Energy Resilience: Estimating Loss Economics

Efficiency Vermont R&D Project: Resilience

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Contents

List of Tables

List of Figures

Executive Summary

Energy resilience investment decisions balance risk mitigation and economic viability, but there are few benchmarks to measure the two. Energy resilience planning requires accurate valuation of potential losses to guide investments in protective measures, many of which use energy themselves, and mitigate risks. Optimal investment balances the potential cost of losses with the cost of installing and operating systems that prevent the losses. Current literature highlights a gap in site-specific data: while federal and insurance sources provide aggregated disaster costs, they lack granularity for individual properties and equipment. Existing tools such as IEEE's Goldbook and NREL's Damage Function Calculator offer estimates but require user-supplied data, limiting their practical application. Vermont's 2023–2024 flood events provided a unique opportunity to address this gap through detailed data collection across municipal, commercial, and residential sectors.

Study Findings:
Analysis of interviews, surveys, and rebate records revealed consistent patterns of losses and costs across sectors that allowed categorization into **tangible** (e.g., building systems, appliances, structural components) and **intangible** (e.g., income, labor diversion, personal time) groups. Municipalities incurred costs in three stages—active event, immediate aftermath, and long-term recovery—while commercial losses clustered around **infrastructure** and **business operations**. Residential respondents reported both building structure and personal belonging losses, with heating systems and major appliances representing the highest repair and replacement costs. Post-disaster price inflation and contractor shortages amplified recovery expenses.

Key Insights:

- Loss Typologies: Five tangible and three intangible categories provide a framework for planners to anticipate economic impacts and integrate them into resilience strategies.
- Cost Benchmarks: Heating systems were the most expensive to replace followed by structural repairs and appliances.
- Labor Costs: Often overlooked, diverted labor imposes hidden economic burdens; formulas for estimating these costs are included in the report.
- Community Dynamics: Volunteer support accelerated recovery, but reliance on unpaid labor introduces uncertainty; planners should assume conservative scenarios requiring full-service provision.
- Policy Gaps: FEMA buyouts were insufficient and slow, underscoring the need for proactive resilience investments and short-term housing strategies.

Implications for Energy Resilience Planning:
The typology framework and cost benchmarks developed in this study enable planners to

quantify potential losses, improve cost-benefit analyses, and prioritize investments. While the data reflects one disaster type in one region, it establishes a foundation for broader application and highlights the need for additional datasets to capture diverse hazards and geographies.

Introduction

A lack of site-specific data to identify potential disaster losses and recovery costs limits energy resilience planning cost benefit analyses steps comparing solution investments. To assess the value of energy resilience investments, stakeholders must understand the potential costs of inaction, especially for critical equipment failures. While general regional disaster cost data exists, it does not reflect item-level losses or offer benchmarks for decision-making. The data gap forces energy resilience planners to make assumptions about potential losses and the associated repair or replacement costs with no benchmark to verify accuracy. Without benchmarks to estimate costs, stakeholders cannot confidently make investment decisions. Vermont's 2023 and 2024 flood events are a valuable data source for understanding disaster losses and recovery costs and provide valuable insights into the financial effort to recover.

Literature Review

Site-specific loss data and repair and replacement costs are limited. Federal agencies report aggregate statistics, but not site-level losses. Until recently, the National Oceanic and Atmospheric Administration (NOAA)'s National Centers for Environmental Information tracked billion-dollar disasters; Vermont experienced 19 such events between 1980 and 2024. While useful for policy and planning, aggregated data lacks precision for site-level risk and cost assessment. The insurance industry similarly tracks event impacts for policy risk planning but lacks site-level granularity. A Ceres report emphasized resilience as critical to insurance affordability and availability. The National Association of Insurance Commissioners (NAIC), supported by industry expert interviews, noted energy resilience can reduce loss risk and premiums, but outcomes vary. Insurers identified correlation between credit scores and proactive loss prevention, suggesting proactive planners are more likely to reduce risk. Post-disaster material and contractor cost spikes —sometimes 20% or more—further complicate insurers' forecasts. The contractor cost spikes result from service demand, supply constraints, and site accessibility.

Following the 2023 and 2024 floods, Vermont initiated the Resilience Implementation Strategy to support Vermont's capacity to "anticipate, respond, adapt, and thrive in the face of current and future conditions and disasters". One component, "Infrastructure Design and Reinforcement," focuses on energy delivery and infrastructure adaptation. Efficiency Vermont's 2024 Energy Resilience Planning Framework supports another component of the state's strategy, "Economic and Environmental Sustainability," which equips businesses to mitigate future disaster impacts and accelerate recovery. State agencies and nonprofits now offer support and training for risk identification and mitigation planning. The Office of Disaster Recovery provided post-flood assistance finding that many small and medium businesses lacked financial or labor resources to recover without support. Vermont Businesses for Social Responsibility (VBSR) helps small businesses identify their resilience needs and create an action plan through the Climate Ready Vermont program.

