, which meant that in some cases it was working with a limited budget and needed to inform customers that the offers were first come, first served.

Not only did Efficiency Vermont encourage specific technologies in the months following the flooding event, but it also made concerted efforts to continue outreach and engagement over many channels to funnel customers to appropriate offers that could benefit them. Efficiency Vermont scheduled free local workshops in flood-impacted communities, which were modeled after its pre-existing Button Up Training Program it ran in partnership with a local Weatherization Assistance Program provider, Capstone Community Action. These workshops covered key topics for property owners to be mindful of when rebuilding after flood damage, concerning health, safety, and efficiency. In addition, Efficiency Vermont staff continued their local presence on the ground in the months after the flooding, answering questions in person in communities as well as setting up informational booths alongside partners.

Overall recovery efforts from Tropical Storm Irene lasted years, including necessary reflections and support for upgrading development patterns and physical infrastructure to avoid impacts of the next great storm. There were many positive outcomes of Efficiency Vermont's efforts post–Tropical Storm Irene. Hundreds of residential customers received direct technical support and field support from Efficiency Vermont staff giving thousands of hours. At least eight community rebuilding workshops led to over 100 home and business flooding assessments and air sealing measures. Over 100 efficient heating and hot water heating systems were installed. In the face of topographic challenges, building back efficiently can only do so much, but there were many positive outcomes of Efficiency Vermont's efforts post-Tropical Storm Irene.

The Great Flood of 2023

Heavy rains and wildfire smoke marked the summer of 2023 even before July 10th and 11th, when the mass flooding event began. Within a 48-hour period, much of the state saw three to nine inches of rainfall, with four to eight inches being commonplace directly over the Green Mountains. Damage from this flooding event was equal to or more significant than what had occurred during Tropical Storm Irene. Effects were once again localized and flash flooding was the result in many cases of oversaturated soil from previous storms (Banacos 2023). Nine counties were declared disaster areas, and many downtowns adjacent to mountainous terrain and riverways were impacted by the flooding (Dockser 2023). At the time this paper was authored, Vermont Emergency Management estimated that at least 4,000 homes and 800 businesses had been impacted, but it is still assessing the total damage (Duffort and Fountain 2023).

Governor Phil Scott declared a state of emergency on July 9, 2023, and key organizations responded swiftly (Banacos 2023). In the aftermath of the storms, agencies made continuing efforts to assess the total impact of the storms and develop a holistic response, with key emergency response personnel stepping in for immediate needs. By July 26, 2023, the PSD Commissioner called upon Vermont's utilities to contribute to the state building back "better and smarter" (Vermont Department of Public Service 2023), encouraging creativity of state and local partnerships to support communities. Working with Vermont's Emergency Board as well as the PSD, Efficiency Vermont made the case for leveraging federal American Rescue Plan Act (ARPA) funding. On July 31, 2023, the state authorized Efficiency Vermont to use this funding, previously appropriated for low-to-moderate income weatherization support, to instead support flood relief for residential properties (Duffort 2023b). Efficiency Vermont also worked collaboratively with the Public Utility Commission to allocate part of its energy efficiency charge funding to support affected businesses (Walke 2024).

While Efficiency Vermont developed programs after the authorization of flood-specific funding, it continued with community and customer support offerings. It promoted its standard customer support line for customers who had general questions about flood recovery, and set up a virtual home assessment service for flood victims in the first few weeks after the flooding. Efficiency Vermont also hosted a residential-focused webinar within a month after the flooding, which presented high-level information on best practices for remediation and equipment replacement. Staff at Efficiency Vermont worked quickly to assess data from the State's general information line, identifying the towns with the most flooding reports and establishing relationship managers for key contacts—resulting in direct outreach to almost 60 communities.

Throughout the month of August 2023, Efficiency Vermont worked with the PSD on rapid development of customer support programs. This included an expedited process to sign necessary agreements and the exploration of relationships with FEMA and other disaster recovery agencies to ensure that program design was not duplicative of other funding sources and that it met customer needs (Walke 2024). Efficiency Vermont paid particular attention to what it could offer adjacent to FEMA support and was mindful of existing long-term contractor shortages that would likely be exacerbated by the flooding. Table 2 below shows the markets supported by the offers, which measures are supported as well as the standards and eligibility; these offerings are for the most part additional to the standard incentives Efficiency Vermont supports (Walke 2024).

