
Emerging Public
Health Needs
for Climate Smart
Technology in
Connecticut
Affordable Housing
August 2024

YALE CENTER on
CLIMATE CHANGE
and **HEALTH**

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THE YALE CENTER ON CLIMATE CHANGE AND HEALTH utilizes research, education, and public health practice to help safeguard the health of human populations from adverse impacts of climate change and human activities that cause climate change. To protect health, we work with academic, government, and civil society partners to utilize science to contribute toward sharply reducing greenhouse gas emissions and building resilience to the climate change impacts that continue to occur. We aim to make local, national, and international impact and to integrate social justice into all of our work.

More information about the Yale Center on Climate Change and Health can be found at: <https://publichealth.yale.edu/climate>.

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State of Connecticut

ANDREW N. MAIS
INSURANCE COMMISSIONER

P.O. Box 816
Hartford, CT 06142-0816



Message from Commissioner Andrew N. Mais, Connecticut Insurance Department

Dear Stakeholders,

As we confront the escalating impacts of climate change across Connecticut, our commitment to safeguarding our communities through enhanced resilience and preparedness has never been more critical. The recent study on the Emerging Health Needs for Climate Smart Technology in Connecticut Affordable Housing underscores the vital need for robust support systems that ensure the safety and well-being of our most vulnerable populations, especially those reliant on home medical devices (HMDs).

Our participation in the National Association of Insurance Commissioners' (NAIC) National Climate Resilience Strategy for Insurance is a testament to our proactive approach in addressing these challenges. This strategy is designed to mitigate losses and expedite recovery from natural disasters, which is crucial for maintaining the continuity of medical care and safeguarding the health of residents dependent on HMDs during power outages and other related emergencies.

In Connecticut, we are taking significant steps to integrate climate resilience into our insurance frameworks. This includes the development of tools and programs that support fortification activities for homeowners and small businesses, particularly in communities most vulnerable to climate impacts. For example, the Department of Energy and Environmental Protection and the Public Utilities Regulatory Authority are overseeing incentive programs for the deployment of clean energy, including the Residential Renewable Energy Solutions and Energy Storage Solutions programs; as well as energy efficiency, including weatherization and heat pump programs. And, the Connecticut Green Bank ("Green Bank") recently expanded its financing programs through Commercial Property Assessed Clean Energy ("C-PACE") and the Smart-E Loan beyond clean energy to now include climate adaptation and resilience measures - helping to confront climate change by not only reducing greenhouse gas emissions, but also increasing our resilience against its impacts. Our efforts are aligned with the state's broader objectives to enhance climate resilience, and consistent with that, my office will convene a working group.

Moreover, the Connecticut Insurance Department (CID) is spearheading initiatives to establish a comprehensive database to monitor homeowner markets and identify coverage gaps. This will enable us to better understand the specific needs of HMD users and ensure that insurance products are adequately designed to meet these needs, thereby closing the protection gap and enhancing the financial security of these individuals.

Our active participation in the NAIC Climate Risk Disclosure Survey and our annual Connecticut Conference on Climate Change and Insurance (C4i) further illustrate our commitment to transparency and ongoing dialogue with stakeholders about the best ways to manage and mitigate climate-related risks.

As we move forward, it is imperative that we continue to work together—government agencies, insurance providers, healthcare professionals, and community leaders—to develop solutions that not only address the immediate challenges posed by climate change but also build long-term sustainability and resilience for all Connecticut residents. With the support of the Robert Wood Johnson Foundation, through the leadership of Governor Lamont, my office at the CID, working with the Green Bank, Clean Energy Group, Operation Fuel, and Yale University, this research should encourage private investment from the healthcare and insurance industries, to work with the public sector, to increase the resiliency of our communities, especially vulnerable communities.

Together, we can create a safer, more resilient Connecticut.

Sincerely,

A handwritten signature in blue ink, appearing to read "A. Mais", with a stylized flourish at the end.

Andrew N. Mais
Insurance Commissioner
Connecticut Insurance Department



An aerial view of Bridgeport, the most populous city in Connecticut. Photo by Red Skies Photography.

EXECUTIVE SUMMARY

This study was designed to better understand the needs of people who use home medical devices (HMDs) when experiencing a power outage. In this study, HMDs were defined as electricity-reliant medical equipment that empower independent living or are necessary for living with a medical condition. This includes but is not limited to life-support equipment (such as dialysis machines and ventilators) and technologies for independent living (such as electric wheelchairs, refrigeration for medicine, and stable indoor temperatures). With a better understanding of how the loss of power impacts HMD users in affordable housing units across Connecticut, more informed decisions can be made regarding the implementation of Climate Smart Technologies (CSTs) through advances in building codes and other policy changes. Ultimately, these changes aim to increase the resiliency of HMD users through advances in building codes, additional incentives, and other policy changes so that they can remain healthy and secure in the face of extreme weather events.

The research team conducted nearly one hundred interviews and focus groups with HMD users living as tenants in various types of affordable housing, building administrators such as Residential Service Coordinators (RSCs), medical professionals and other care givers of HMD users, and analyzed the data using a rapid qualitative analysis approach. Originally the plan was to hear from HMD users through focus groups; however, due to challenges in recruiting and organizing these groups, most data was collected through individual interviews. The research team included students from the Yale School of Public Health class EPH 555/ENV 959 – ‘Clinic in Climate Change, Law and Public Health’ (the lead authors of this paper), researchers from the Yale Program for Recovery and Community Health, and staff of Operation Fuel. Additional partners include the Connecticut Green Bank, Connecticut Insurance Department, the Clean Energy Group and American Microgrid Solutions. The project was funded by the Robert Wood Johnson

Foundation, the Energy Storage Solutions program overseen by the Public Utilities Regulatory Authority (“PURA”), paid for by electric ratepayers, and administered by the Connecticut Green Bank, Eversource, and UI. This project was also supported in part through a funding award from the US Department of Energy (DOE) Building Technologies Office to advance climate resilient energy codes for multifamily affordable housing

We learned from HMD users that their definition of HMD is considerably more expansive than expected. We specifically asked about dialysis machines, ventilators, oxygen concentrators, CPAP machines, electric wheelchairs, mobility scooters, suction pumps, refrigerators for medication and medical conditions that require a highly specific diet, and air conditioning and heating for medical conditions that require stable temperatures. During conversations with participants, they also mentioned additional things that they defined as essential for their health, including elevators, cell phones, cell phone-based health applications, internet, medical alert devices, humidifiers, dehumidifiers, air purifiers, and fans. The HMDs that people mentioned are used for various things including monitoring health conditions and communicating with medical providers and other care providers, mobility, indoor temperature, and air quality regulation, breathing assistance and oxygen regulation, and storing medically necessary items. Two particularly important issues that emerged that we had not specifically asked about included the importance of electricity-dependent devices for monitoring health and for essential health-related communications. We also heard from many people about the need to use emergency services to enter and exit their buildings when elevators are out. We also heard that many people rely on more than one HMD and often are not the only HMD user in their households. Some mentioned that they struggle to afford what they see as elevated electricity costs due to their HMD use; at the time that

we conducted the interviews the now available low-income discount rate was not available, and we did not hear mention of it in our conversations. While some people report having medical hardship protection, some said it was difficult to navigate the renewal process while others were not aware of the program.

Existing strategies to prepare for and navigate power outages vary depending on factors such as building type, location, HMD type, individual mobility, individual support systems, and access to backup power. People described stocking up on supplies to be ready for bad weather that might cause a power outage and improvising refrigeration methods for storing medications and food (i.e., filling Ziploc bags with ice or water). In case of evacuation, most people said they prefer to seek refuge with family or friends, if possible, but some said they have no-one who they can stay with. A few mentioned having to go to hospital, pay for a hotel or find a shelter. We spoke with some housing facility administrators who described emergency plans based on each residents' specific needs and access to social support; but many residents were unaware of emergency planning within their building. People living in buildings with backup power options explained how critical that was to allow them to continue using and charging their HMDs; though when it is only available in hallways it can be inconvenient. Some people described using their car to charge their devices or access air conditioning when backup power options are unavailable.

Emotional distress and mental health emerged as significant themes, with many participants expressing feelings of stress and anxiety about their dependence on electricity, the related expense, and their fear of power outages. Some people also said they were afraid about personal safety and potential crime during power outages. Some people spoke of coping strategies include relying on community or other social support systems and turning to their faith for comfort.

When asked about their willingness to utilize communal areas during power outages, participants had mixed

opinions. Many were receptive to the idea, particularly those who had no relatives or friends close by they could stay with. They emphasized the importance of features such as outlets, refrigerators, good accessibility, and access to Wi-Fi or phones in these spaces to satisfy medical and personal needs. Some said that they would be uncomfortable using the area due to concerns about privacy and lack of space and anxiety about social interaction.

Finally, we asked participants about their familiarity with solar and battery storage, but many lacked experience with or knowledge about these technologies. While some showed interest in solar power installation, some raised concerns about the expense, which they feared may be passed onto tenants, and doubts about its ability to sufficiently power an entire building.

We present the following recommendations based on our study findings:

- 1 Expand the definition of HMDs to include devices related to monitoring health conditions and communicating with care providers, mobility, and devices that maintain air flow and quality.**
- 2 Ensure that residents are signed up for utility alerts in case of impending bad weather.**
- 3 Utilize expertise of home health aides and nurses, who understand both medical issues that arise during power outages and socioeconomic and other barriers faced by HMD when seeking help.**
- 4 Consider the financial burden on emergency services and healthcare facilities related to supporting HMD users during power outages when conducting cost-benefit analyses of installing backup power.**
- 5 Ensure that procedures for assisting HMD users during power outages consider and accommodate the high anxiety and stress that they experience at those times.**

- 6 Require housing providers to have emergency plans that meet the specific needs of each resident and must improve communications with residents about emergency plans.**
 - 7 Require housing providers to establish accessible and safe common spaces that can be easily used by HMD users as short-term solutions during power outages.**
 - 8 Facilitate learning between different housing providers.**
 - 9 Access State and Federal Incentives and Financing.**
 - 10 Support Public-Private Partnerships for Investment.**
-



Tornado damage in downtown Bridgeport. [iStock.com/Denis Tangney Jr](https://www.istock.com/photo/Denis-Tangney-Jr)

1

This introductory section is taken from the original grant proposal prepared for the Robert Wood Johnson Foundation by the CT Green Bank and partners (Garcia 2022).

2

Per Public Act 20-05, vulnerable communities means populations that may be disproportionately impacted by the effects of climate change, including, but not limited to, low and moderate income communities, environmental justice communities pursuant to section 22a-20a, communities eligible for community reinvestment pursuant to section 36a-30 and the Community Reinvestment Act of 1977, 12 USC 2901 et seq., as amended from time to time, populations with increased risk and limited means to adapt to the effects of climate change, or as further defined by the Department of Energy and Environmental Protection in consultation with community representatives.

3

Connecticut Public Utilities Regulatory Authority Docket No. 17-12-03RE01 - PURA Investigation into Distribution System Planning of the Electric Distribution Companies - Energy Affordability.