Several publicly available tools guide disaster impact estimations. The Institute of Electrical and Electronics Engineers (IEEE)'s Goldbook (P493, *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems*) provides outage and cost estimates by building type. While a revision is in progress, the latest version of the Goldbook is from 2007, making it a reference rather than a precise estimator. First Street's tool uses proprietary data from Arup to estimate address-level, weather-related costs, but requires a subscription. The 9th National Risk Assessment: The Insurance Issue outlines Arup's datapoints. The National Renewable Energy Laboratory (NREL)'s Customer Damage Function Calculator (CDF) estimates item-specific damage costs but requires user-supplied replacement costs, which may not be available. The Interruption Cost Estimate (ICE) Calculator estimates outage costs for utilities but lacks specificity for individual homes or businesses.

Methods

This study conducted a site-specific loss assessment and cost valuation from the 2023 and 2024 flood events. Data collection included interviews with municipalities, businesses, and contractors, an online survey of homeowners and renters, informal discussions at Vermont events, and Efficiency Vermont flood rebate records. Rebate submissions required invoices, which provided data on repair and replacement costs, though they did not distinguish between the two. Where available, installation and ancillary costs were included. While methods exist to quantify the value of life, protecting life is a prerequisite for energy resilience, therefore placing a value on it is inappropriate for energy resilience planning. Vermont businesses, homeowners, and renters were asked about their loss and recovery experiences, with discussions targeting regions where businesses received the highest combined flood-related rebates (Table 1). The online survey included all residential respondents who had accessed flood-related rebates.

Town	Incentive
Montpelier	$199,388
Barre	$42,075
Ludlow	$39,389
Springfield	$32,000
Johnson	$27,309

Table 1 - Towns' total flood-related commercial rebates

Results

This study cataloged site-specific losses and their associated repair and replacement costs.

- Losses: Items at risk of damage or destruction.
- Costs: Expenses for repair or replacement, the item value if irreplaceable, or willingness-to-pay to protect it. Some items may lack market value but hold emotional significance, which influences investment decisions.

Losses

Respondent-reported physical losses informed the development of a structured risk-mapping framework. This structure integrates into the energy resilience planning process to aid the loss-identification process.

Residential and commercial data analysis categorized losses as tangible or intangible, each further divided into five typologies (Table 2).

Typology	Definition	Examples
Property Features	Property features peripheral to the main structure with or without energy-using systems	Driveway Storage shed
Building Shell	Materials comprising the building structure	Foundation Sheetrock Flooring
Building Systems	Equipment permanently installed in a structure or on the property to serve building environmental requirements	Boiler/furnace Septic system Solar panels
Equipment and Appliances	Items that can be disconnected and moved	Refrigerator Vehicles Mobile devices
Other Goods and Materials	Items that do not use energy and are stored in or around a building	Books Vital records Medicines

Table 2 - Tangible loss categories

Intangible losses impose financial costs or result in economic loss. For example, independent contractors reported income losses when flood water washed away sheds housing the tools and materials needed for their work. Intangible losses were categorized into three typologies (Table 3), all related to lost or diverted labor and productivity.

Typology	Definition	Examples
Income	Wages or profits expected but not realized after an adverse event	Unpaid time off from a job Job loss Sales that cannot complete
Labor	Salary amount for staff labor diverted from job duties to event response	Staff conducting cleanup work Staff repairing or resetting equipment
Personal time	Individual’s time diverted to recovery efforts from daily life activities	Accessing support resources Filing insurance claims Mental health care

Table 3 – Intangible Loss Sources

Costs

Disaster response and recovery costs fell into two categories: community level or individual level. Individual costs were further divided into commercial or residential, based on the primary use of each space. All residents bear community-level expenses through taxes or reduced services. Costs reflect the expense to restore normal function or the willingness-to-pay to protect assets.

Community Costs

State and local governments incurred costs across three stages (Figure 1): responding to the active event, community support in the immediate aftermath, and facilitating long term recovery. Municipalities also faced challenges from impacts to their own buildings, which are categorized under Commercial Costs.

Figure 1 – Municipal Cost Incurrence Stages

Municipal interviews revealed that expenditure types shifted as the flood event ended and recovery began (Figure 3). Large costs included $40,000 to repair a generator supporting emergency services and over $100,000 in capital expenditures to dry and preserve historical records from flooded basements. Many towns did not have estimates for the cost of providing resources such as dumpsters, trash service, and cleanup equipment like vacuum trucks for basement water removal.