Table 2: Programs Efficiency Vermont administered during the Great Flood of 2023, with associated measures and funding sources

Customer type	Technologies and Services	Standards & Eligibility

Residential (Single-Family, Multifamily)	Appliances; Water Heaters (Fossil Fuel, Electric, and Heat Pump); Fossil Fuel-based Boilers and Furnaces; Wood Boilers and Furnaces; Wood/Pellet Stoves; Heat Pumps (Ducted and Ductless); 200 Amp Electrical Panel or Subpanel; Building envelope airsealing and Insulation with Health and Safety Measures; Financing	Standard: ENERGY STAR® Certified where applicable (Appliances, Boilers and Furnaces); Efficiency Vermont Qualified Product Listed for Heat Pumps, Heat Pump Water Heaters, and Wood Stoves; Meet or exceed 85% peak efficiency for Wood Pellet Boilers and Furnaces; Meet or exceed code for air sealing and insulation measures; Eligibility: Flood impacted (within certain date ranges within specific localities for some of the programming); Household income of less than 120% of Area Median Income*; some replacement only; no FEMA duplication**;
Residential Rental Properties	Large Appliances; Small Appliances; Fossil-fuel based boilers and furnaces; Central Pellet Boiler or Furnaces; Wood/Pellet Stoves; Heat Pumps (Ductless and Ducted); Water Heaters (Fossil Fuel, Electric, or Heat Pump); Building envelope airsealing and insulation with Health and Safety Measures	Standard: ENERGY STAR® Certified where applicable (Appliances, Boilers and Furnaces); Efficiency Vermont Qualified Product Listed for Heat Pumps, Heat Pump Water Heaters, and Wood Stoves; Meet or exceed 85% peak efficiency for Wood Pellet Boilers and Furnaces; Meet or exceed code for air sealing and insulation measures; Eligibility: Flood impacted (within certain date ranges within specific localities for some of the programming); Household income of less than 120% of Area Median Income per rent levels*; some replacement only; no FEMA duplication**;

Commercial	Heat Pumps; Heat Pump Water Heaters; Evaporators; Condensing Units; Commercial Kitchen Equipment	Standard: Efficiency Vermont Qualified Product Listed for all technologies; Eligibility: Flood impacted, damage incurred on or after July 7, 2023
Contractors	Trade ally incentives for eligible HVAC equipment installs	Standard: Installed HVAC technology is eligible for customer-facing rebates; Eligibility: Flood impacted customers served

*Some standard incentives are available for households which are not 120% AMI or below, in most cases they are not flood-specific
**For all cases, customers may not duplicate FEMA funding and are required to undergo the FEMA process if applicable.

Residents and businesses could access incentives related to the suite of programs described in Table 2 starting on September 5, 2023. Eligible customers could self-select the technologies for which they were seeking an incentive, with monetary limits per technology and an overall $10,000 limit. Business customers could access incentives of up to $4,000 per technology, with a cap on the number of rebates that they could receive (Efficiency Vermont 2024). Contractor-based incentives focusing on heating, ventilation, and air conditioning equipment were launched later in the fall of 2023 and required contractors to sign specific participation agreements, to encourage them to help customers navigate the application process. All incentives offered followed a downstream model, with reimbursement available either to the customer or the contractor. For residential customers, already-purchased technology could be eligible for rebates within an allowance, given that a number of customers needed to replace essential equipment as quickly as possible (Walke 2024).

In the weeks following the launch of incentive programs, collaboration continued with local partners working on the ground, and some immediate intelligence gathering caused a few changes in service delivery. Efficiency Vermont plugged into an effort led by other EEUs and distribution utilities to coordinate work scopes on behalf of customers, highlighting some of the challenges of a downstream incentive model in the wake of a disaster. This led to Efficiency Vermont's creation, in partnership with a local credit union, of a financing program to front-load incentives for customers who otherwise would not have been able to afford the upfront cost or other financing options for equipment. Responding to repeated reports that some customers were approaching the heating season without reliable means to replace critical heating systems, Efficiency Vermont also worked more directly with contractors. Continued outreach and engagement efforts with myriad state and local actors funneled customers into support programs and considered unique circumstances as they arose. This outreach included maintaining field staff in heavily impacted communities, regularly connecting with other utilities aiding in recovery efforts, hosting additional webinars, and connecting with other local nonprofits delivering assistance on the ground (Walke 2024).