4

See <https://empowerprogram.hhs.gov/empowermap>. This includes the total electricity-dependent number, by location, that represents the total number of beneficiaries with claims in Centers for Medicare and Medicaid Services (CMS) databases for: ventilator, bilevel positive airway pressure (BiPAP) machine, enteral feeding machine, intravenous (IV) infusion pump, suction pump, at-home dialysis machine, electric wheelchair, electric scooter, and electric bed equipment in the past 13 months; oxygen concentrator equipment in the past 36 months; and implanted cardiac devices that include left ventricular assistive device (LVAD), right ventricular assistive device (RVAD), bi-ventricular assistive device (BIVAD), and total artificial heart (TAH) in the past 5 years.

BACKGROUND

In August 2020, Tropical Storm Isaias resulted in 800,000 electric customers in Connecticut losing power from heavy rains and wind, many of them for over a week.¹ In July 2022, a heat wave crept across the United States, setting record-high temperatures. In recent years, Connecticut has experienced rain bombs, heat domes, polar vortexes, and other weather-related phenomena induced by climate change that have caused grid outages and temperature-related emergencies. While hospitals and other critical infrastructure are typically fitted with onsite backup generation for use during blackouts, multiple studies have demonstrated the substantial effect of power disruptions on people with Home Medical Devices (HMDs). HMDs are electricity-reliant medical equipment that empower independent living or are necessary for living with a medical condition. They include life-support equipment (such as dialysis machines and ventilators) and technologies for independent living (such as electric wheelchairs, refrigeration for medicine, and stable indoor temperatures).

For users of HMDs, interruptions to the electric supply can compromise treatment, wellbeing, or survival. Respiratory illnesses like asthma, require ventilators and oxygen concentrators, chronic health conditions like diabetes, require refrigeration of medicine, and aging in place of elders, requires comfortable indoor temperatures in the event of extreme weather-related events. The consequences of disruption to supply of electricity for those reliant on HMDs in vulnerable communities² can be harmful or even fatal. In Connecticut, 2.0% of Eversource Energy and 2.4% of Avangrid customers receive medical hardship protection – nearly 30,000 customers. Nearly 90% of these customers have life-threatening conditions.³ Medical hardship protection programs in Connecticut allow for low-income residents who rely on electricity to treat a serious medical condition to avoid having their electricity shut off even if they fall behind on their bills (i.e., use an electricity-powered HMD). While this is already a sizeable number, it is worth noting that it may vastly under-estimate the number of people dependent on HMDs. Close to 22,000 of Connecticut’s 736,000 Medicare beneficiaries in Connecticut rely on electricity-dependent medical equipment, according to Empower⁴, and even this source only provides data for certain types of “common electricity-dependent medical equipment” and does not include HMD types that we heard are important to people such as refrigeration or heating/cooling, for instance.

Climate Smart Technology and Home Medical Devices for Affordable Housing (henceforth the Project) seeks to understand the investment needed in Climate Smart Technology (CST), including backup power (e.g., solar power, battery storage) and stable indoor temperature (e.g., efficient heating and cooling, weatherization).

The deployment of such technologies in affordable housing can increase the resilience⁵ of tenants who are reliant on HMDs for their health, allowing medically vulnerable residents to safely shelter in place. Electricity-dependent individuals turn to hospitals in the event of a power outage to keep their HMDs functioning. Increasing resilience at home through CST deployment can mitigate demand on medical facilities during an emergency event, helping to improve their overall resilience.

This report covers the qualitative component of a broader multi-collaborative effort with the Connecticut Green Bank, the Connecticut Insurance Department, the non-profit Clean Energy Group and American Microgrid Solutions. The initial phase of the work, which sought to understand the investment needed in CST, including backup power and stable indoor temperature, was funded by the Robert Wood Johnson Foundation and the Energy Storage Solutions program. To do this, the larger team carried out three activities: Community Engagement (covered in detail in this report), Technical Assistance⁶, and Technology Deployment⁷. The U.S. Department of Energy has granted funding to continue to develop and advance implementation of a Climate Resilient Energy (CRE) code for the installation of climate resilient energy systems to power essential services for multifamily affordable housing residents during grid outages.

⁵ Per Public Act 20-05, resilience means the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from deliberate attacks, accidents or naturally occurring threats or incidents, including, but not limited to, threats or incidents associated with the impacts of climate change.

⁶ Technical Assistance – assessment by the Clean Energy Group of no less than 15 affordable housing properties located in vulnerable communities in terms of their technical and economic potential for the deployment of CST.

⁷ Technology Deployment – where appropriate, investment by the Connecticut Green Bank in the deployment of CST through innovative, replicable, and scalable financing mechanisms, including recommendations for how to structure an investment fund that invites the insurance and health care industries to invest capital into the deployment of CST.

The qualitative component reported here was conducted through a partnership between Operation Fuel, a Connecticut-based non-profit whose mission is “to ensure equitable access to energy for all in Connecticut by providing year-round energy and utility assistance, promoting energy independence, and advocating for affordable energy” (Operation Fuel, 2022), the Yale School of Public Health’s Clinic Class in Climate Justice, Law, and Public Health (YSPH-Clinic Class), and the Yale Department of Psychiatry’s Program for Recovery and Community Health (Yale-PRCH). The qualitative research began in January 2023 and continued through the spring of 2024.

METHODS

The qualitative project team included staff and interns from Operation Fuel, Master of Public Health Students from the YSPH-Clinic Class of Spring 2023 and Fall 2023, and Researchers from Yale-PRCH; henceforth referred to as the project team. Yale University's Institutional Review Board approved the study protocol before data collection started (IRB Protocol No. 2000034608).

Sampling Strategy and Participants

The project team recruited HMD users across the state of Connecticut through various methods, including contacting affordable housing facility property managers, distributing informational flyers, tabling at organization events such as food pantries, farmers' markets, utility assistance clinics, presenting at community meetings including the Commission on Disabilities monthly meeting and Continuum of Care, and reaching out to personal contacts. Initial efforts to recruit participants by contacting property managers of affordable housing facilities did not prove successful. Some property managers were outspoken in their disinterest in sharing information about our study with their tenants.

Eligible individuals were (1) over the age of 18, (2) either used and/or cared for someone who used an electricity-powered HMD and (3) lived in affordable housing. Participant addresses were cross-referenced using a list of affordable housing facilities across the state.

We also directly recruited affordable housing staff to participate, including resident service coordinators (RSCs) and administrators of affordable housing facilities. Additionally, after some initial data collection we realized that medical professionals could offer a crucial perspective on the issues, we expanded our recruitment to healthcare professionals such as doctors, nurses, and medical assistants who have experience working with this population. Each participant was only allowed to participate in this study once, through either an interview or focus group. Ultimately, we spoke with a total of ninety-four participants across 23 sites—locations are provided in Figure 1—about HMDs, power outages, and their impacts on affordable housing residents.

Many of the sites included in the study are in census tracts that are overburdened and underserved, as indicated by the Climate and Economic Justice Screening Tool (CEJST)⁸, or are designated as distressed municipalities as defined by the Connecticut Department of Economic and Community Development⁹. See Table 1 for more details. These designations mean that the sites are eligible for additional federal and state incentives for these properties.

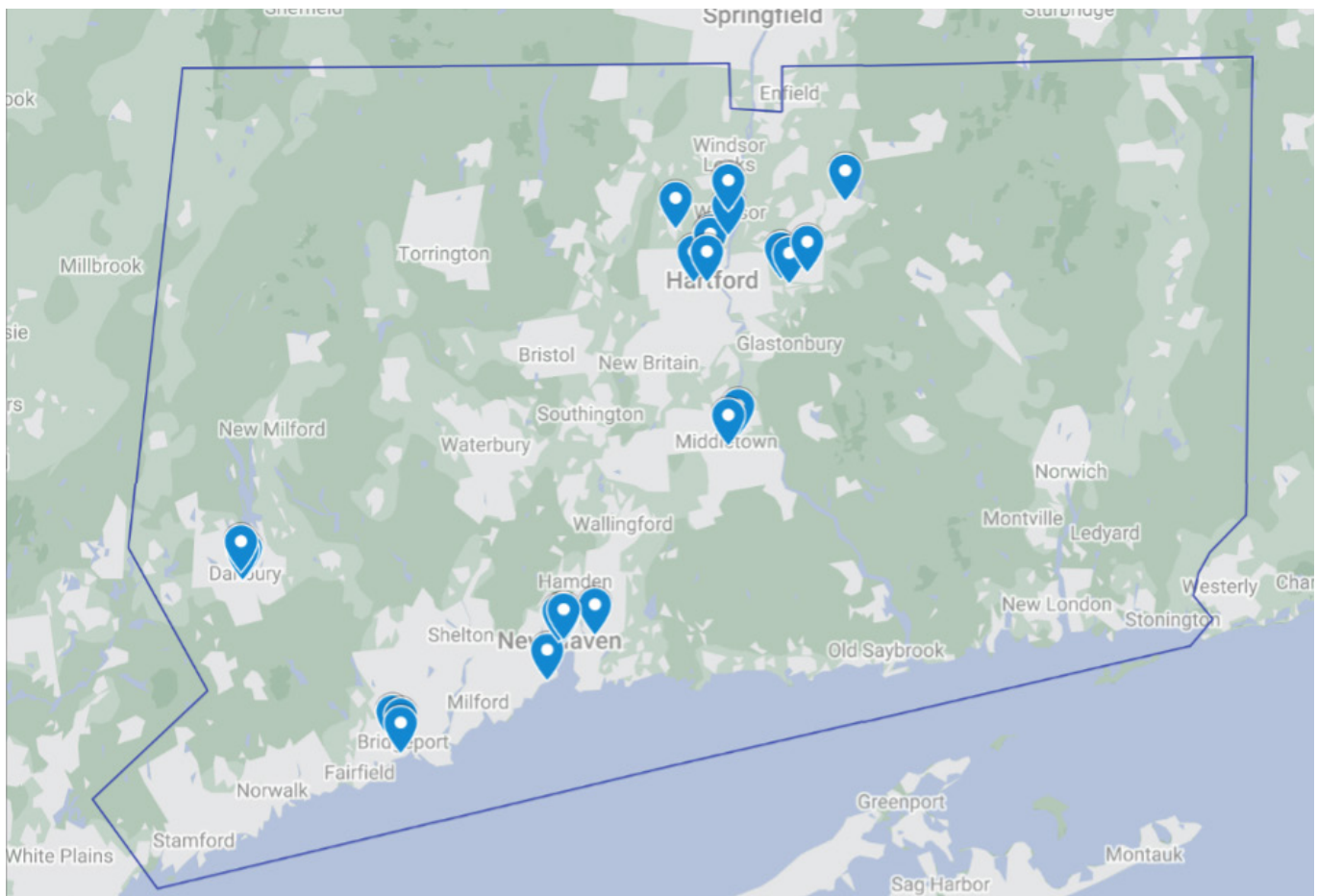


FIGURE 1: Map of Building Locations

⁸ See <https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5>. The CEJST tool was created as a result of an executive order signed in January 2021 by President Biden (i.e., Tackling the Climate Crisis at Home and Abroad) that directed the Council on Environmental Quality (“CEQ”) to develop a tool that is an interactive map that uses data as indicators of burdens in eight categories (i.e., climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development) to identify communities that are experiencing these burdens. These are the communities that are disadvantaged because they are overburdened and underserved.