Staff labor shifted from primary job functions to response tasks, including clearing basements ahead of flooding, assessing facility damage, and physical cleanup. Emergency responders increased staffing, incurring additional wage and overtime costs, while routine duties were deferred, resulting in additional labor later. Municipalities incurred additional labor

Municipal Long Term Income Loss

On February 7, 2024, Governor Phil Scott signed Act 82 authorizing municipalities to apply for state education tax reimbursement for flood-impacted properties between July 1 and October 15, 2023. Municipalities must abate the property taxes before April 15, 2024 to qualify. Table 6 detail tax abatement costs. At least 16 towns lost over $455,000 in tax revenue due to the flooding. The State reimbursed these funds, but some towns will see a permanent tax base loss if properties are not repaired and reoccupied. Given dataset limitations, municipal tax losses are likely greater.

and material expenses in the immediate aftermath to repair roads, bridges, and culverts. Municipal utilities such as water and wastewater treatment incurred labor and material expenses to protect the sites during the flood and ensure safe operation after. See the Commercial Costs for labor cost estimation.

Long term, municipalities faced reduced tax revenue due to tax abatements for damaged properties and tax base loss for properties not repaired. Town representatives went beyond their usual responsibilities to help residents access resources and navigate regulatory requirements for rebuilding, which represents additional labor costs.

Commercial Costs

Commercial respondents reported losses in all five tangible loss typologies (Table 2) and most intangible losses in the labor typology (Table 3). Some businesses reported income typology losses, while others saw net gains—primarily those providing essential goods and services, and those receiving community support.

Commercial interviews revealed costs (Table 7) fell into two areas: infrastructure and business operations (Figure 2), which varied by business or organization type. Losses aligned with the

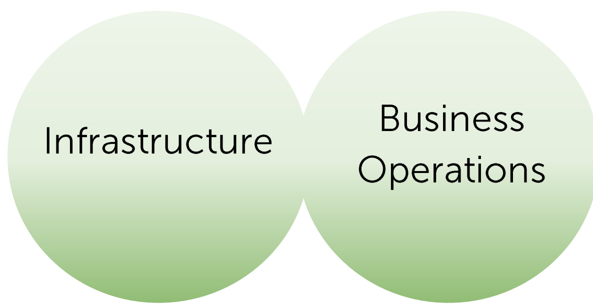

Figure 2 - Commercial cost impact areas

active event, immediate aftermath, and long-term recovery stages identified in the municipal data (Figure 1), though not all businesses incurred costs at every stage. In the active event stage, costs were primarily labor-related: moving products and equipment out of the flood zone or shoring up a building. Immediate aftermath expenses varied from minor driveway repair or appliance replacements to substantial building structure repair. Businesses leasing space frequently reported sharing infrastructure recovery responsibility with the landlord. See Table 8 for reported losses in each category.

The rebate dataset for commercial properties included 30 unique pieces of equipment. The highest reported costs were for repairing or replacing walk-in refrigeration equipment. Condensing units or evaporators averaged $36,000, followed by an average of $34,000 to replace a furnace. (See Figure 4 for all commercial equipment and cost averages.) Businesses accessed 19 flood-related rebates for heat pumps, more than any other equipment, followed by boilers and commercial kitchen equipment (Table 4).

Item	Count
Boiler, oil	4
Boiler, propane	5
Convection Oven	4
Heat pump, residential	19
Pump, Circulator	5
Refrigeration, Condensing Unit	3
Refrigeration, Evaporator	3
Refrigerator, Reach in	3

Table 4 - Largest number of commercial flood-related rebates

Interview respondents reported a wide range of costs, from $400 culvert repairs to $100,000 in inventory losses. Long-term costs exceeded $2 million, including lost rental income, major building and campus repairs, and shifts in business investment strategy such as pivoting to a more conservative growth plan or personnel reduction. Some business closures had cascading community impacts, such as a food desert created by a grocery store's permanent closure, and damage at a hardware store forcing residents to travel farther for supplies. Many businesses reported two to four feet of basement flooding, which caused significant damage to submerged heating systems and stored items.

Most businesses could not report labor costs from flood response and recovery because they did not consider labor a flood-imposed cost and did not track it. Hourly and salaried staff were paid normal wages, with few businesses imposing overtime to prevent employee burnout. Flood-related tasks diverted staff from normal operations, so labor did not generate economic benefit.

To estimate these costs, multiply each hour of staff work for the event recovery by a rate equal to the individual's hourly labor costs (including fringe benefits) and compensated time off (Equation 1). For salaried staff, their annual compensation is prorated based on expected work hours (Equation 2). Total labor losses are determined using Equation 3.

$$L = W \ x \ h$$

L = individual hourly employee's total labor cost
W = wage inclusive of fringe benefits and compensated time off
h = hours spent on recovery efforts

Equation 1 - Hourly employee's total labor cost due to disruptive event

$$S = (Y \div H) \times h$$

S = individual salaried employee's total labor cost
Y = yearly salary inclusive of fringe benefits and compensated time off
H = hours expected to work annually
h = hours spend on recovery efforts

Equation 2 - Salaried employee's total labor cost due to disruptive event

$$C = \Sigma L + \Sigma S$$

C = total labor losses
L = individual hourly employee's total labor cost
S = individual salaried employee's total labor cost

Equation 3 - Total losses due to staff labor diverted to recovery tasks

Residential Costs

Residential respondents reported losses within all five tangible typologies (Table 2) and three intangible typologies (Table 3). Compared to municipal or commercial respondents, they were more likely to report sentimental losses, such as books, vital records, and gardens or landscaping, and less likely to repair or replace them.

