Photo by Dennis Schroeder, NREL 45241

National Community Solar Partnership Multifamily Affordable Housing Portfolio Screening Approach

Overview

Community solar offers multiple benefits to providers and residents of multifamily affordable housing (MFAH), including access to affordable renewable energy for low- and moderate-income households, tax credits and other financial benefits for property owners, and increased community resilience when paired with energy storage. Even so, MFAH providers interested in realizing these benefits may need support to identify where to start or how to expand and accelerate solar deployment across their property portfolios once they have completed their first few installations.

As part of the National Community Solar Partnership (NCSP) MFAH Collaborative, the National Renewable Energy Laboratory (NREL) developed a portfolio screening approach for MFAH providers to evaluate their multi-state building portfolios for community solar project viability. By utilizing NREL's companion Policy Screening Workbook in conjunction with the web-based tools PVWatts® Calculator and REopt™ (Renewable Energy Integration and Optimization), MFAH providers can take a data-informed approach to identifying and prioritizing buildings in their portfolios that are most amenable to community solar development. Figure 1 illustrates the steps in this process and the questions answered at each step.

NCSP and the MFAH Collaborative

The National Community Solar Partnership (NCSP) is a coalition of community solar stakeholders working to expand access to affordable community solar to every U.S. household and enable communities to realize meaningful benefits, such as reduced energy burdens, increased resilience, and workforce development. The NCSP is a U.S. Department of Energy (DOE) initiative led by the Solar Energy Technologies Office, in collaboration with NREL and Lawrence Berkeley National Laboratory. Partners leverage peer networks, technical assistance, and informational resources to set goals and overcome barriers to expanding community solar access.

One way the NCSP delivers technical assistance is through collaboratives, which are groups of partners within sectors seeking to address common barriers to community solar deployment through peer exchange and support from technical experts. Convened in 2020, the MFAH Collaborative aimed to increase community solar access for MFAH residents nationwide. Thirteen MFAH providers from across the United States—with portfolios ranging in size from five buildings to more than 300—participated in the collaborative and received technical support from DOE, NREL, and partners Urban Ingenuity and Stewards of Affordable Housing for the Future (SAHF).