These communities receive access to additional federal incentives (e.g., through the GGRF). See her for the order <https://www.federalregister.gov/documents/2021/02/01/2021-02177/tackling-the-climate-crisis-at-home-and-abroad#:~:text=Sec.%202023,%20Justice40,40-percent%20goal>.

⁹ See https://portal.ct.gov/decd/content/about_decd/research-and-publications/o2_review_publications/distressed-municipalities.

DESCRIPTION OF HOUSING LOCATIONS FROM WHERE PARTICIPANTS WERE RECRUITED

LOCATIONS	CEJST	DISTRESSED MUNICIPALITIES	BUILDING CHARACTERISTICS	OWNERSHIP	SUPPORT STAFF ADVERTISED*
Bella Vista Apartments, New Haven	X	X	Senior and disabled living, large high-rise community	Private	Yes
110 Martin St., Hartford	X	X	9-unit low rise	Private	No
121 Westland St., Hartford	X	X	Single family home	Private	No
Squire village, Manchester			2 story, 328 units composed of townhouses and apartments	Private	Yes
Surfside, Savin Rock, West Haven		X	Elderly/Disabled, low rise 254 unit	Public	Yes
Florence Mill Apartment, Vernon, CT	X		Senior and disability housing	Private	Yes
Ninth Square Apartments, New Haven		X	High rise building downtown	Private	Yes
Shepherd Park Elderly Housing, Evergreen Ave, Hartford	X	X	307-unit elderly housing complex low rise	Private	Yes
Westhill Gardens II, Carver Lane - Manchester		X	99 apartments, single story and low rise	Public	Yes

TABLE 1: Description of housing locations from where participants were recruited.

*This column indicates if listings or websites for these buildings advertise support staff such as a resident services coordinator.

DESCRIPTION OF HOUSING LOCATIONS FROM WHERE PARTICIPANTS WERE RECRUITED (CONT.)

LOCATIONS	CEJST	DISTRESSED MUNICIPALITIES	BUILDING CHARACTERISTICS	OWNERSHIP	SUPPORT STAFF ADVERTISED*
Chatham Court - Portland		X	48 units between 5 low rise buildings	Public	Yes
Wooster Manor (36 West Wooster Street) - Danbury	X		98-unit high rise elderly housing	Public	Yes
Putnam Towers (25 Beaver Street) - Danbury	X		54-unit high rise elderly housing	Public	Yes
Crosby Manor (84 West Wooster Street) - Danbury	X		50-unit low rise elderly housing	Public	Yes
Interfaith Homes - Bridgeport	X	X	28 units, two story buildings for elderly residents	Private	No
Capen Street, Hartford	X	X	6-unit high rise	Private	No
Capitol Towers - Hartford	X	X	9 stories 144 units/ elderly & persons with disabilities	Private	Yes
Millbrook Village, Windsor	X	X	60 units row house/ elderly & disability	Public	Yes
Shad Run Terrace, Windsor			52 One Bedroom row house apartment units/elderly & disability	Public	Yes

**DESCRIPTION OF HOUSING LOCATIONS FROM WHERE
PARTICIPANTS WERE RECRUITED (CONT.)**

LOCATIONS	CEJST	DISTRESSED MUNICIPALITIES	BUILDING CHARACTERISTICS	OWNERSHIP	SUPPORT STAFF ADVERTISED*
John Fitch Court, Windsor			40 units low rise former school building turned into housing	Public	Yes
South Green Apartments Middletown	X		125 units, 4 story complex, 8 Housing for Elderly/Persons with Disability	Private	Yes
Harrison Apartments - Bridgeport	X	X	102 unit five-story building,	Private	Yes
Maplewood Court - Bridgeport	X	X	32-unit low rise	Private	No
The Towers - New Haven	X	X	328-unit high rise, Towers complex	Private	Yes

Data collection: focus groups and individual interviews

When we first started the study, the intent was to gather data from HMD users through focus groups (FGs). However, the project team faced significant challenges recruiting for FGs; as mentioned, property managers were unwilling to assist in recruiting for and convening FGs and without their support it was extremely difficult to organize the FGs. We recruited some people through other recruitment channels and after conducting individual interviews with them, it became clear both that many individuals preferred to discuss the issues privately, and that the individual format allowed for collection of richer, more detailed information. As a result, the team decided to offer both FGs and individual interview options. Ultimately the team conducted 33 in-depth interviews and nine FGs with 45 HMD users for a total of seventy-eight HMD users. Each participant was asked to complete an electronic survey on a tablet that included questions about demographics, HMD use and preferences and building type. Sixty-seven participants completed these surveys; some were missed due to researcher oversight, and in other cases the data did not upload properly. Six individuals were recruited from among clients using services at the Connecticut Mental Health center in New Haven, with the goal of understanding the perspectives of people with serious mental illness, who are known to experience particularly high rates of fatality during extreme heat events; these interviews were conducted later than the others and findings from those interviews will be included in an appendix to this report. To expand knowledge about HMDs and health conditions, the project team also interviewed four health professionals specializing in diabetes and other chronic conditions. Finally, the team spoke with twelve staff of affordable housing facilities, including RSCs, administrative and volunteer staff.

The project team designed a guide for FG discussions with questions covering the following domains: (1) existing needs (e.g., HMD use, reliance on electricity), (2) power outages (e.g., experience with and prep for power outages), (3) potential opportunities (e.g., suggestions for building improvements), and (4) additional questions (e.g., experience with energy-efficient technologies, energy bill costs). The guide was later adapted for individual interviews, with the same domains covered. To ensure that we captured all types of HMDs, we developed a list of the HMDs that we thought might be relevant and included this list in the interview guide. The list included dialysis machines, ventilators, oxygen concentrators, CPAP machines, electric wheelchairs, mobility scooters, suction pumps, refrigerators, specifically for medication and medical conditions that require a highly specific diet, and air conditioning and heating for medical conditions that require stable temperature.

FGs and interviews were conducted either in-person, by phone, or via an online video chatting platform (i.e., Zoom), depending on participants' preferences and availability. FGs were designed to take between 60 and 90 minutes, and interviews were designed to take between 30 and 60 minutes. Each interview was conducted by one or two team members and one or two notetakers. Interviews with Spanish speakers were conducted with native Spanish-speaking research team members. Prior to starting each FG or interview, researchers reviewed the informed consent form with participants, and they provided verbal consent before participating in the study. Participant completed the electronic survey after the completion of the FGs or interviews. All participants were compensated with \$100 in the form of cash, physical or virtual gift card or credit for an onsite convenience store in their building.

All FGs and individual interviews were recorded and sent externally for transcription (Ubiquitous Transcription Service). In addition, observational notes were taken during FGs and interviews, and each interviewer wrote a short summary of the session after its completion. Data collection began in March 2023 and continued until March 2024.

Analytical Approach

Quantitative data collected on tablets was stored on Qualtrics and was analyzed to create descriptive statistics; these are provided in Appendix One. Rapid qualitative analysis methods were used to analyze the qualitative data in this study. Rapid qualitative analysis, in this context, refers to the categorization of transcription notes and summaries into predefined categories based on the FG/interview guide; these categories evolved as more themes emerged over the course of data collection. The original domains were developed by the Spring 2023 YSPH-Clinic student team. For HMD users, caretakers, and medical professionals, analytical domains included (1) dependence on electricity, (2) existing strategies for planning and preparation, (3) emotional impact and mental health, (4) potential solutions, and (5) other. For RSCs and other affordable housing supervisors, analytical domains included the (1) role of RSC, (2) backup power options, (3) HMDs and intake/new residents, (4) unplanned outages, (5) managing personalities/recognizing anxieties, (6) planned outages, (7) evacuations, (8) communication, (9) disability code/emergency policies, and (10) other.

Analysis took place in three phases (first, second, and third or combined analysis). During the first and second phases, a different project team member was assigned to analyze each interview or FG transcript, with each transcript analyzed by two separate people. The analysis involved reading transcripts and/or listening to recordings more than once and reading interview or FG summaries. The analyzers used

the domains above to identify key findings, descriptions, and representative quotes within their respective domains and to insert that information into a summary table. The third analysis phase involved merging the two summary tables for a particular transcript into a single summary table. Since our project team included two different YSPH-Clinic classes as well as researchers from outside the class, this method allowed us to maintain consistency across our analyses. It also allowed for the analyst group to review the same data and agree on emerging themes and key findings. Last, we transferred the summary results to a compiled Excel file to facilitate the identification of themes. These themes will be discussed in further detail in the following section.

FINDINGS

A. DEPENDENCE ON ELECTRICITY

To give a sense about the frequency of use of different types of HMDs across our sample, we have included numbers in parentheses. The numbers represent either how many people reported they used the device in our Qualtrics survey or how many times an HMD was mentioned in an individual interview or FG (for clarification, we counted mentions in focus groups as 1, though there could have been multiple participants who also used the device). Note that not every participant completed a survey; therefore, the numbers do not exactly represent the sample we spoke to and should not be used to make definitive statements. This was a qualitative study with the primary purpose of reporting on as many different experiences as possible, rather than generating statistically significant data.

People have multiple HMDs and critically depend on them for various uses

Many participants (44 of 62 survey respondents) said that they personally used more than one HMD and/or were not the only HMD user in the household; often participants' partners, parents, or their children were reliant on HMDs. Participants reported using HMDs primarily for communication, medical monitoring, mobility, indoor temperature/air quality regulation, and breathing or oxygen regulation. Notably, when we asked participants about devices reliant on electricity that were essential for their health, we heard about additional devices that had not been on our original list. As mentioned, our original list of HMDs included dialysis machines, ventilators, oxygen concentrators, CPAP machines, electric wheelchairs, mobility scooters, suction pumps, refrigerators, specifically for medication and medical conditions that require a highly specific diet, and air conditioning and heating for medical conditions that require stable temperatures. During conversations with participants, they also mentioned elevators, cell phones, cell phone-based health applications, internet, medical alert devices, humidifiers, dehumidifiers, air purifiers, and fans. We will discuss this further below.

Most HMDs that people use require an active connection to an electrical outlet to function. Others had a rechargeable battery, often charged every night, allowing participants to operate their devices while mobile. When people spoke about their HMDs, they said that they were not there simply for comfort or convenience but essential for their health; some devices were literally life-saving. A user of multiple HMDs reiterated the significance of these devices, "It's hard for me to sleep... 'cause

I don't have the machine and, you know, I stop breathing so much. So, it is a matter of life and death with that machine that I have”.

A doctor who was interviewed for the study provided insight on electricity reliance while living with chronic conditions:

“It’s really hard to live with any really major chronic condition without electricity these days. I can’t imagine doing that, actually. For some people, it may be the one particular thing, not being able to charge your wheelchair, or your CPAP machine so your oxygen drops while you’re sleeping and that can cause problems, or you get dehydrated because of heat. But more likely, it’s all these other things.”