The rebate dataset showed residential customers spent the most on heating systems. An outlier in heating system conversions, with expenses significantly higher than other heating system types, made air to water heat pumps and their thermal distribution the costliest. Interviews revealed some distribution systems sustained damage and required repair even if the heat source remained unchanged. Heat pumps averaged $14,000, boilers averaged $12,500, and furnaces averaged $8,500. Domestic hot water heaters and appliances were a substantial share of remaining equipment, with water heaters averaging $8,500 and appliances ranging from $250 to $4,000. Heat pumps received the most rebates at 136 followed by refrigerators at 67 (Table 5). Actual losses extended beyond rebated items. Online surveys reported 68 sources of damage or loss, many of which were never repaired or replaced (Figure 6). Building systems such as space heating, water heating, and large appliances were more likely to be repaired or replaced than personal belongings such as books, media, personal documents, and clothing (Table 10).

Item	Count
Air Purifier, Residential	21
Boiler, oil	21
Boiler, propane	59
Dehumidifier, residential	60
Dryer, residential	50
Furnace, propane	30
Heat pump, residential	136
Refrigerator, Residential	67
Washer, residential	51
Water heater, electric	66
Water Heater, Heat Pump	33

Table 5 - Largest number of flood-related residential rebates

Interview respondents reported a range of losses including $5,000 for cleanup and restoration services, $200 for localized mold mitigation and up to $15,000 for full-service mold remediation, $12,000 to demolish a garage to comply with insurance requirements, and $7,000 to replace a tool collection. One respondent spent $320 for a professional to snake a camera through the basement drainage pipes to look for debris blockage. Washed out driveways were a frequent expense that could reach $15,000. Residents were sometimes innovative with items they had on hand: One respondent spent $45 for two horse blankets which were cut in thirds and laid across a gravel driveway ahead of the event in staggered rows, creating a barrier to slow water flow and limit damage.

Interviews with municipalities and community nonprofits revealed extensive costs for severely damaged homes. Physically lifting and relocating a house out of a floodplain was estimated at $250,000, raising it on the existing foundation could cost $60,000 to build helical piles plus $150,000 to raise the structure and install it on the piles. Mold remediation averaged $15,000. Severely damaged homes often required full hydronic distribution or electrical wiring replacement, reaching $20,000.

Residential interviews revealed long-term and permanent housing loss due to bulk water infiltration, sewer backup, or structural damage. Immediate housing needs required financial resources for temporary housing. Some stayed with family or friends locally or outside the region, but jobs, children's school schedules, or family availability sometimes forced households to find rental housing while repairing or rebuilding. For some families, concurrently paying a mortgage and rental expense could be catastrophic. Missed mortgage payments had consequences beyond credit scores, including disqualification from certain support programs. Some respondents found it easier to walk away from their property than to take on a recovery effort.

Discussion

The loss typology structure in Table 2 and Table 3 emerged from the data collected from municipal, commercial, and residential sectors, resulting in a structured method to assess potential economic losses and support Steps 3 and 4 of Efficiency Vermont's Energy Resilience Planning Framework. Data from all three sectors aligned with these typologies, demonstrating their cross-sector applicability. Commercial data was uniquely clustered around two key areas: infrastructure and business operations (Figure 2), revealing two loss pathways commercial planners should evaluate during their planning processes. Infrastructure losses were primarily tangible, involving non-inventory physical assets, while operational losses were both tangible and intangible, such as diverted personnel labor, lost sales, and physical devices like credit card payment systems.

Municipal and commercial data diverged sufficiently to warrant analyzing the sectors separately. While building and facility losses applied to both sectors, municipalities' unique responsibility to residents introduced additional loss and cost concerns. A distinct set of disaster stages emerged for municipalities (Figure 1) indicating municipal energy resilience planning should consider defined stages. Some municipal expenses appeared in multiple disaster stages with differing magnitude and scope, so they may be considered multiple times in the energy resilience planning process. For example, fire trucks were used during both the active event and immediate aftermath, while town trucks supported cleanup and long-term infrastructure repair.

Municipal and commercial respondents struggled to identify labor typology losses and costs, often viewing flood-response tasks as normal duties. Labor expenses remained unchanged from normal operations but diverted staff labor delayed business operations and impacted organizational financial viability. Normal business labor must still be performed in the future, adding to future labor expenses. Personal time typology is uncommon in municipal and commercial sectors, as work is not typically personal. Residential personal time losses appeared in the personal time typology but similarly respondents did not view them as meaningful losses. Residential losses in the labor typology were rare, occurring when a residence employed domestic assistance such as a housekeeper or a nanny. The labor loss calculations in Equation 1-3 account for how respondents incurred labor expenses associated with the flooding events. These calculations help planners assess how an event could impact their labor typology.

