COMMUNITIES LEAP
U.S. DEPARTMENT OF ENERGY

Sabathani Community Center Solar + Battery Resilience Hub

To meet south Minneapolis, Minnesota's clean energy goals, the community is exploring opportunities to transition Sabathani Community Center into a resilience hub to provide critical community services during power outages, including shelter and warmth or cooling, continued food distribution services, and more. Resilience hubs can support the **Minneapolis Climate Equity Plan** by reducing carbon emissions and increasing community resilience to extreme weather conditions.

The National Renewable Energy Laboratory (NREL), through the U.S. Department of Energy's Communities LEAP (Local Energy Action Program) pilot, worked with Sabathani as well as Renewable Energy Partners, a Minnesota-based Black-owned and operated solar developer, to quantify the costs and benefits of installing stand-alone solar photovoltaics (PV) and PV paired with battery systems to reduce energy costs, avoid emissions, and improve resilience.

Sabathani is a Black-led organization that welcomes 150,000 individuals annually, predominantly lower-income people of color. Learn more: https://sabathani.org/.

Solar PV and Battery Analysis Approach

NREL used REopt®, a techno-economic decision support platform, to assess the economic, emissions, and resilience impacts of potential on-site solar PV and battery storage investments at Sabathani. This tool identifies the optimal mix of renewable energy, energy storage, and grid electricity to meet cost savings, resilience, emissions reductions, and energy performance goals. Learn more about the REopt web tool at https://reopt.nrel.gov/tool.

PV and PV + Battery REopt Results

The NREL team modeled different solar plus battery options using REopt for Sabathani to better understand the range of possible benefits. The following results consider four investment options: (1) solar PV on Sabathani's currently available roof area, with no battery, (2) pairing the rooftop solar with a battery to provide 48 hours of resilience, (3) the cost-optimal size of solar PV and battery capacity to provide resilience, and (4) the smallest solar and battery system that can provide resilience without net financial cost. The three battery system designs highlighted below can provide 2-days of resilience for Sabathani. Note that the results and benefits from this analysis are preliminary and may change based on project needs, system design, and engineering analysis.

Figure 1. Analysis of PV and PV + Battery Infrastructure Options for the Sabathani Community Center

		Scenarios Providing Two Days of Resilience			
	Investment Strategies	**Rooftop Solar PV** 180 kW PV, no battery	**Rooftop Solar PV + Battery*** 180 kW PV, 591-kW battery	**Cost-Optimal** Solar PV + Battery** 690 kW PV, 305-kW battery	**Break-Even Solar PV + Battery** 530 kW PV, 362-kW battery
$	**Net Present Value (NPV)**	**$309k**	**-$1,235k**	**$505k**	**$0**
	Solar PV Capital + Operations and Maintenance *Costs*	-$267k	-$267k	-$1,021k	-$785k
	Battery Capital *Cost*	$0	-$1,870k	-$965k	-$1,144k
	Utility Bill *Savings*	$576k	$902k	$2,491k	$1,929k
	% of Demand Met with Renewable Energy	**26%**	**25%**	**96%**	**73%**
CO_2	**Avoided Carbon Dioxide Emissions*** **	**521 tons**	**442 tons**	**2,196 tons**	**1,700 tons**
	Avoided Health Damage Cost** **	**$193k**	**$181k**	**$728k**	**$558k**

* All modeled batteries have an 8-hour duration. Battery operations and maintenance costs are not included.
** Cost-optimal refers to the system size that could provide the most savings for Sabathani, compared to their current energy costs, while still meeting the 2-day resilience goal.
*** Estimated avoided carbon dioxide emissions from grid-purchased electricity over 25 years in metric tons.
**** Estimated value of avoided premature deaths due to sulfur dioxide, nitrogen oxide, and particulate matter emissions from fossil fuel generation on the grid over 25 years.

Anticipated Financial Benefits

By maximizing the current suitable roof area, the community could experience 25-year net savings of $309k (13% savings) compared to expected energy costs without solar (Figure 1). Net savings are the difference between the cost of the system and the reduced utility costs over the lifetime of the system. To provide 48 hours of resilience, Sabathani would need to pair this solar system with a large battery, which would come at a net financial cost of $1.2M. However, if Sabathani were able to expand beyond the current roof area (e.g., through solar PV parking canopies), a 690 kW-DC system paired with a smaller battery system could both provide resilience and net financial savings of $505k. A 530-kW PV system paired with a 362-kW battery is the smallest system size that would meet Sabathani's resilience goal without a net financial cost (Figure 1).

Anticipated Environmental Benefits

Investment in a solar PV and battery system could reduce carbon dioxide emission from Sabathani's electricity consumption between 442 and 2,196 metric tons over 25 years, depending primarily on the size of PV system installed. This is equivalent to taking 98 to 489 gas-powered cars off the road for 1-year. By using less grid electricity, a solar PV and battery system at Sabathani could also avoid up to $728k in health damages across the South Minneapolis area from sulfur dioxide, nitrogen oxide, and particulate matter over 25 years.

Anticipated Resilience Benefits

A 180-kW rooftop solar PV system coupled with an 8-hour, 591-kW battery system has an estimated 97% chance of meeting Sabathani's critical load (50% of the typical load) during a 2-day power outage and an estimated 64% chance of meeting its critical load during a 5-day outage.

Photo courtesy of Sabathani Community Center

Key Modeling Assumptions Used in the NREL Analysis:

- Results do not include costs for battery operations and maintenance, interconnection, potential grid upgrades, or additional islanding equipment. Note that costs can vary between projects and may be considerable based on project needs.
- This analysis assumes capital costs of $1,850/kW-DC for solar PV and $403/kW plus $350/kWh for battery systems, as estimated by Renewable Energy Partners. Note that if solar parking canopies are pursued, capital costs are likely to be higher than those estimated in this analysis.
- A 40% Investment Tax Credit has been included in the capital cost for both battery and solar PV. No grant funding was considered in this analysis but is likely to be pursued.
- The battery duration is assumed to be 8 hours.
- For all scenarios that include a battery, the system was sized such that the solar and battery could support 50% of Sabathani's typical loads throughout a "worst-case" 48-hour power outage.
- Net savings equal the present value of total savings over a 25-year period, as compared to business-as-usual energy costs, assuming a 5% discount rate.
- Sabathani's assumed electric load included anticipated load from a to-be-installed geothermal heat pump.
- The assumed net metering compensation reflects Xcel's Net Energy Metering program and the Solar Demand Credit, as available at the time of the analysis.
- Avoided health-related emissions are estimated using the U.S. Environmental Protection Agency's AVERT database, and avoided health costs are estimated using the EASIUR model.
- Avoided climate emissions are estimated using NREL's Cambium dataset, assuming long-run hourly marginal emissions for Minnesota averaged over years 2024 to 2049.

To learn more about this project, visit https://www.energy.gov/communitiesLEAP/minneapolis-minnesota.

COMMUNITIES LEAP
U.S. DEPARTMENT OF ENERGY

For more information about Communities LEAP, visit:
energy.gov/communitiesLEAP

Produced for the U.S. Department of Energy by the National Renewable Energy Laboratory (NREL).
DOE/GO-102024-6196 · March 2024