Devices for communication and monitoring

Some participants (12 of 62 survey respondents) mentioned a communication device when we asked about HMDs, explaining that those devices are critical for their health. They described using cell phones, landlines, and medical alert devices (watches or necklaces) to maintain a direct line of contact with family members, caregivers, or medical professionals in the event of a fall or an unexpected medical emergency. One participant described their reliance on a medical alert device: *“I charge it every night and when I put it on it’s with me for the day whenever I am.”* Some participants depend on medical monitoring through cell phone applications or other devices that share live data with medical professionals or alert themselves. These devices include Libre and Dexcom, a glucose monitor and compatible automated insulin pump that delivers medication for participants with diabetes. One participant highlighted the interdependence between different devices, saying: *“[they]...all work together. My cell phone, blood PDM, the pod, which is the insulin pump itself, and the Dexcom...all four things coincide all day long, and they work together to keep me alive basically.”* Another participant shared their experience, saying: *“I have Libre 2 insulin, I think. And if we don’t have electricity and my phone dies, obviously I’m not able to check what my blood sugar is.”* A FG participant described how their monitor connected them to their health provider,

“...then I put this against the machine, it goes straight to the doctor’s office. And I need it for to check my sugar. I need it for that, to plug that up, too. So, everything when I check my blood, it goes straight to the doctor’s office because I live by myself. ‘Cause I got a bad heart, so they want to know what’s going on.”

Another participant shared that their defibrillator is connected to a monitor, which must be plugged into a wall outlet. He said: *“It will tell you if some of my devices are defective or if I’m on the verge of having a heart attack or if I need to go to the hospital right away.”*

In addition to cell phone-based applications, some participants use devices to monitor their blood pressure or O₂ monitors that need to be plugged in or require charging to track their blood pressure levels and oxygen saturation. This monitoring allows them to make appropriate decisions to manage their conditions, such as going to the hospital, or deciding they need to use a different device like an oxygen tank.

Devices and equipment for mobility

Some participants (12 of 62 survey respondents) depend on electric wheelchairs or scooters for mobility within and outside their homes. A participant who is heavily reliant on her wheelchair and electricity for medical devices uses an electric lift to transfer between her wheelchair and bed and has an electric door opener that allows her to leave her apartment. The participant expressed concern about not knowing where to go or what actions to take if she had to evacuate her fifth-floor apartment during prolonged power outages,

Well, I do have an electric wheelchair, which I do plug in every night to charge up the wheelchair. I also have an electric lift that I use to transfer back and forth from my wheelchair to my bed. So, I’m pretty heavily reliant on both things for my safety and mobility... Yeah, I don’t know, ‘cause, like, especially if it were to last a couple of days, even if, like a hotel, I really have no way to transfer from my wheelchair to a hotel bed. So, that is kind of a fear of mine. If we ever had [to] evacuate, I’m not sure where I would go to, to be honest. But I just really hope it doesn’t happen.

Given participants’ mobility constraints, many mentioned concerns with elevators. 42 of 62 survey respondents use elevators to exit their building. Elevators are not considered HMDs, but many respondents mentioned reliance on an elevator and their frustration or fear related to broken-down elevators. Residents with mobility limits or who are non-ambulatory and unable to use flights of stairs can become stranded in their homes during power outages, or when elevators are not working. This is a particular consideration for residents who live on upper-level building floors. A home nursing assistant shared that during power outages, she must call 911 for paramedic personnel to transport non-ambulatory residents down the stairs and

to the hospital to receive their HMD treatment, particularly if the resident relies on oxygen. One participant recounted the everyday necessity of elevators: *“Last week, both our elevators were down, and I couldn’t get out the house, because I can’t walk down the stairs”*, the participant recounted. *“I can’t walk down like that.”* Another participant said, *“it was a close call one-time last year, because both elevators on the front were down. And I had gone somewhere, and I came back, and I was like praying that the elevator on the side would work. Because I was like, if that doesn’t work, I don’t know what I’m gonna do.”*

While most people living in a building with elevators had experienced situations where at least one elevator was not working, some expressed their fear that during a power outage the elevators would stop working. One participant summarized the importance of elevators and other devices that facilitate their mobility:

“...I’m on the fifth floor. So, for a power outage, I doubt the elevators would be running. I’d tell you about it, too, I actually have a device that I use to open my door, a remote control...I don’t even know if I could exit without any electricity because...it runs off electricity for the door to open and close.”

LOW-INCOME DISCOUNT RATE (LDR)

is effective December 2023, allows qualifying low-income Connecticut residents to sign up for a discount on their electric bills. The low-income discount rate is tiered, depending on income level:

Tier 1: 10% discount applies to households at or below 60% of the state median income.

Tier 2: 50% discount applies to households at or below 160% of the federal poverty guideline. The LIDR program helps residents facing financial hardship manage their energy costs. Contact your electric provider (Eversource or United Illuminating) to learn more and apply. You must re-qualify for the discount every year.

Devices for indoor temperature/air quality regulation

Some participants (9 of 62 survey respondents) regulate the internal temperatures of their homes to manage their medical conditions. For example, they use air conditioners during the summer months and turn the heat up or use portable electric heaters during the cold months when temperature changes exacerbate their medical conditions. One participant described this challenge. *“It was, in the summertime, it was really, really hot.”*, she said. *“So I had a harder time... with trying to keep cool and to keep from going into an asthma attack.”* Another participant shared,

“[a power outage is] really difficult because of the air conditioning especially, because that affects my breathing in the summer...it’s difficult for anybody to go through that, but especially when you’re – you know, need to take a treatment. You know, you have to wait, you know? And especially if you have no air conditioning, you know, it’s not a good situation.”

Other participants talked about the importance of maintaining an adequately warm temperature. One participant described relying on a space heater - *“Well at least for when you take chemo – chemotherapy you experience that you’ll be like cold.”, she explained. “I only turn the heater in auto, because, you know, warm it up, the apartment I will start coughing because the asthma and I have to get the balance”.*

THE WINTER MORATORIUM

Connecticut’s Winter Protection Program safeguards low-income residents facing financial hardship from utility shutoffs during winter months (November 1st to May 1st). To qualify, residents must demonstrate hardship through income eligibility or specific circumstances like serious illness. This can include people

who receive government benefits for energy assistance; whose sole source of financial support is from Social Security or Veteran’s Administration; whose income levels fall below 60 percent of the state median income; or have a serious illness (themselves or household members).

A mother shared her need to maintain stable temperatures for her children: *“Yeah, very cold temperatures can flare up their (two sons) asthma and for my daughter it can start to irritate her muscles if it’s too cold.” she explained. “I need to use everything from putting the heat all the way up sometimes in the winter as well as using an electric heater.” A participant described her family members’ dependence on air conditioners. “...These are brick buildings and it doesn’t get much circulation” she said. “So my brother’s bedridden and I have to have his oxygen on. I have to have the air circulate, he has to have the air conditioner.”*

Some participants use humidifiers and dehumidifiers to allow them to breathe freely. A mother described needing a humidifier when her children were congested due to their asthma and bronchitis: *“I put the humidifier on, which is also for when they are congested, so they get the air, the little vapor/mist,” she explained, adding that their conditions worsened after living in their apartment, a former school turned residential building, for over a year,*

But I have already realized that the girl wakes up all the time congested. And it's like I say but why is she congested if there is no one sick in the home. It's mostly the – I don't know, like I explained to you, if it has anything to do with it being like a basement, retaining moisture. I don't know if she has... Also that

MEDICAL HARDSHIP PROTECTION

Connecticut residents with documented medical challenges including a “serious illness” or “life-threatening situation” are protected against utility shutoffs. This program safeguards access to essential utilities like electricity and natural gas, which can be critical for operating life-saving medical equipment or maintaining a

healthy environment for those with chronic conditions. Documentation from a medical professional is required. Regardless of your medical status, if you're struggling to pay your bills, please reach out to your utility to set up a payment plan.

it is enclosed. All you see is darkness in that apartment. When you open the windows what you can see is the earth.

Some participants use air purifiers and fans to improve air circulation. A health provider described the significance of temperature regulation for certain medical conditions.

“So if they have autonomic dysfunction where the nerves are affected, they can't actually sweat and cool as well”, the provider said. “And then when they get dehydrated, their blood sugars can spike really fast. And so that presents

INFLATION REDUCTION ACT (IRA)

is a federal law passed in August of 2022 by President Biden, that includes investment tax credits to support the deployment of renewable energy and battery storage projects across the United States. Tax credits through the IRA are available through 2032 and include a 30% investment tax credit for renewable energy and battery storage projects, with additional incentives of

10% for projects located in “energy communities”, 10-20% for projects located in “low-income communities”, and 10% for projects that use “domestic content”. The IRA provides tax credits that can range from 30 to 70% depending upon the details of the project, and through “direct payment,” state, municipal, and nonprofit projects can access these investment tax credits.

a lot of problems. It's very dangerous to get overheated and dehydrated as a person with diabetes."

Another health provider told us about the concerns for people with diabetes. *"When I think about what people need power for... I think that the thing I would worry most about is heating and cooling," she said. "People with diabetes, especially if they've had diabetes for a long time, their sort of cooling system in the body doesn't work normally."*

Devices for breathing/oxygen regulation

Several participants and/or their families rely on equipment for breathing or oxygen regulation, including nebulizers (19 survey respondents), CPAP machines (17 survey respondents), oxygen concentrators/tanks (8 survey respondents), and ventilators (1 survey respondent) to deliver immediate support for their medical conditions. A CPAP user shared the length of time they use their device: "I do use my CPAP and I use it at night, so and then by the time I get on at night, then I get off in the morning... So it – it's actually going – actually going all night."

Other participants described their consistent use of their device and the consequences of being unable to use it:

"I always, like I said, keep my, my nebulizer machine has to be plugged up at all times. Because I constantly need it, you know...So I would have to hurry and plug that up. Because if the lights go out and everything, if it's the summertime, and there is no air coming into me, I'm going to have asthma attacks."

Devices for medically necessary storage

Several participants (19 of 62 survey respondents) described refrigeration as essential for their food or medication storage, most commonly for those with diabetes. A participant described their refrigeration needs: "As far as medication, insulin medication and probiotics that have to be refrigerated all the time". Another participant said, "I'm on the Fasenra, that's the medication that I'm on, it has to be refrigerated. You can leave it out for X amount of time where it's room temperature where it's okay but there's a window and anything past that window they'll tell you don't utilize that medication."

Participants also talked about food spoilage, which can affect health directly in cases when they have health conditions that require specific diets, such as diabetes. A doctor interviewed for the study shared knowledge on this issue regarding food spoilage during a power outage:

“Right, that we take for granted. Just having unspoiled food,” the doctor said. “So for diabetes, food insecurity is a huge issue both in terms of it can actually contribute to diabetes because when you have access to really poor quality food, they are typically these highly-concentrated sweets and they can spike your blood sugars. But then if you have lack of access to food or a source of sugar, it can go really low, as well, in terms of your blood sugars. So having stable access to good-quality food that can sustain is really important.”

Residents are concerned about the impact of HMD usage on their energy costs

Electricity costs can be high for residents who use HMDs due to the additional power required for these devices. This impact is particularly severe for those who require multiple HMDs. People whose utility costs are not included in rent struggle to afford bills. A mother of three young children depending on five HMDs talked about how challenging it was to keep up with the electricity bill: *“Honestly, right now I have a payment plan because I’m really behind on the bill,” she said. “My bill, honestly, I have the application, and it is more than \$1,000.00 behind.”*

Participants most often spoke about the electricity burden related to the use of air conditioners in the summer. Some affordable housing buildings are also poorly insulated, which can increase electricity costs.:

“Yeah. I mean, in the past, I’ve taken advantage of like budget billing, where you have one set amount you pay every month,” one participant explained. “Or I, sometimes, like if my bill got really high, I would participate in the matching payment program. I’ve been able to keep up with it more or less lately. But it usually runs higher in the summer because I’m running the air conditioner.”