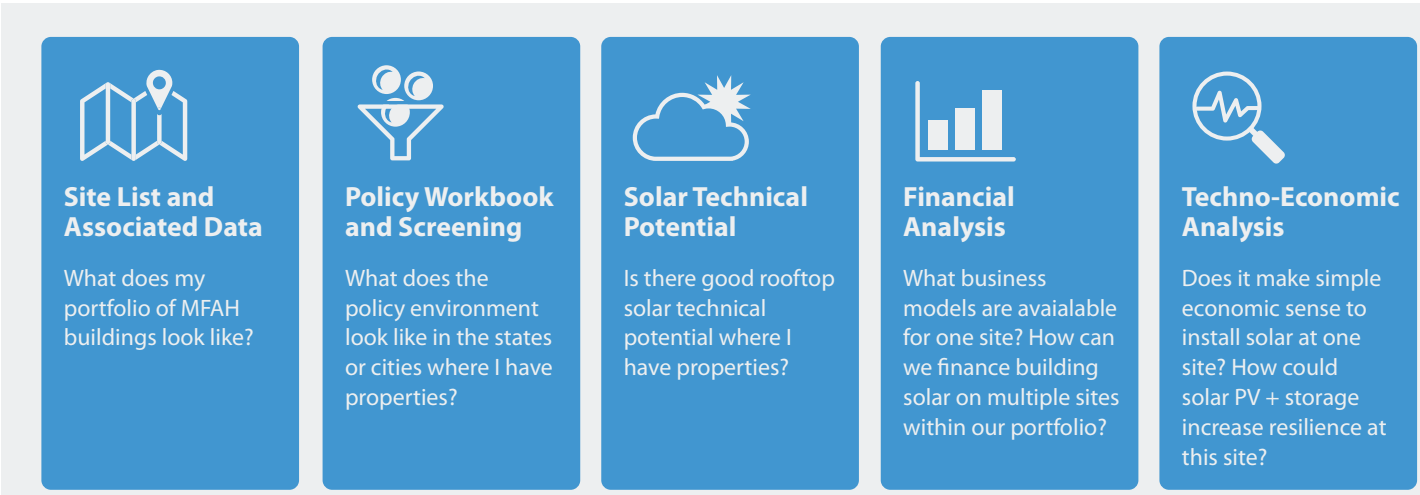

Figure 1. MFAH portfolio screening steps and questions answered at each step

Portfolio Screening Approach

MFAH Collaborative members identified two primary use cases for taking a portfolio-wide approach to evaluating sites for solar project development. These approaches can help MFAH providers decide if it makes technical and financial sense to build a community solar project at one or more properties for on-site use.

In the first case, MFAH providers may want to look across their property portfolios and determine the maximum number of sites that are good candidates for solar development in order to take advantage of economies of scale. One example—a pooled approach to project financing—is described in more detail below. Overarching questions for this case include:

- What is the total community solar opportunity across my portfolio?
- For which properties is community solar development economically viable?

In the second case, MFAH providers may want to identify a few highest-priority sites within their portfolios where it makes the most sense to get started with solar project development. As part of this process, the major decision points for MFAH providers are whether to build solar projects to consume power on site or, alternatively, to sell electricity directly to the grid, and whether to subscribe their buildings to existing community solar programs or possibly host a project to which the building may not be the subscriber. The guiding question in this use case is:

- Which are the priority properties for community solar development within my portfolio, and where are they located?

MFAH providers may consider how each approach addresses various barriers to MFAH solar project development. For instance, access to capital and operational capacity may determine how an MFAH provider goes about building a project for on-site use. In parallel with this effort, NREL developed an issue brief, Community Solar Opportunities, Barriers, and Considerations for Multifamily Affordable Housing, that summarizes four community solar models that have been deployed in the field—solar hosting, utility partnerships, new construction/rehabilitation, and off-site community solar—along with related considerations for providers and residents. The issue brief, along with this portfolio screening fact sheet, can help MFAH providers navigate the various technical, financial, and operational decision points that come with developing solar projects.

The portfolio screening approach helps MFAH providers identify and prioritize sites in their building portfolios for solar development. The framework down-selects properties based on policy environment, solar technical potential, solar system sizes and resilience components, and financing mechanisms. This approach guides housing providers through answering the following questions:

- What does my portfolio of MFAH buildings look like in terms of location, energy use and costs, metering structures, etc.?

- What does the community solar policy environment look like in the states or cities where I have properties?
- Is there good rooftop solar potential where my properties are located?
- What site-specific information do I need to create a simple economic model for each site?
- What business models are available for solar deployment at my properties?
- How can we finance developing solar on multiple sites within our portfolio?
- Does it make simple economic sense to build a solar system for one or more properties?
- How could a solar photovoltaic (PV) system increase the resilience of individual properties?
- How do we get to construction of a community solar system?

Portfolio Screening Steps

To develop the portfolio screening approach, NREL worked with MFAH Collaborative members to define the steps required for an MFAH provider to assess a multi-state portfolio for solar development. Each step in the approach is designed to provide flexibility in the use case suited to the provider's needs: to identify a small subset of optimal sites, or to provide information to support data-driven decision-making across a portfolio. Appendix A summarizes the guiding questions above, analysis steps, and primary results. The steps we took to analyze each portfolio are listed below. Note that steps two through four may be conducted concurrently, as illustrated in Figure 2.