Volunteer and community support were key to helping commercial and residential respondents resume normal operations. Volunteer teams were available in the immediate aftermath and for up to two weeks, making them highly accessible resources. Businesses credited organized volunteer efforts and intentional community patronage as the primary factor in recovery. Residential respondents relied on neighbors for sharing tools and skills to repair each other's properties. In contrast, paid services, such as clean up and restoration providers and skilled trades, were the primary constraint on recovery time. They were slower to access due to providers' schedules and funding access delays, though they were required for full recovery

FEMA Buyouts

Respondents reported challenging FEMA buyout processes, with payments a fraction of expectation. One mobile homeowner received just $10,000, while others reported receiving less than $100,000: frequently insufficient to cover mortgage balances. Buyouts could take up to two years, requiring families to maintain mortgage payments while also covering alternative housing. FEMA does not release buyout statistics, so in 2019 NPR submitted a Freedom of Information Act request to access it and released it on their website. Although the dataset covers 1989–2019 and excludes recent flood events, it offers insight into FEMA's payout history. Of the 173 Vermont buyouts, nine from years 2022 and 2007 ranged between $27,200 and $166,437 (Table 9), while the average home price in Vermont in 2007 was $197,000. The timeline for buyouts caused additional hardship for some residents in Johnson, Vermont. Residents reported hurdles accessing FEMA support that left them without safe housing or the financial supported they needed. A homeowner who could afford to cover alternative housing costs and the mortgage on the destroyed property were rendered ineligible for assistance when the mortgage payments fell behind. Some also reported inaccessible requirements including requests for documents which had been destroyed in the floods.

because their skillsets were typically unavailable among volunteers. Volunteer labor is hard to quantify because costs may be indirect or absorbed by others, such as a volunteer absent from a job or municipalities offering town facilities to stage volunteers, which incurs facility costs but benefits residents. Planners should consider whether they can reasonably expect volunteer labor, and plan conservatively for scenarios requiring full-service provision without it. Some businesses provided essential supplies and services while managing their own flood impacts, blurring the divide between municipal and commercial resilience. Interviews noted increased demand for cleaning supplies, dehumidifiers, and quick-prep food. When businesses were heavily damaged, residents had to travel farther for goods and services, introducing barriers for those with limited ability to travel. Wholesale suppliers faced delivery challenges due to road inaccessibility or their own damages, leading to faster food spoilage or supply bottlenecks. Businesses expressed pride and a sense of responsibility in supporting their communities, but since community resilience is a municipal government duty, coordinated energy resilience planning is crucial to ensure businesses providing critical services are supported and accessible.

Residential respondents reported losses in all tangible typologies. Unlike businesses that could suspend operations, residents faced difficult choices if their homes became uninhabitable, and low-income households were impacted more heavily. When homes were not occupiable, respondents focused on building structure and system repair over belongings, with limited budgets requiring tough decisions. Insurance and support programs helped cover recovery costs, but payments were not immediate, and they did not cover all expenses, highlighting the need for short-to medium-term housing plans in residential resilience strategies. Some took an opportunity to upgrade or change building systems, such as heat pumps in lieu of fossil fuel.

The data produced a benchmark for costs to repair or replace many building systems and equipment. Many respondents reported higher-than-average costs, and insurance experts similarly indicated that costs go up in the aftermath of a disaster, so typical market prices are not a good measure for the cost to recover from a disaster. The data presented in the appendices constitutes a benchmark for estimating costs, but it represents one disaster type in one state, so to be broadly useful it will require additional data points for event types and loss types. Inflation and local economies will also impact the costs. Planners should account for inflationary pressures, product and contractor availability, and existing partners when determining economic metrics, the amount they consider a catastrophic loss, and how much to invest in energy resilience.

Conclusion

Integrating these loss and cost structures into the Efficiency Vermont Energy Resilience Planning Framework offers a detailed structure to accurately and optimally identify planning variables and guide decision making and support well-founded conclusions. Ongoing additions of newly available data in these datasets will help the Energy Resilience Support Program maintain a more robust and comprehensive dataset. Future work should evaluate resilience measures that will support low-income customers through simultaneous resilience support and energy bill reductions.