Some find it difficult even to obtain these necessities. As one participant said, “I never got [AC] because I couldn’t afford it.”

When we asked people about experiences of power outages, some mentioned their experiences of having their electricity shut off due to non-payment. A health provider

said that most of her patients were worried about disconnection due to non-payment, *“That’s what my patients are worried about, is being shut off by the electric company, not an accidental shut off or weather-related shut off.”* she said.

While some interviewees reported having medical hardship protection (so that their electricity cannot be shut off), one resident shared that they face difficulty during the required annual renewal process when there is a risk of electricity being turned off while the paperwork is being processed. Some of the participants we spoke to were unaware they could seek protection from shut off, *“I didn’t even know about it until I owed so much money from running the machines, because my son had to be on partial oxygen...and my bill went astronomical,”* said one participant. *“And it wasn’t till I was in shut off that the electric company said to me, you have this or this.”* A mother of three young children using nebulizers, an electric heater, and refrigeration for medication had their electricity disconnected while waiting for their medical hardship protection to renew. She said, *“You know, if I can remember, I think that might have happened maybe once and they had to come back out and turn it back on.”*

B. RESIDENTS/PROPERTY MANAGEMENT UTILIZE VARIOUS STRATEGIES DURING POWER OUTAGES

Interviews and FGs with HMD users, community service organizations, affordable housing complex staff and healthcare providers shed light on the range and viability of existing strategies that people currently use during a power outage. Experiences and preparedness vary depending on location/building, HMD type, individual mobility, presence of nearby friends and family, access to backup power, and other factors.

Stocking up on supplies in response to forecasts/utility warnings

People often spoke about stocking up on food and flashlights, and keeping refrigerators closed during outages to protect food and medicine. Those who take insulin and other medications mentioned purchasing ice or coolers to prolong efficacy. Some individuals try to remain in this state of preparedness constantly, while others respond to notifications from their utility providers when strong weather is forecasted. *“Well I’m signed up with Eversource because of my equipment”,* one person said. *“So, they always call me and let me know there’s going to be a storm and I already know what to do.”*

“The light company has done this... they will call and let you know that they’re –it’s gonna be a bad weather and it might cause the lights or anything to go out,” said another participant. “So they prepare me for that, which is really excellent...I try to keep my cell phone charged when I know that bad weather is coming and they’re looking for the lights to go out.”

Others mentioned setting notifications from weather apps and fire department scanners to remain vigilant against blackouts.

Some people had not thought about what they might do in case of a weather-related power outage. One participant expressed appreciation in our conversation, highlighting that they hadn’t thought about these issues before. - “*Now that you brought that to my attention, ‘cause I had never even thought to or known to do that...have a back-up plan,*” they said. Other people did not seem to have any plan in place. An employee from a non-profit that provides support to people who are food or housing insecure shared their perspective about this.

“I would say, if I had to make an educated guess, that these people do not have a plan”, they said. “They operate in an existence of survival and planning further than the day to day is not realistic for them when you’re in survival mode. So, I would say my educated guess would be that there is no plan or preparation as individuals.”

Using alternatives to refrigeration

HMD users who rely on refrigeration to safely store their medication or specific foods expressed concern about how long they could stay in their apartment during a long-term outage. One participant recounted freezing Ziploc bags filled with water to ensure that their food would last through a power outage:

“So, they were just saying fill up some water bottles and put them in your freezer so that if the energy goes out the water bottles will still have a little freeze to them”, the participant said. “Or they said put water in some Zip-Lock bags and put them in the freezer with your food in that situation where it could be an outage.”

One individual was concerned about how long ice would keep their medication adequately cold. “*If we don’t have electricity, I’m going to have to keep it in ice and how long the ice is going to help?*” the participant asked.



Solar panels on the roof of an affordable multifamily property in Windsor Locks.

One participant who attended an interview with his blind and diabetic female relative, recounted the difficulties they faced during a three-day power outage finding places in the city to keep their insulin cold. He mentioned having to discard all the contents of their refrigerator, including both food and insulin.

“We had to find a way around, and I had to help you everywhere you walked,” he said. “Basically, I had to help her get places to walk, find places because we couldn’t see, and at the time I had to find a place to get some ice to keep her insulin cold. We lost everything like refrigerator stuff with the food, with insulin and everything.”

Spoilage of a refrigerator full of food can be a significant financial setback for a person with low-income. Repeatedly purchasing ice or freezer packs may also be costly, as a nurse from a home healthcare organization commented. “*We ensure that they have an ice pack and a cooler so that they can put their insulin in there as needed,*” the nurse explained. “*And a lot of these patients just don’t have the funding to go out and buy those things for themselves.*”

Evacuation

Although we did not explicitly ask about family members and friends during the interviews, many participants emphasized the importance of support from friends and family during power outages. Several participants mentioned that they would visit a friend or family member’s house, or local stores, to access electricity or recharge their devices. When asked about where they went to plug in their nebulizer during a

ENERGY STORAGE SOLUTIONS

Energy Storage Solutions is an incentive program co-administered by the Connecticut Green Bank with Eversource Energy and United Illuminating in Connecticut for single family homeowners and multifamily affordable housing properties for battery storage. The program provides an upfront incentive (i.e., \$250-\$600 per kilowatt-hour) and an ongoing performance-based incentive (e.g., \$225 per kilowatt for years 1 through 5

and \$130 per kilowatt for years 6 through 10) over a 10-year period. The deployment and dispatch of battery storage projects in Connecticut through the program, will increase resilience for families and decrease energy costs on all ratepayers by reducing peak electric demand. For more details, please visit the Energy Storage Solutions website - [click here](#).

power outage, one participant responded: *“Yes. Um, my mom lives around the corner from me, so I – I – I went – I eventually did go to my mom’s house until my lights and everything came back on.”* *“Sometimes it might stop on me and when I’m outside and if I don’t have that charger with me, I’m stuck,”* said a woman who uses an electric wheelchair. *“I have to either call my daughter or somebody to come get me so I can find someplace where I can go and plug it in to get charged up.”* Another participant said, *“I don’t have a plan, but I would have to call my children, somebody...I would have to call somebody to come and get me.”*

A resident who relies on a nebulizer every four hours for health shared their experience with finding outlets for treatment during a past power outage:

“Yeah, four to six hours, no lighting,” the resident said. *“Okay, I was sick last year, and Bridgeport had the biggest outage the next day. There’s nowhere for me to plug up...the gas station wouldn’t even let me plug it up. And I’m like I need it. My breathing, my breathing, my breathing. I had to go all the way to the Bridgeport Hospital, my best friend had to take me all the way to the Bridgeport Hospital to use my nebulizer...There is nowhere there’s accessible to do it. It’s nowhere. I had to go to the hospital.”*

Some people may not have relatives nearby who can offer any assistance, or their relatives may also have no power.

GREENHOUSE GAS REDUCTION FUND

(GGRF) is a \$27 billion federal climate justice incentive program included within the IRA that is modelled after the Connecticut Green Bank and implemented by the Environmental Protection Agency (“EPA”). The GGRF includes \$7 billion for a “Solar for All” program,

\$6 billion for a “Clean Communities Investment Accelerator” program, and \$14 billion for a “National Clean Investment Fund”. For details on the GGRF, please visit the EPA website - [click here](#).

“I really don’t have anywhere to go,” explained one resident. *‘Cause if somebody else’s lights is out, I can’t go to their house. I was saying ‘cause if they have the same situation as my living situation if their heat go out, why would I go to their home? ... I could probably go there, but like I said, at this present time, that – that might have the same situation because of the way the heat is – is – is linked”.*

Some study participants live in a facility with the resources to relocate vulnerable individuals to hotels during times of crisis. During a FG at one facility for the elderly and disabled, a participant described a long-term outage, during which *“half this building had to go to a hotel for three months.”* However, hotels are not necessarily set up to accommodate every medical condition and HMD that users may require. One participant had to go to a hospital instead and got a large bill from that hospital. *“We accumulated a bill ‘cause my brother’s bedridden and the hotels don’t accommodate bedridden people,”* she said. *“So, we actually got that \$200-some thousand bill I’m still paying on because they couldn’t accommodate him to give him a room in a hotel because hotels don’t have hospital beds.”*

For one mother of a son with severe asthma, neither staying with family nor being put up in a hotel was an option. During an outage, she *“needed to borrow money to stay in a motel”* because of concerns for her child’s access to nebulizer treatment and air conditioning. She explained, *“especially if they have a cold or congestion along with it, which is very, very common for asthma patients in the colder months...I would have to go somewhere else.”*

Still others simply do not know what they would do or where they would go during a power outage. Upon reflection, one couple agreed, *“[if] it gets really bad, then we’ll probably try to find a shelter or, you know...a church, somewhere that’ll let us come in and use their power.”* Some residents mentioned churches, shelters, schools, and public outlets where they may be able to plug in.

As mentioned above, 42 of 62 survey respondents indicated that they rely on elevators to be able to enter and exit their homes. Their ability to evacuate or even return to their home during a blackout can be determined by elevator function; even though we specifically asked about power outages, many of those who were dependent on elevators spoke about experiences when the elevator in their building had been broken, to illustrate what might happen during a power outage. One individual reported her husband had to spend the night in a community space *“He couldn’t get upstairs. There was no elevator. It was a blackout,”* she said.

Transporting large devices like a CPAP can be cumbersome, as one participant described. *“It interferes because, you know...got to travel with it...make sure that my meds can be refrigerated and...my machine got water in it...so the machine can run. And putting on the side of my bed...and the equipment...it’s challenging having a machine like that.”* Another individual shared a similar story. *“I have to take my oxygen... I mean the oxygen tanks. I got to fill them up. Make sure I have enough for the following day. I got to take my medication for my COPD, the machine. I got to take the insulin*

with me. Everything that got to be refrigerated...” “I don’t know what I would do to be honest with you. I know I’d be hefty to carry down the stairs,” said another individual who relies on an electric wheelchair and hospital bed. *“So I’m sure everybody hopes the power doesn’t go out. But it was gonna be like a long-term thing, I might have to...”*

Some individuals may also simply be reluctant to leave. One person who uses oxygen and a CPAP machine on a nightly basis said that he would rather stay at home, even if he wasn’t able to use his HMDs. He had been evacuated in the past, during a 3-day outage. *“If I wasn’t ordered out, I would have stayed here because it was if you put on enough clothes, you could stay warm,”* he said.

Use of backup power

Many facilities use emergency generators to power hallway outlets. For example, a large senior living community in New Haven that includes two large tower buildings has a backup generator that keeps the heat on, as well as lights in hallways and common areas, and elevators. Notably, it does not power AC and there is no AC in hallways. This facility is seeking funds for a generator to power all apartments; this should be relatively straightforward for one of their buildings, which is master-metered, but more complicated for the second building in which residents who pay their own bills.