1. **Site List and Associated Data Generation:** ***Identify general characteristics of an organization's building portfolio***. To synthesize portfolio-wide building information for each organization, we created a list of all buildings in the organization's portfolio, including each site's street address and state, using ENERGY STAR Portfolio Manager. This allowed us to consolidate and download building-specific data.
2. **Policy Workbook and Screening:** ***Identify which states across the portfolio are most amenable to MFAH solar development.*** As a part of the portfolio screening process, NREL developed a comprehensive Policy Screening Workbook to assess the legislative, regulatory, and program-based opportunities for community solar in multifamily housing across all 50 states. By incorporating major policy and regulatory mechanisms relevant to the deployment of solar in multifamily buildings, the policy screening workbook assigns one of four values to each state: Positive, Neutral/Positive, Neutral/Limited, and Limited.
   - **Positive** states are those with established, well-rounded policy regimes that are most likely to make MFAH solar deployment technically possible and financially sound. These policies might include dedicated community solar programming, virtual net metering, and varied financing options.
   - **Neutral** states have more limited policy and regulatory landscapes that may require consideration of more site-specific details, such as utility territory, to assess whether solar development would be technically and financially feasible. States in the **Neutral/Positive** category may bolster limited regulatory regimes with financial incentives, while states in the **Neutral/Limited** category are limited in both their regulatory and incentive landscapes. In Neutral states, individual utilities or municipalities may offer programming and incentives not mandated by their state, such as utility-sponsored community solar programs or net metering.
   - For states in the **Limited** category, the current policy environment is not explicitly supportive of MFAH solar development.

[1] We geocoded addresses for select multifamily housing locations using Placekey, a universal standard identifier for any physical place, using Uber's H3 index. Multifamily housing locations commonly include multiple buildings. In all cases, we identified parcels encompassing a multifamily housing location by overlaying the geocoded coordinates onto parcel vector data (licensed from LightBox). We used parcel geometry to query building footprints within each parcel from Esri's feature service for Microsoft's building footprints data set, which is continuously updated.

[2] We applied a building profile to each building of interest that was not modeled in the national assessment, allowing an estimation of aspect, slope, and overall area of developable planes per roof. These profiles do not consider setbacks or maximum array size. Planes with slopes less than 10.5 degrees were derated by 30% to reflect panel spacing for avoiding self-shading, while planes with slopes greater than or equal to 10.5 degrees were derated by 2%. We calculated building-level capacity by multiplying developable area (m^2) of each roof with capacity density (W/m^2), which was assumed to be 170 W/m^2 for a 72-cell monocrystalline array with an efficiency of 19.5% and a packing density of 88%. We rated per-plane capacity according to the building profile. We used NREL's System Advisor Model through PySAM to calculate annual generation for each plane, which was then aggregated to the building level. In this case, we used 2019 solar irradiance data from the National Solar Radiation Database. For multifamily housing locations where there is more than one building per parcel, we aggregated the building-level results to the parcel for a total potential capacity and potential annual energy production. These estimates were then appended to the original multifamily housing location tables.

Using the policy matrix, we assigned values to each site in the organizations' portfolios based on the state in which each site is located. We then used these values to identify which sites were likely to be most amenable to MFAH solar development, primarily those in the Positive and Neutral/Positive state policy categories.

3. **Solar Technical Potential**: ***Generate an upper boundary estimate of potential capacity and generation of rooftop solar PV for select locations.*** Once we had a list of properties in each portfolio and had assigned a state policy value to each site, we calculated the solar PV technical potential for all sites using existing rooftop PV classifications and publicly available tools and data from NREL. First, we geocoded portfolio addresses provided by participating members and generated a geographically situated list of buildings of interest.[1] Then, we aggregated results from NREL's national rooftop solar PV technical potential assessment to form a typical building profile in order to accurately model each building's expected PV system size and annual electricity production.[2] It was then possible to further down-select the list of properties for solar development by screening for those that met a minimum threshold of solar PV technical potential.

4. **Financial Analysis:** ***Evaluate financing options for rooftop or community solar for select locations.*** Using the priority sites in each organization's portfolio (based on policy environment and solar PV technical potential), NCSP Multifamily Affordable Housing Portfolio Modeling Tool (user guide and Excel-based tool) used its MFAH Portfolio Financial Model to evaluate the economics of multiple business models, including direct ownership, joint ventures to monetize tax credits, and third-party ownership, on a site-specific basis. This analysis allowed for comparison of the value of free energy, estimated income from solar renewable energy certificates (SRECs), total benefit, upfront cost, ongoing costs, total net benefit, return on investment, and payback period. Following the financial analysis of individual sites, Urban Ingenuity entered data from each site into a model to evaluate different business models for the pool of projects to maximize economic outputs for building owners and additional benefits for tenants.