Appendix A – Municipal Data

Row Labels	Homestead Abatement Reimbursement	Non-homestead Abatement Reimbursement	Interest Reimbursement	2023 Count	2024 Count	Total Abatements
Barre City	$15,123.26	$29,359.71	$0.00	39		39
Berlin	$10,168.27	$5,416.14	$0.00	29		29
Cavendish	$601.51	$8,946.86		3		3
Hardwick	$1,353.56	$6,167.50	$0.00	5		5
Jamaica	$2,388.85	$0.00	$0.00	1		1
Johnson	$2,949.71	$15,301.01	$0.00	10		10
Londonderry	$3,765.77	$15,328.73	$0.00	12		12
Ludlow	$9,910.02	$56,344.49	$88,849.00	44	1	45
Middlesex	$1,900.60	$0.00		2		2
Montpelier	$11,158.77	$197,063.01	$0.00	27		27
Morristown	$2,595.36	$0.00	$0.00	1		1
Ripton	$1,932.45	$0.00	$0.00	1		1
Waterbury	$3,768.52	$13,788.44	$0.00	7	2	9
Weston	$4,140.12	$8,201.52	$0.00	3	2	5
Wolcott	$1,399.21	$1,636.08	$0.00	3		3
Woodbury	$1,613.52	$1,602.68	$0.00	2		2
Total	**$74,769.50**	**$359,156.17**	**$88,849.00**	**189**	**5**	**194**

Table 6 – Education tax reimbursement from the state to municipalities for abated taxes due to flood damage in 2023

Active Event

- Mobilizing and staging response assets
- Staffing essential functions
- Emergency Operations Activation
- Municipal utility preparation
- Public shelter standup

Immediate Aftermath

- Municipal-owned rental property recovery
- Backup generator repair
- Rental space for temporary office relocation
- Building structure cleanup, recovery, and repairs
- Vital record and document recovery
- Municipal utility recovery
- Municipal-owned equipment repair
- Critical infrastructure repair
- Staff labor diversion to recovery

Long Term Recovery

- Municipal budget diverted to repair and recovery
- Public works projects to mitigate future damage
- Community outreach and education
- Loss of businesses providing essential products and services

Figure 3 - Expenses municipalities incurred in the 3 event stages

Appendix B – Commercial Data

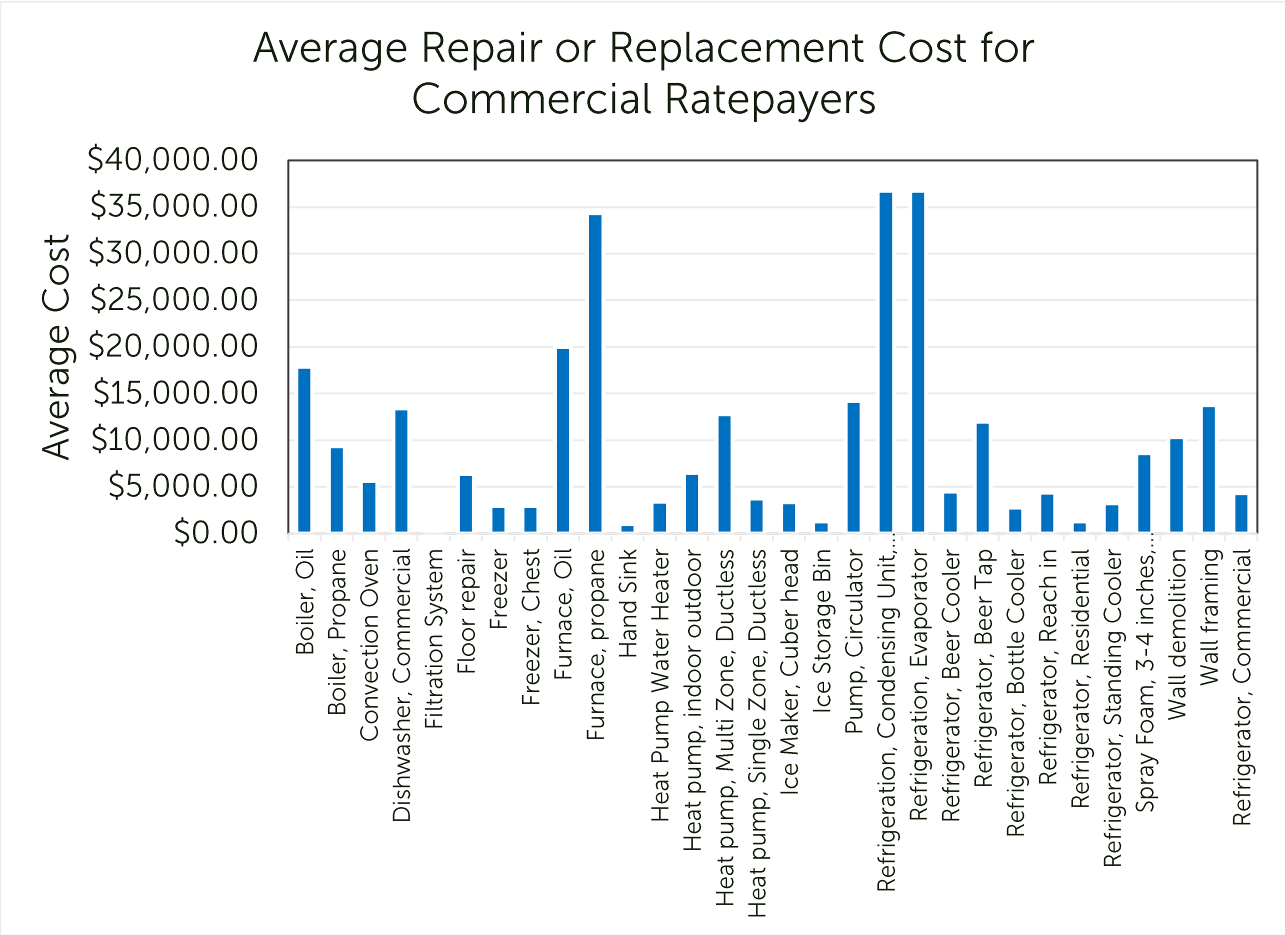

Figure 4 - Average Repair or Replacement Cost for Commercial Ratepayers Based on Rebate Submissions