Backup power in hallways is clearly useful. As one individual shared, *“Myself, I use an electric scooter because of my injury...And when the power goes out, we rely on that little red box in the hallway. We have generators, but sometimes it takes generators time to kick on.”* However, while hallway outlets are helpful, participants expressed some concerns about them. For example, one participant expressed confusion about where backup power was being supplied. *“...Sometimes the lights come back on, the sockets don’t work.”* they said. Using the plugs can be physically challenging as well. One resident noted, *“Well, my brother uses it ‘cause of the oxygen that he’s on and he’s bedridden. So, I have to try to push everything towards the door in order to run that cord out.”* At the senior housing facility mentioned above, staff indicated being concerned about the tripping hazard associated with having extension cords running from apartments out to the hallway outlets.

During an interview with staff from a housing authority facility, they mentioned that they have an onsite generator available for emergency power, but it does not power the entire building or individual units. *“If the power goes out, we’ll get dispatch in and we do have a generator on site, so that would, uh, generate power for our commu-*

nity building in the hall, laundry room.” This building had in the past had Eversource install a temporary generator to power the entire building when it lost power due to a damaged wire, “There was actually an instance last month where an underground wire came, broke loose and they had no power. So Eversource brought a temporary generator just for that building for, you know, 10 or 12 hours that they had to work on the units,” one staff person explained.

One individual who uses a CPAP machine said how much better things were since their building installed a generator. He said, *“If the – the power should go out, it will blink out for a little while and come back on ‘cause they gave me a generator. But when we didn’t have a generator here, that was bad. No heat, no refrigerator, and no, um, stove to cook on. That’s pretty bad.”*

Some people who live in buildings that do not have backup power told us that if they have access to a car they use that for emergency power during an outage. If they expect that a power outage is coming, they fill their car with gas to be ready to provide backup power. Others mentioned that they would use their cars for air conditioning and to charge essential devices such as phones and glucose monitors.

“I happened to be in the car when the attack happened,” said a participant, who is asthmatic. “It’s like choking on a cracker crumb. And then it spreads down into the sternum. Becomes a wheeze. Then it becomes a migraine. So it was just as easy to turn on the AC and get a Pepsi or hot cup of tea and just sit there and wind down.”

Those who do not have access to generators said that they wished they did. *“I’ve been thinking about buying myself a small generator so at least I could put it on the porch if something happens”,* said a participant with sleep apnea who lives in a smaller building without administration. *“I’m not gonna put everything there... Only the basic things that I really need... Uh, just the phone and-and-and my CPAP machine and my inhaler. Those things I really need every day.”*

Advanced planning by facility administration and communication with residents

Some facilities have plans in place to assist residents in case of power outage. A large senior living community in New Haven has a particularly well-developed plan in place. As staff who participated in a FG at that facility put it, the plan is designed to address *“everything they think can go wrong”* in a 72 period after the onset of an emergency. In case of a power outage, they explained, the staff immediately meet to coordinate communication and efforts. They maintain a master list indicating which residents

use HMDs; in case of an outage, they have a stock of extension cords that they take to the apartments and connect with the hallway outlets, that remain powered by a generator. A large elderly and disabled facility in New Haven has a similar plan. *“Our big thing is to keep a list of who utilizes what so that in an emergency situation we can make sure that that person is getting what they need immediately,”* explained one staff person. At a smaller housing facility, RSCs and maintenance staff work together to assess residents’ needs. They explained, *“So typically, they’ll have like an oxygen-in-use sticker on the door that – that’ll give us, you know, kind of an alert ... so if there is an issue with that building, you know, we kind of go door to door, let everybody know the issue, and then we know from there if they have oxygen.”*

At the above mentioned large senior living community in New Haven, they also have a plan to move residents to the dining room, if needed. This room is equipped with backup generators, allowing the staff to keep residents cool and fed.

“Plans would be made to either evacuate or to figure out how to move residents downstairs,” explained the staff person. *“We can cool the downstairs. So oftentimes what we would do is we would use our dining room, it’s huge. And the kitchen is backed up by generators. So during those 72 hours, we can pump out meals, we can deliver meals... People can come downstairs. So, for 72 hours, I think we’re fairly self-sufficient. I feel very confident that we could take care of our folks. And in those 72 hours, I think that’s also enough time for our leadership team to partner with our care team to say, “All right, who’s the highest priority? Who do we need to get out of here first?””*

Additionally, the staff of this facility maintains records of each resident’s needs including contact information, a list of family members, and power of attorney arrangements. This approach ensures that each resident is properly cared for and facilitates quick responses to individual requirements during times of crisis.

“We are proactive in doing stuff like that” explained another staff member. *“So, you know, when we know what’s coming, it’s good to be prepared, better safe than sorry in that regard.”*

The elderly and disabled facility in New Haven also asks residents to inform them of who they should call in an emergency, including a power outage. While this is an important thing to do, it is worth noting that it may cause anxiety for some. As one resident told us, *“I have a feeling that they don’t have [backup power] here because they sent us a paper that said, “In case of an emergency, do you have a person that you could go to?””*

Not all residents of buildings with emergency plans are aware of them. We interviewed several residents who were not aware of any emergency planning or backup power options. One individual expressed confusion. “If we have a generator - in the community room, we’re supposed to have one there. It’s there. I don’t know why they don’t use it,” they said. At another facility, one participant wondered the same about solar panels on site. Our FGs at the above-mentioned senior living community with residents and staff highlighted the importance of good communication, particularly in emergencies. This facility has a robust communications system, including daily phone call check-ins, robocalls, regular emails, newsletters, bulletin boards, and information on their website. A resident described these efforts as “total communication.” Another resident said, “And [staff] also call and check up on us, and make sure we’re all right every morning.” Additionally, if residents have questions regarding emergencies, they can call the front desk, where a staff member is present 24 hours a day, seven days a week, to answer questions or concerns. One resident described, “I would call the office downstairs. I’ve had a couple of emergencies, and the people come right away.” Despite efforts to improve communication, a focus group with Spanish speakers suggested that the line of communication with Spanish speakers has potential for improvement. Spanish-speaking residents desire more information regarding preparation; their lack of information led them to believe there was a “Lack of preparation in the building.”

Alongside disseminating information through various methods, this facility actively fosters community engagement through residents’ town halls and monthly meetings. The former provides an open platform for residents to voice their concerns and discuss proposed changes among themselves. The latter facilitates a dialogue between staff and residents. This facility’s proactive approach to community building through activities and social gatherings seems to have significantly enhanced social cohesion.” This feature was not as pronounced among neighbors in other buildings.

C. RESIDENTS EXPERIENCE SIGNIFICANT EMOTIONAL CHALLENGES RELATED TO POWER OUTAGES

Anxiety, fear, and coping strategies

Many participants described the emotional impact related to power outages. It is important to note that while we did not explicitly ask about emotional impact and mental health in the interviews and focus groups, it still emerged as a significant

theme; most participants reported feeling anxious about the topic, as did staff. One RSC, when speaking about a resident, stated:

“...we have the one woman who, because the power went off, she went into distress...she has an anxiety disorder, so she panicked and worked herself into a frenzy. So it was, like, calling the fire department to come, uh, have her removed and taken to the emergency room so that she can calm down, because she felt like she couldn't stay in her apartment without the electricity on. But it was – it's more of, like, an anxiety mixed with the oxygen dependency type thing, which I understand.”

The same RSC shared an understanding for the toll that evacuation takes. *“It's actually a simple process, but when you're the person that's being displaced, I know it feels like a lot because a lot is happening in a short time,”* she said. An at-home nurse aide who has experienced caring for patients during a power outage summarized the impact that outages have on patients: *“...it's like their whole world is turned upside down just for that little moment of change,”* the nurse said. One resident who said she typically avoids socializing with others expressed her anxiety about having to spend time in a congregate setting in case of evacuation.

“Well, I-I'll be honest with you, I'm not, um – let me put it to you. I'm a person that doesn't socialize with anybody,” she said. *“I'm not a friendly person... I'm not a pet lover... And in those places sometimes people bring pets or you've got people – I have my little mental issues too. I've got my little mental issues too. I've got my little problems. I won't be nice to you. I take medication for that too”*

When asked about the possibility of power going out due to falling trees from storms, one participant stated, *“I get anxiety. I get anxious.”* This same participant expressed more generally anxiety about the impact of extreme weather and its consequences on both electricity access and housing security. She said that she often gets anxious about the impact of excess precipitation, wind, and hurricanes on trees that are hanging over people's houses:

“This kind of made me think about it – all the storms that we're having lately, the rain, the ground being saturated there is trees all over the place, and it doesn't matter that the electric company comes by and trims this way. The tree is still there. And I just mentioned to housing we got trees that are hanging over the roof. If it falls someone is in trouble, you know what I mean? And it's just causing a bunch of problems. So that's a concern, the wind, hurricanes, all that stuff that we have could be an issue.”

One participant talked about her fear of fire due to an outage. *“My son...He lit candles. I go, no because I’m scared of fire”* she said. *“I was screaming, you know how people with anxiety scream. I was acting all out. And so, we got some flashlights, thank God for flashlights.”*

Participants also shared general feelings of anxiety over the thought of having to make challenging decisions when it comes to their children’s safety. One participant expressed concern about the possibility of facing a dilemma during a power outage, fearing the need to choose between caring for her daughter or sharing electricity with someone in greater need. The participant recounted a situation where she endured a hurricane-related power outage in Puerto Rico. She said that the government was distributing generators to community members in need, which she ultimately let her neighbors have. She reflected on making the difficult decision of keeping the generator for her daughter or giving it to a neighbor.

“The generators. They were givin’ it to people who need it but, you know people used to do in the community, they were giving to those people who got, uh, you know, seniors and, you know, people who really, really need it because the machines and stuff like that,” she said. “And I remember there was, like, they give me this but I give it to my neighbor because she really need it, so that’s, like, number one thing, and – and it melts my heart ‘cause I was like, oh my God, if I would be in a situation and I [need it] and my neighbor need it, um, and my daughter need it, I would definitely give it to my neighbor, but I make sure that when my daughter ever need treatment, I will go to [my] house and plug it in, you know, and give her the treatment, but because she need it the most, I would give it to [her]. Um, yeah, and that situation’s really very hard because you know you need it, but at [the] same time, somebody need it more than you.”

Her comments also point to the coping strategies that people use to manage the stress of a power outage. Many participants talked about reliance on family and friends. For some residents, the sense of community outweighed having knowledge of accessibility or an emergency power outage plan was more important. When asked what residents would do to prepare for an outage, in addition to gathering materials, one resident added, *“Check on your neighbor”*. A participant noted that she specifically selected her apartment because she had friends who reside in the same complex:

“I just, when I did move here, I had a couple of friends who lived in, you know, the same complex, that the same building but the same complex. And it’s just convenience-wise, it was good. You know, so that was more, played a bigger factor for me, then the, you know, as far as electricity, or usage, or anything like that.”

Participants who have friends and family to rely on expressed less anxiety about short-term power outages. As one participant explained, *“I do have a niece that lives in Manchester, Connecticut, which isn’t that far. And my younger daughter is here with me, she’s an adult, she’s 32 and everything. So, everybody’s on point. I have two wonderful neighbors that would check on me in that instance.”*

One individual noted how they turn to their faith in moments of discomfort. *“I began to get that flashlight, and read that Bible, and call on Him, and He comforted me, and the strength – and He gave me the strength that I need to go – to go on,”* they said.