As of early 2024, preliminary results demonstrate a wide reach of programs launched in support of flood-impacted customers. To date, there have been around 2,000 customer-level interactions with a mix of residents and businesses. Web-based resources have seen over 8,000

pageviews from roughly 3,700 users. Over 200 residential-focused applications have been received, with successful rebates delivered to about 150 end-recipients. 65 business applications have been received, with 50 of those applications receiving payment (Walke 2024). There is still a long road to recovery, and many customers who still need to be served. Applying lessons learned from this experience can serve more customers more efficiently in the future.

Lessons Learned

While no two significant climatic events are exactly alike, comparisons between these two events and associated responses can inform future planning. In retrospect, Efficiency Vermont experienced these two events at very different points on its trajectory as an established EEU. Tropical Storm Irene was a first-of-its-kind event in a time with growing support for efficiency solutions—but not an advanced market. By contrast, the Great Flood of 2023 occurred when the organization was more mature and there was a more robust state-level framework in place for support of efficiency and climate mitigation solutions. That said, during Tropical Storm Irene, Efficiency Vermont was in the first year of its three-year EEU planning cycle, whereas for the Great Flood of 2023, it was in the last year of its planning cycle and had moved away from high-volume, low–acquisition cost measures. This meant it had less traditional EEU budget to put toward recovery in 2023; federal resources allowed it to provide more support, but carried more requirements. In 2023, Efficiency Vermont also was continuing to recover from COVID-era supply chain disruptions causing contractor shortages.

Many measures and engagement tactics changed between Tropical Storm Irene and the Great Flood of 2023, reflecting the events, the local need, and the base funding sources. Between the two events, Efficiency Vermont had discontinued support of fossil fuel–fired equipment, but fossil fuel equipment was included in the support package during the Great Flood of 2023, in recognition that doing so would lead to greater customer access and that promoting ENERGY STAR® equipment over baseline might still lead to gains in efficiency. Another notable difference is the inclusion in the Great Flood of 2023 of heat pump technology, including water heaters, ducted, and ductless systems; these have had transformational success in the State of Vermont. The response to the most recent flooding event included panel upgrades, whereas the response to Tropical Storm Irene did not. The new funding source supporting this work maps to an identified strategy for reduction of GHGs per the State's Climate Action Plan (Vermont Climate Council 2021).

While there were some differences in the support offered to households during both events, several strategies were strikingly similar. During both events, Efficiency Vermont promoted means for direct communication between customers and staff, demonstrating its prioritization of customer needs. In engagement and educational efforts, Efficiency Vermont hosted public informational sessions, maintained physical presence in impacted communities to ensure its customers could understand and participate in offers, and offered support for local leaders and on-the-ground organizations. Further, with both events the organization supported and set aside time for staff to volunteer for recovery efforts; for Tropical Storm Irene, there was a specific day of service and in the Great Flood of 2023 staff were connected with individual opportunities to contribute at their discretion. While Efficiency Vermont's engagement tactics have been successful, reflections have indicated that more specific case management services for these kinds of events are needed and perhaps not the exact role an EEU can play (Walke 2024). In both events, Efficiency Vermont provided support for critical heating infrastructure and promoted the use of its EEU-supported technologies to flood victims.