Reported cost burdens	Reported cost
church repairing and replacing bottom of drywall, damaged pews, books, flooring, hydronic distribution	$60,000 plus volunteer labor from congregation members
Flooring replacement	$40,000 in large business
driveway gravel replacement	$6,000 plus staff labor
property damage at large commercial campus including all structural and mechanical repairs, landlord responsibility	$500,000 per property
labor to move grocery inventory to walk-in coolers ahead of event	4 staff at labor rate for 45 minutes each
large building supplier inventory losses	$1 million
physically move historic building structure out of flood plane	$650,000
filling and placing sandbags	staff and volunteer labor rates
move basement contents and boiler burners to upper levels	4 staff at 5 hours each
company truck	$100,000 to replace
wall repair - replace sheathing, insulation, sheetrock in medium warehouse building	$10,000
inventory loss in severely damaged business, disposal labor	$1 million
restoration services in severely damaged large business	$500,000
restoration services in severely damaged small business	$60,000
floor tile removal and replacement in large retail business complex	$70,000 removal and $150,000 replacement
demolish large retail structure	$175,000
small retail store inventory, furniture, computer replacement	20 volunteers for a week to clean out, $75,000 replacement costs
large property owner rental income loss due to tenants' lost sales	$600,000 rental income lost
large property owner rental income loss due to unservicable storefronts	$12,500 per square foot
boiler repair	$2,000
Point of sale computers and peripherals	$10,000 to replace
Estimated lost sales in severely damaged retail store	$2 million
small business flood insurance premium quote in aftermath	$11,000 per year
large property owner flood insurance umbrella policy premium increase in aftermath	$140,000 per year
raise condensing units off the ground onto racks at small business	$1,000
medium sized contractor detached garage repair	$5,000
furniture	$25,000
fuel storage tank, above ground	$3,000
floor door	$50,000 per door
flood gate	$12,000 per gate
equipment trailer	$10,000

Table 7 - Costs commercial respondents reported during interviews.

Reported Loss	Area of Cost Incurrence
Temporary rental space to continue minimal operation during recovery	Infrastructure
Replace large appliances rendered unserviceable	Infrastructure
Lost sales due to temporary closure, building inaccessibility, limited products, etc.	Business Operations
Inventory destroyed in the event	Business Operations
Permanently cease basement use	Infrastructure
Temporary business closure for recovery activities	Business Operations
Labor diverted from normal duties for recovery tasks	Business Operations
Building structure repairs such as flooring or drywall replacement	Infrastructure
Landscape and hardscape repair	Infrastructure
Material donations to support community recovery	Business Operations
Insurance premium changes	Business Operations
Decreased product quality due to impacts on suppliers	Business Operations
Long term property value	Business Operations
Business vehicles	Infrastructure
Furniture and retail fixtures	Infrastructure
Property cleanup and recovery	Infrastructure
Building system repair or replacement	Infrastructure

Table 8 - Commercial losses and their cost incurrence areas

Appendix C – Residential Data

Address	City	State	Zip	Price Paid
638 EAST BARRE RD.	BARRE	VT	05641	166,437.00
640 EAST BARRE RD.	BARRE	VT	05641	100,182.00
2383 RT 15 WEST	HARDWICK	VT	05843	70,209.00
111 GRANT ST	VAN BUREN	VT	04785	62,000.00
111 WATER ST	VAN BUREN	VT	04785	55,700.00
554 MAIN ST	VAN BUREN	VT	04785	47,600.00
548 EAST BURKE RD	LYNDONVILLE	VT	05851	37,058.00
112 GRANT ST	VAN BUREN	VT	04785	34,700.00
156 ST. BRUNO STREET	VAN BUREN	VT	04785	27,200.00