Concern about safety during power outages

Some residents expressed concern about safety from crime during a power outage. One participant expressed anxiety about the possibility of looting and violent crime occurring during a power outage, which amplifies her fear for her and her daughter’s safety, *“cause I don’t know if anybody gonna go purging or what, you know. They feel like, ‘The lights are out. Let’s go purging. Let’s go get somebody out,’ and, you know. That’s a bad joke.”* Another resident also expressed anxiety about the lack of warning about power outages and concern about safety, saying, *“It gave me a lot of anxiety ‘cause I didn’t know when the power was gonna go out in – on the – on the block...you have people around that are glad the lights go out, so they can come and probably hurt you...that anxiety is there, you know, paranoia.”*

Stress related to socioeconomic barriers

While our questions focused on HMDs and weather-related power outages, the conversation sometimes turned to power disconnection due to non-payment, as people spoke about their experiences of coping without electricity. Many participants expressed worry and stress regarding the affordability of energy bills and maintaining access to electricity, especially for those reliant on HMDs as consistent usage of these devices significantly increases energy bills.

“It’s very much higher. It’s a surge, you know. Everything – when you plug something in, it’s a jump in your lights. You know?” said one participant. “So when you turn that [nebulizer] machine, when you plug the machine, and plus when you turn it on, it’s a surge because it’s a high, it’s a high vacuum, you know? Yes. So I’m on it for a half hour, 45 minutes. So that is a ... surge from there. I don’t... I need it. What am I supposed to do? You know, it’s gonna raise your [electric] bill.”

When asked about her experience with disconnection from electricity, one FG participant said, *“Well, I kind of panicked.”* At the time, this participant had a roommate who was on oxygen. She describes a situation where the utility company was going to disconnect her electricity: *“And they were going to come and cut the lights out. I said, you can’t cut the lights out... Well I told them that you know, they can’t cut it off because she’s – she could have died,”* she said.

Financial constraints are also a barrier to participants’ ability to adequately prepare for power outages. A visiting nurse provides an example about how some of her patients are unable to stock up on food, batteries, and other essentials to maintain comfort in their homes during an outage:

“For a lot of my patients who are fairly comfortable, then they are very well prepared,” she said “It comes down basically to finances. For us, we go out and we’ll go and do four or five days’ worth of shopping. We’ll get our bread in and our milk in and whatever we need so that we can make things in the home and we have access to that. But if you don’t have \$200.00 to go and drop to go do that, then that becomes an issue.”

The nurse emphasized another significant source of stress—many of her patients are living on tight budgets and lack the knowledge to manage their finances effectively. This often results in rapid depletion of their money, leaving them unable to pay for their energy bills or prepare for outages:

“Oh, I think it’s a huge issue for them, yeah. It’s definitely something that’s that, and the cost of their food, and living within a budget is very difficult. And a lot of people are very good with that and able to do that, but there’s I’d say a good 50 percent that don’t know how to budget, and so by mid-month, they’ve run out of money, and so it’s a problem. Luckily, they can’t get shut off in the winter for heat, so that’s a good thing.”

D. ADDITIONAL OBSERVATIONS - HOMELESSNESS AND INCARCERATION

Two participants raised issues related to experiences of people who are homeless or incarcerated, that we considered important to share. One participant highlighted the difficulties of navigating homelessness and shelter life during a power outage. *“Well, we didn’t leave because when we experienced this power outage, we were homeless and it was COVID, so the shelters put a lot of people up in hotels, and the power outage – we were stuck there, so we didn’t have nowhere to go to,”* they said. They expressed feeling stranded, with open shelters and hotels being overcrowded and even more prone to power outages due to the high volume of occupants relying on electricity, *“That was in the transition when I was in the shelter because it was due to a storm that the power got knocked out, and because everybody was using their electricity, it blew out the power for like three or four days.”*

Another participant who relies on a CPAP machine nightly, told us about her experience of incarceration. She said that throughout her incarceration, the facility failed to

RESIDENTIAL RENEWABLE ENERGY SOLUTIONS

(RRES) is an incentive program administered by Ever-source Energy and United Illuminating in Connecticut for single family homeowners and multifamily affordable housing properties for renewable energy (e.g., solar PV). RRES provides a tariff (i.e., credit) of \$0.3739 per kilowatt-hour of renewable energy production from an

eligible project over a 20-year period. The deployment of renewable energy projects in Connecticut through RRES, will reduce energy costs on families. For more details on RRES, please visit the Public Utilities Regulatory Authority - [click here](#).

provide her with the services she needed, leaving her unable to sleep due to breathing difficulties. Despite being transferred to a medical facility, the staff still failed to provide her with a CPAP machine, aggravating her sense of vulnerability:

“That was – and that’s something regardless of what your situation is, regardless of where, even if you’re in a mental institution or something, especially people in our position, should have those opportunities,” she said.

“And as far as I’m concerned that was negligent on their part. Not providing me the services I need...That was my most absolute – you can tell I’m getting a little angry – that was my most absolute inconvenience, unsafe concern emotionally, physically, and every which way. So, it’s not necessarily elderly housing, It’s a system wide problem everywhere.”

SOLAR MAP

a financing program of the Connecticut Green Bank, the Solar Marketplace Assistance Program (“Solar Map”) provides technical assistance and financial assistance to state, municipal, and multifamily affordable properties for the deployment of solar + storage. Solar MAP helps property owners understand the potential for reducing energy costs and increasing resilience through

the investment in and deployment of solar PV and battery storage. The Connecticut Green Bank provides no money down financing to assist property owners in realizing the benefits of clean energy. For more information on Solar MAP, please visit the website - [click here](#).

E. POTENTIAL SOLUTIONS (RESIDENTS’ PERSPECTIVES)

Common spaces

Overall, participants were receptive to the idea when asked about a communal space; one resident said, “It just would make sense to me”. They continued, “if they had that

PROJECT SUNBRIDGE

is a Connecticut Department of Energy and Environmental Protection (“DEEP”) led “Solar for All” project of the GGRF, including the Connecticut Department of Housing (“DOH”), Connecticut Department of Economic and Community Development (“DECD”), Connecticut Housing Finance Authority (“CHFA”), and the Connecticut Green Bank. Project SunBridge will reach low-income and disadvantaged community households across the state of Connecticut, with a priority focus

on affordable housing units, to allow for greater access to residential solar, increased resilience and grid benefits, and investments in quality jobs and businesses. Connecticut residents will benefit from financial assistance with increased incentives, more accessible loans, and low-cost capital for solar and storage, as well as technical assistance for clean energy workforce development and community engagement.

one spot that those people in that general area could get to for lifesaving measures, like if they had to bring their oxygen, they could have an oxygen cannula taken there or to even charge their phones if you got a generator going on or plug in a nebulizer. You know what I'm saying? And these are things that there's the difference of them having quality life as well and to keep them from having to go to hospital." Others offered ideas to ensure a communal space met their needs. One participant shared, "You want it spacious, and you want air to move around, and you want to make sure that [residents are] comfortable." Residents understand the value of having communal space and how these resources can help support other support systems, such as local hospitals.

Interviewees were asked about their willingness to use a common space that had power in the event of a power outage with responses eliciting mixed opinions. Most participants were open to using common spaces, if necessary. One tenant summed up what many said about access to a common space..

"I do wish that in my complex that they had one place, they had a generator that would accommodate the tenants down here, because everybody can't be mobile and get to the point where they say call 211 or United Way and all of that," they said. "So if they had the main building where the offices are, if in this complex in particular or even for the other properties that they have and have some kind of system where they know who is reliant on certain stuff, that they could get those people to that one building that had that generator where they would be able to be on lifesaving things."

When asked about which features of a common room would be important in satisfying their medical or personal needs, the most commonly mentioned features included outlets, a refrigerator, accessibility (e.g., access to the space, disability accommodations), television, thermal regulation (i.e. air conditioning, heating, and fans), a generator, food and water, and access to technology (e.g., Internet, Wi-Fi, telephone or cellphone). Other noteworthy features included sufficient space capacity for health and privacy reasons, awareness of the situation at hand, and disability-specific accommodations (e.g., reclining chairs, tables for eating).

While most agreed that a common space with power would be helpful, people said that it would only work in the short term. Some tenants expressed concerns about using a common space, including personal privacy concerns, the general discomfort that arises from sharing a space with individuals and potentially strangers, and the fear of illnesses spreading due to physical proximity with others. One participant said, "*No. I mean, it depends on the duration of expectancy to be in that room with –*

for a period of time. I-I hope, you know, it wouldn't be for a long period of time that we'd be uncomfortable with one another." Another expressed aversion to socializing with neighbors when asked about using a shared space. *"I'm not comfortable around a lot – you know, there's people live above me, I'm still not comfortable, you know, with them,"* they said. *"So I would be a little bit uncomfortable like that."* Some participants said that they would rather travel elsewhere than use a common space. During a FG one participant asked the other, *"If this generator worked, won't you come up here? Say if it's going to be out for an hour, you wouldn't come sit in here for an hour? You'd run to your sister's that fast?"* The interviewee responded: *"Yeah, I sure would."* They were then asked, *"Is it due to comfort, because you'll be comfortable there?"* The interviewee responded: *"Yeah."* One resident specifically mentions that nothing that would make her feel more at ease in a communal space, even during a power outage. She said, *"If I try sleeping anywhere else besides my own home, I can't sleep."*

Some participants feared leaving medications in a shared refrigerator and other personal belongings in a shared space. One tenant expressed the following when discussing their approval of a shared refrigerator.

"So, people, and again you're not bringing your food here to save your food. That's, you know, it is what it is, but certainly people could put their medication in here and have it labeled or such, you know, or staff monitors it may be or something so that people aren't messing with it. This is a community room. That's exactly what it is, and it's just to me it's common sense to have a situation where people can get that."

A caretaker of an HMD user, who relies on the refrigeration of medication, suggested providing a "safe room," where people could store oxygen, medications, and other medical essentials without having to resort to going to the hospital during an emergency.

Solar and battery storage

We also asked participants for their thoughts about solar and battery storage as a solution to keeping the power on during an outage, but most people we spoke with had limited experience or knowledge about this topic. While those who had heard of the technologies were supportive of the idea, the main concerns they raised related to cost – people were concerned that the expense incurred by the property owner would be passed onto the tenants. During one FG a participant said, *"Well, I mean I think the solar panel would be good for being something extra. They could still keep*

the electricity but that'd be something extra and there's no harm. It's good to have," said one resident. Later in the conversation, he said, *"make sure it's free."*

Some residents said about solar or batter storage that their opinion was not relevant as they did not have decision making power, as tenants, over whether the technology would be installed. One participant said, *"I don't have solar panels. I don't have the option of putting [solar panels] in because I rent, I don't own,"* they said.

Building staff shared a similar openness to solar technology but were concerned about the cost. A building staff member said when discussing solar, *"So I wouldn't expect anybody to voluntarily do this unless there was some financial support from HUD or whoever else."* At the senior living community mentioned above, staff told us that while they had thought about installing solar, the layout of their campus is not ideal; they have limited roof space, and it is extremely windy.