Efficiency Vermont is currently undertaking an "After Action Review" to scrutinize the latest response and the organization's process, with the goal of creating a roadmap for future events. So far, the organization has determined the following key lessons with wide applicability:

- Urgent priorities like an emergency response will stress test an organization's processes and relationships. Understanding this can help prepare for hurdles that arise, as well as identify opportunities for continuous improvement.
- Understanding the role of the organization and how it fits into the greater context of a state/federal response is critical and best considered before, rather than during, an active emergency response.
- The timing of an emergency response is very different from that of typical efficiency program deployment and, in part, requires a different process.
- Working alongside FEMA is sufficiently complex that it may require a specialized skill set and approach.
- Affected residents and businesses need support navigating the application and documentation processes of each agency. Efficiency Vermont's willingness and ability to discuss recovery tasks with flood victims was impactful: Case management should be a key element of future planning.
- Optimizing communication timing and identifying audiences to address during a catastrophe are important tasks that proved different from standard efficiency work.
- Flood programming and the subsequent "After Action Review" process has provided a chance to collect feedback and has helped identify equity-related (procedural, structural, and distributional), cultural, and organizational growth opportunities.

Apart from the "After Action Review," Efficiency Vermont is continuing to work with state-level entities and partners to evaluate overall response tactics and determine changes and planning that might be needed to avoid the most severe outcomes in the future. While emergency and hazard mitigation plans classify responsibilities at the state level, there is more to be said about the role that non-state actors can and do play (Walke 2024).

Conclusion & Implications for Energy Efficiency Programs

Research and demonstrations indicate the value of including energy efficiency, resilience, and renewables in emergency planning (National Renewable Energy Laboratory 2014). The logic seems clear: the benefits of energy resources, which make them supportable by programs regardless of the tie-in with disaster response, could be amplified if installed at the point of rebuilding interventions.

What is often less clear is the path for implementation and program design tactics that could lead to desirable outcomes in the event of disaster. Drawing upon Vermont's experience, efficiency programs across the country could do the following to increase their impact:

1. Identify state-level plans and operating procedures around emergency declarations and expected recurrence of natural disasters, based on historical data or future modeling.
2. Coordinate with actors who have statutorily defined roles and responsibilities to locate potential gaps in emergency responses as they relate to energy solutions. Prepare response plans that map to state-level operating procedures.
3. Complete annual (or more frequent) reviews of pre-prepared response packages based on expected natural disaster types and potential funding sources that can be deployed quickly. Depending on the regulatory structure of the efficiency program, consider including disaster measures within an approved budget to enable quick deployment.

4. Create standard agreement language with partners for specific funding in the event of an emergency.
5. Solicit feedback from a diversity of actors on pre-prepared response packages to ensure that they support equitable access.
6. Create an internal organizational chart and operational continuity plan to identify key roles as natural disaster leads. Doing this in advance minimizes the time spent allocating resources during an emergency.
7. Continue education on the latest federal standards and programs supporting disaster recovery.

Given that certain natural disasters will occur more frequently in the face of the warming climate, we recommend that efficiency programs continue due diligence in these efforts in anticipation of the next event and consider pre-event focused planning. This is in service of both energy resiliency as well as more broad definitions of resiliency as they pertain to climate change. It is important to consider natural disasters as a point of intervention during which inefficient or non-operational equipment can be replaced in addition to creating best practices around how technologies can be installed which are more resilient. This may include strategies to include technologies such as batteries which can increase access to energy more consistently through outages, or may involve jurisdictional enforcement of the installation of critical equipment above flood levels, as was seen in some Vermont localities (Lindner 2023). Having emergency and hazard mitigation plans include proactive strategies for consistent transitions ahead of and in service to the next disaster may mitigate the degree of urgency which arises during the natural disaster itself.

A key challenge in delivering programming during natural disasters that do not have neat recurrence intervals is that staff turnover can lead to lack of continuity in best practices. It is important for efficiency programs to stay engaged in this space, maintaining key documents and processes to protect and advance shared knowledge. Regardless of natural disasters, decades of evidence demonstrate the value of energy efficiency, renewable energy, and resilience measures. Pairing energy efficiency measures with disaster recovery within localities across the United States and beyond could prove to be an important point of intervention for end-use customers to ensure that the replaced or added equipment provides increased benefit for its lifetime. To support long-term community resilience, efficiency programs can and should play a more active role within emergency response paradigms.

References

Anderson, K., Wertlieb, M. 2022. “Long known for its dwindling population, Vermont sees a recent uptick in new residents.” www.vermontpublic.org/local-news/2022-08-24/long-known-for-its-dwindling-population-vermont-sees-a-recent-uptick-in-new-residents.