Table 9 - FEMA Buyout Prices for Vermont Properties in 2002 and 2007

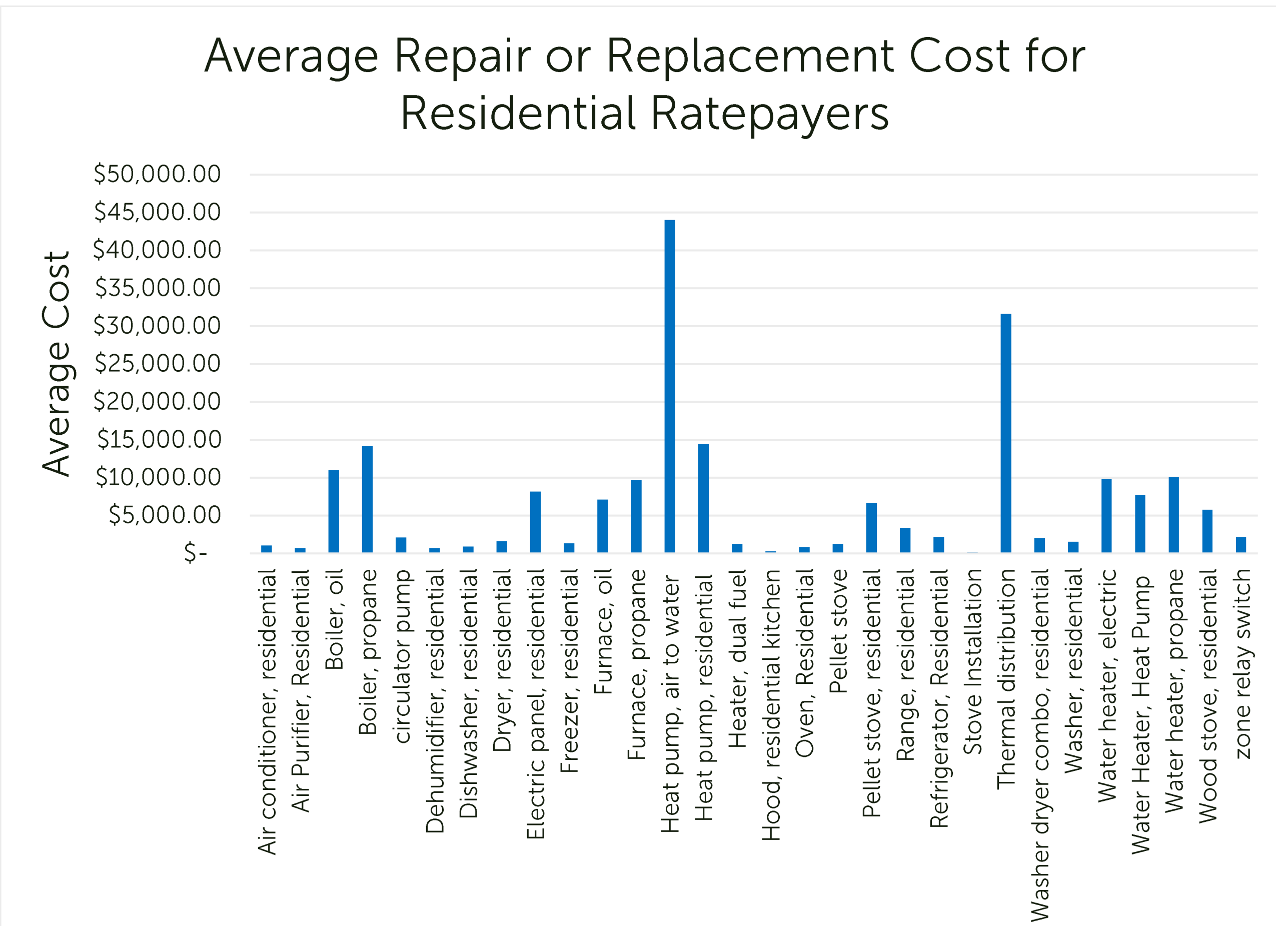

Figure 5 - Average Repair or Replacement Cost for Residential Ratepayers Based on Rebate Submissions

Figure 6 - Residential damages reported through surveys and discussions

Probability of not repairing or replacing	
lawnmower, ride	100.00%
family documents	91.67%
books/media	89.47%
lawn games	88.89%
detached garage	87.50%
important documents	84.62%
storage shed	81.82%
sports equipment	75.00%
vital records	75.00%
water sports equipment	75.00%
fitness equipment	72.73%
clothing	68.42%
camping equipment	66.67%
food	66.67%
lawn mower, push	66.67%
porch	66.67%
siding	62.50%
bike	60.00%
fuel storage tank, buried	60.00%
furniture	59.09%
tools, small	55.56%
deck	50.00%
water softener	50.00%
computer and peripherals	45.45%
flooring	41.18%
landline	40.00%
ventilation	40.00%
fuel storage tank, above ground	37.50%
carpet	31.25%
wall	30.77%
foundation	25.00%
dehumidifier	23.53%
oven	22.22%
electrical panel/wiring	21.05%
mobile devices	20.00%
refrigerator	20.00%
television	20.00%
vehicle	20.00%
DHW heater	19.23%
washer	15.00%
sump pump	14.29%
dryer	13.04%
Furnace/boiler	12.90%
dishwasher	12.50%

internet access devices	12.50%
heat pump	0.00%

Table 10 - Likelihood that items were not repaired or replaced for items with a minimum of 4 datapoints