Some tenants expressed a desire to own their own portable batteries, generators, and other sources of backup power. We had a health fair last week," said one person. *"It would've been nice if they had somebody, like a company that came in and said, 'Okay, if the electricity went off, we could supply generators through Medicare or your insurance company.'"*

RECOMMENDATIONS

This study aimed to understand the needs of HMD users' reliance on electricity to inform future building codes and planning. We created our interview and FG guides based on existing literature on the topic and conversations with experts in energy and housing insecurity and disability access. We identified eight recommendations that are listed and expanded upon below.

- 1 Expand the definition of HMDs to include devices related to monitoring health conditions and communicating with care providers, mobility, and devices that maintain air flow and quality.
 - 2 Ensure that residents are signed up for utility alerts in case of impending bad weather.
 - 3 Utilize expertise of home health aides and nurses, who understand both medical issues that arise during power outages and socioeconomic and other barriers faced by HMD when seeking help.
 - 4 Consider the financial burden on emergency services and healthcare facilities related to supporting HMD users during power outages when conducting cost-benefit analyses of installing backup power.
 - 5 Ensure that procedures for assisting HMD users during power outages consider and accommodate the high anxiety and stress that they experience at those times.
 - 6 Require housing providers to have emergency plans that meet the specific needs of each resident and must improve communications with residents about emergency plans.
 - 7 Require housing providers to establish accessible and safe common spaces that can be easily used by HMD users as short-term solutions during power outages.
 - 8 Facilitate learning between different housing providers.
 - 9 Access state and federal incentives and financing
 - 10 Public-private partnerships for investment
-

1 Expand the definition of HMDs to include devices related to monitoring health conditions and communicating with care providers, mobility, and devices that maintain air flow and quality.

Our initial list of Home Medical Devices (HMDs) was incomplete. We heard from participants that elevators, cell phones, cell phone-based health applications, the internet, medical alert devices, hearing aids and lactation pumps are all essential for managing their health and mobility. Our understanding of what constituted an HMD expanded to include devices that enable monitoring of health conditions and that enable communication with care providers, and mobility. Elevator failures are an enormous barrier for individuals with mobility issues and who live in high rise buildings. For individuals with respiratory illnesses, such as asthma and chronic obstructive pulmonary disease (COPD), we learned that fans, air purifiers, humidifiers, and dehumidifiers are necessary for everyday life in conjunction with heating and cooling.

2 Use utility weather alerts

While it is paramount that housing facilities have emergency plans in place, many individual residents may also benefit from being notified by the utility company's alert system so that they can take steps to prepare themselves.

3 Recognize expertise of home health aides and nurses

We learned that home health aides and nurses have extensive knowledge and experience in helping HMD users to navigate power outages. They not only understand medical issues that may arise during an outage, but also the socioeconomic and other barriers that our study population may commonly face when seeking solutions. Ongoing preparations for building code developments should include home health aides and nurses in advisory boards and other planning endeavors.

4 Consider potential cost savings to emergency services and hospitals

When HMD users must evacuate during even short power outages due to lack of backup power, it puts an enormous burden on the emergency services and healthcare facilities that have to care for them. More resilient buildings would cut down on their expenses.

5 Recognize and address anxiety and stress

HMD users' frequently expressed anxiety and fear when discussing preparing for power outages. This topic arose persistently even though we did not directly

address it in an interview question. All solutions, including those involving shared space and access to emergency power, should incorporate expectations for panic and emotional distress in addition to physical health challenges.

6 Require housing providers to have well-communicated emergency plans

Some of the facilities that we visited have comprehensive emergency plans that include details about each residents' specific needs, and that are well communicated to residents, such that they are confident that they will be taken care of in case of a power outage. This should be required in all buildings. Housing providers must be held to a high standard when it comes to communicating emergency plans to building residents; both in listening to their concerns and ideas, and in sharing emergency preparedness plans. We found a wide disparity in understanding and preparedness among residents within facilities, and between different facilities. Also, while many study participants said they would be able to rely on friends and family for transportation and access to power, this was not true for all, and cannot be relied on as a strategy in case of power outages. Housing providers cannot assume that a resident will receive external help and must have strong lines of communication and preparedness tailored to each resident's needs. Our interviews also pointed to examples of success when such steps are taken.

7 Require housing providers to provide a common space for short power outages, while recognizing limitations

Our study highlights the value of a common space powered by solar or another form of backup energy within affordable housing complexes. Many study participants shared that they would use this resource, especially in the context of short-term usage. Interviews yielded insight into individual concerns regarding privacy, safety, and accessibility of power as well as new questions about how long an individual would remain in that situation. At the same time, others shared experiences in which they had successfully weathered past power outages using generator-powered common spaces during past outages. A minority of participants indicated that they would likely not use a common space, so alternative arrangements need to be made for such individuals.

8 Facilitate learning between different housing providers

We noted significant differences between experiences of residents in different buildings, with some buildings having detailed preparedness plans and communications systems, and others much more limited arrangements. While the type of facility, management arrangements and of course access to funding shapes what

is possible, it would be helpful for property managers to learn from each other's plans and systems. Given the reluctance of some property managers to speak with us, this learning may have to be required, or highly encouraged, by regulators. We have most detail from the Towers in New Haven, given the willingness of management of that facility to speak with us. Key lessons learned from that facility that stood out include; i) having a team of RSCs to be able to build relationships with residents and be available to manage emergency situations (the Towers has more RSCs than "probably any HUD building in the country and we're still pushing for more"); ii) investing in effective communications systems that not only allow management to push information out through multiple channels, but also empower residents to communicate with each other and with management; iii) investing in energy saving equipment (they have a co-generation boiler) to free up funds to invest in resilience; iv) proactively engaging with experts to explore new possibilities, and funding sources to enable innovative investments. Again, the Towers has access to funding that allow them to do what other facilities may not be able to do, illustrating that public funds must be made available to allow those facilities to take the necessary steps to build resilience.

9 Access state and federal incentives and financing

As noted in the report, there are extensive state and federal incentives for climate smart technologies, including, but not limited to, Residential Renewable Energy Solutions, Energy Storage Solutions, investment tax credits and Greenhouse Gas Reduction Funds through the Inflation Reduction Act. Many of these programs provide additional incentives for properties located in vulnerable or burdened communities. Beyond incentives, there is technical assistance and financial assistance available through organizations such as the Connecticut Green Bank. Together, incentives and financing, can reduce energy costs for tenants and property owners, while increasing the resilience of tenants during a power outage, especially those with home medical device needs.

10 Public-private partnerships for investment

The healthcare and insurance industries working alongside the public and philanthropic sectors have the potential to unlock more investment in climate smart technologies at affordable housing properties to increase resilience for those living with home medical devices. Our study indicates that more investment in such technologies in affordable housing properties, will enable people living with home medical devices to be more resilient to the impacts of climate change, including during a grid outage.

STUDY LIMITATIONS

Two separate research groups, Yale MPH students and Operation Fuel, conducted interviews in collaboration but working separately, which may have resulted in some incongruence in the procedure and delivery of interview questions. Summaries and notes were inconsistently written following the completion of each focus group or interview. Additionally, post-interview or post-focus group quantitative surveys were only given to and completed by some participants, with a total of 67 surveys completed or partially completed out of more than 78 total participants. Because of this, the quantitative analysis does not reflect the whole cohort of participants in the qualitative analysis portion of the study. Some takeaways and responses from focus groups were more difficult to reflect in transcripts than from interviews. Nonverbal forms of agreement or disagreement brief moments of talking over one another are not easily represented on a transcript.

Additionally, within the interview scripts, the “potential solutions” section may have been leading. Residents were asked if they would use a common space, a predefined potential solution. This was then taken a step further by asking if people thought specific items listed would be helpful in that space (e.g., shared refrigerator, outlets, etc.). These types of questions made analysis difficult with yes/no responses and limited descriptive quotes in response to certain potential solutions. While these questions elicited some useful information, it would have been more helpful to use more open-ended questions in the FG and interviews and limit the specific questions to the survey.

Finally, the unwillingness of many property managers to participate in our study leaves out an important voice in implementing a climate smart solution for HMD users in affordable housing. Future endeavors should consider potential resistance from this groups.

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APPENDIX

POST-INTERVIEW QUESTIONNAIRE RESPONSES

There are 67 interviewee responses included in the following analysis. Given that there were more than 67 individuals interviewed, this survey does not represent everyone included in the study. The survey responses are divided below into three parts: 1) General Description of Participants, 2) Dependence on Electricity, and 3) Strategies & Potential Solutions.

Age distribution

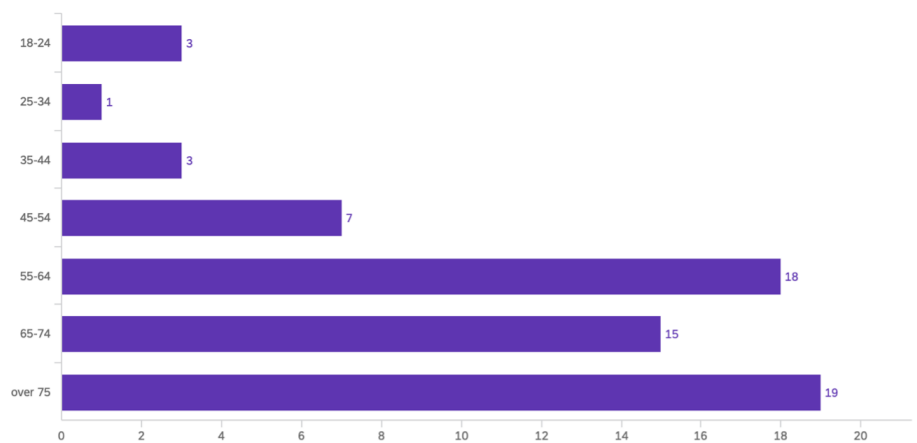


FIGURE 2: Reported age ranges of survey respondents. Age ranges of study participants who completed the quantitative survey following the interview or focus group, shown by frequency.

General Description of Participants

- 73% are women, most were over 55 years of age
- 40% identify as Black and 29% identified as White
- 22% identify as Hispanic or Latine
- 90% speak English and 10% Spanish as a primary language,
- 76% report being either retired (45%) or unable to work (31%)
- 75% have an income of less than \$25,000 pa.
- 85% of participants report having a disability

Building types

- 62% live in a building that is six or more stories high.
- 57% use an elevator to exit their home; only 16% said they live on the ground floor.
- 73% have access to hallway outlets (we did not ask whether those outlets have power in case of an outage)

Dependence on HMDs

- 66% rely on more than one HMD
- The most common HMDs are nebulizers, CPAP machines, and refrigerators

Electricity use/experience of outages

- 57% pay their own utilities. Of this group, 65% receive energy assistance, and 62% have medical hardship protection.
- 24% experience power outages multiple times a year; 16% experience power outages every year or so
- Of those who have experienced an outage, 36% said the outage lasted hours or less than a day; 14% said they lasted multiple days

Strategies & Potential Solutions

Only 28% reported that they have access to backup power, the vast majority from a generator.

- When asked about what they would need access to, to shelter in place during an outage, the five most important things indicated were, ranked in order of importance: (1) an outlet for charging, (2) refrigeration, (3) heating and cooling, (4) cell phone and (5) private space