Bacanos, P. 2023. “The Great Vermont Flood of 10-11 July 2023: Preliminary Meteorological Summary.” www.weather.gov/btv/The-Great-Vermont-Flood-of-10-11-July-2023-Preliminary-Meteorological-Summary.

Baker, D., Kahl, K., Surwilo, J. 2020. “Vermont Mobile Home Park Research: Approaches to Mobile Home Destruction.” dec.vermont.gov/sites/dec/files/wmp/SolidWaste/Documents/Approaches-to-Mobile-Home-Deconstruction.pdf.

Barewicz, M., DeGeus, F., Kidder, B., Stapleton, K., Willey, R. 2023. *Economic & Demographic Profile Series: Vermont 2023*. www.labor.state.vt.us/profile2023.pdf

D'Auria, P. 2023. "Vermont was seen as a climate haven. This summer has complicated that image." vtdigger.org/2023/07/24/vermont-was-seen-as-a-climate-haven-this-summer-has-complicated-that-image/.

Dockser, C. 2023. "Who's getting money from FEMA in Vermont? What the data shows so far." www.vermontpublic.org/local-news/2023-08-21/vermont-fema-flood-disaster-money-aid-data-map-housing-other-needs.

Duffort, L. 2023a. "The flood waters disproportionately hit Vermont's affordable housing stock – at the worst time." vtdigger.org/2023/07/31/the-flood-waters-disproportionately-hit-vermonts-affordable-housing-stock-at-the-worst-time/.

Duffort, L. 2023b. "Efficiency Vermont to provide grants to renters and homeowners impacted by flooding." vtdigger.org/2023/07/31/efficiency-vermont-to-provide-grants-to-renters-and-homeowners-impacted-by-flooding/.

Duffort, L., Fountain, K. 2023. "Preliminary tally indicates Vermont floods damaged more than 4,000 homes and 800 businesses." https://vtdigger.org/2023/07/26/preliminary-tally-indicates-vermont-floods-damaged-more-than-4000-homes-and-800-businesses/.

Efficiency Vermont. 2021. "20-Year Impact Report." https://www.efficiencyvermont.com/20-year-impact-report#ir-year-2020.

Efficiency Vermont. 2024. "Flood Recovery Rebates for Homeowners and Renters." https://www.efficiencyvermont.com/floodRebate.

FEMA. 2019. "Help After a Disaster: FEMA Individual Assistance Can Help You Recover." www.fema.gov/sites/default/files/2020-08/fema_help-after-disaster_english_trifold.pdf

FEMA. 2021. "History of FEMA." www.fema.gov/about/history.

FEMA. 2022. "Historical Flood Risk and Costs: Vermont." www.fema.gov/data-visualization/historical-flood-risk-and-costs.

FEMA. 2023. "National Flood Insurance Program: Summary of Coverage." agents.floodsmart.gov/sites/default/files/fema_nfip-summary-coverage-brochure-12-2023.pdf.

FEMA. 2024a. "Hazard Mitigation Plan Status." www.fema.gov/emergency-managers/risk-management/hazard-mitigation-planning/status.

FEMA. 2024b. "Biden-Harris Administration Announces New Actions to Help Communities Reduce Greenhouse Gas Emissions, Build Back Stronger, Cleaner, and More Resilient Post-Disaster." https://www.fema.gov/press-release/20240130/biden-harris-administration-announces-new-actions-help-communities-reduce.

Lee, K. 2018. “Integrating Efficiency in Disaster Recovery.” www.seealliance.org/wp-content/uploads/Resilience_EL-Edits-1.6.20.pdf

Lindner, W. 2023. “Post-flood, a migration of cellar equipment begins.” https://vtdigger.org/2023/11/07/post-flood-a-migration-of-cellar-equipment-begins/

National Renewable Energy Laboratory. 2014. “Becoming Resilient: Disaster Planning and Recovery.” https://www.nrel.gov/docs/fy14osti/61997.pdf

State of Vermont. 2024a. “Rising Danger: The Cost of Flooding.” floodready.vermont.gov/flood_costs.

State of Vermont. 2024b. “Adapt Buildings and Critical Infrastructure.” floodready.vermont.gov/improve_infrastructure.

United States Census. 2023. “QuickFacts: Vermont.” www.census.gov/quickfacts/fact/table/VT/PST04522.

United States Department of Housing and Urban Development. 2023. “HUD Disaster Resources.” www.hud.gov/disaster_resources.

United States Energy Information Administration. 2023. “Vermont: State Profile and Energy Estimates.” www.eia.gov/state/analysis.php?sid=VT

United States Government Accountability Office. 2022. “Disaster Recovery: Actions Needed to Improve the Federal Approach.” www.gao.gov/products/gao-23-104956#:~:text=The%20federal%20government%20has%20provided,to%20turn%20to%20for%20help.

Van Wie, D. 2021. “The Power of Water: Ten Years After Tropical Storm Irene.” www.clf.org/blog/feature/tropical-storm-irene-the-power-of-water/.

Vermont Agency of Administration. 2021. “Established Examples of Frontline Communities.” aoa.vermont.gov/sites/aoa/files/Boards/VCC/Frontline%20%20Impacted%20Communities%205.4.21.pdf.

Vermont Agency of Natural Resources. 2024. “Resilience Implementation Strategy.” climatechange.vermont.gov/resilience.

Vermont Climate Council. 2021. “Initial Vermont Climate Action Plan.” https://outside.vermont.gov/agency/anr/climatecouncil/Shared%20Documents/Initial%20Climate%20Action%20Plan%20-%20Final%20-%2012-1-21.pdf

Vermont Emergency Management. 2019. “State Emergency Management Plan.” vem.vermont.gov/plans/state.

Vermont Emergency Management. 2023. “2023 Vermont State Hazard Mitigation Plan.” https://vem.vermont.gov/sites/demhs/files/documents/2023%20SHMP_Adopted%20Draft%20Jan2024.pdf

Vermont Futures Project. 2023. “Vermont Demographics.” vtfuturesproject.org/vermont-demographics/

Vermont Housing Finance Agency. 2022a. “Estimated housing units by housing type.” www.housingdata.org/profile/housing-stock/housing-units

Vermont Housing Finance Agency. 2022b. “Year Structure Built.” www.housingdata.org/profile/housing-needs/year-structure-built

Vermont Department of Public Service. 1998. “Fueling Vermont’s Future: Comprehensive Energy Plan and Greenhouse Gas Action Plan.” https://publicservice.vermont.gov/sites/dps/files/documents/Pubs_Plans_Reports/State_Plans/Comp_Energy_Plan/1998/CEP%201998%20overview.pdf

Vermont Department of Public Service. 2011. “Comprehensive Energy Plan: Facts, Analysis, and Recommendations Volume 2.” https://publicservice.vermont.gov/sites/dps/files/documents/Pubs_Plans_Reports/State_Plans/Comp_Energy_Plan/2011/2011%20CEP_Volume%202%5B1%5D.pdf

Vermont Department of Public Service. 2013. “State of Vermont: Energy Assurance Plan.” https://publicservice.vermont.gov/sites/dps/files/documents/VT%20Energy%20Assurance%20Plan%20August%202013.pdf.

Vermont Department of Public Service. 2023. “PSD Commissioner Tierney’s Call to Action to Vermont Utilities.” https://publicservice.vermont.gov/announcements/psd-commissioner-tierneys-call-action-vermont-utilities

Vermont Department of Public Service. 2024. “About Us.” https://publicservice.vermont.gov/about-us.

Vermont Public Utility Commission. 2024. “EEU Budgets, Performance Goals, and Annual Plans. https://puc.vermont.gov/energy-efficiency-utility-program/eeu-budgets-performance-goals-and-annual-plans.

Water Science School (WSS), U.S. Geological Survey. 2018. “The 100-Year Flood.” https://www.usgs.gov/special-topics/water-science-school/science/100-year-flood.

Walke, P. 2024. “Efficiency Vermont Flood Recovery: Testimony to Senate Government Operations.” PowerPoint presentation. https://legislature.vermont.gov/Documents/2024/WorkGroups/Senate%20Government%20Operations/Bills/S.310/Witness%20Documents/W~Peter%20Walke~Efficiency%20Vermont%20Flood%20Recovery%20Slides~2-1-2024.pdf