5. **Techno-Economic Analysis:** ***Determine optimal system sizes, electricity generation, and other core metrics for select locations.*** Using the REopt techno-economic decision support tool, we identified valuable metrics for a representative sample of the prioritized list from Steps 2 and 3, including optimal system sizes, electricity generation, total life cycle cost of electricity, net present value, and capital cost. Scenarios included economic versus resilience objectives, different financing mechanisms, maximum versus optimal system sizing, and sensitivities on cost and other inputs.

6. **Next Steps:** ***Identify the key next steps to pursue construction for the selected list of sites, which may include continued data gathering, site verification, and stakeholder engagement.*** The portfolio screening process serves as an initial site screening strategy, and MFAH housing providers may need to conduct a more granular review of building characteristics, utility incentives, and availability of financing as they move toward implementation.

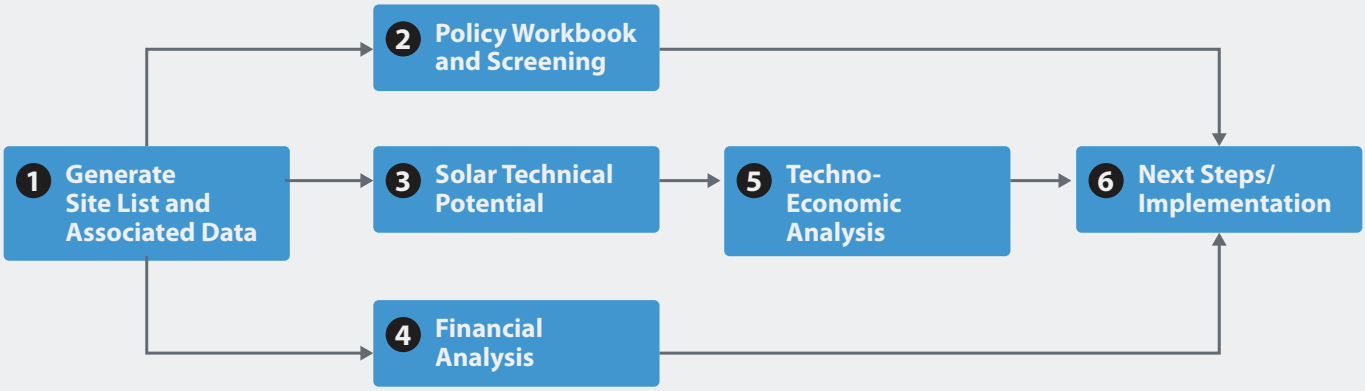

Figure 2. Steps 2–4 of the portfolio screening process can be conducted concurrently

Case Study: How Two MFAH Collaborative Members Benefited From This Approach

Case 1: National Church Residences

National Church Residences (NCR) is an MFAH housing provider with 340 properties across 25 states. NCR's goal for the portfolio screening process was to gain a holistic view of its portfolio's potential to aid in managing the change from business as usual to incorporating solar throughout the NCR portfolio. In order to provide a breadth of information across the portfolio, we assessed the NCR portfolio based on statewide policy landscapes, rooftop solar technical potential, and blended electricity costs, in parallel with a portfolio-wide financial analysis. Finally, we utilized REopt to identify the optimal solar-plus-storage system size and financial outcomes for one representative NCR site, with the goal of providing a workflow for NCR to utilize in select future solar-plus-storage screening assessments. The final analysis identified 40 prime focus sites in the 340-site portfolio, approximately 12% of NCR's volume. Because NCR was interested in exploring resilience options, we modeled the systems based on varying outage and critical load components and determined that a solar-plus-storage paired system could feasibly protect the site's critical load for up to a 2-day outage. Overall, our analysis showed that it would be cost effective for NCR to deploy both solar PV and a battery storage system at the site, with an overall estimated net present value of up to $65,000.

Case 2: Preservation of Affordable Housing

Preservation of Affordable Housing (POAH) is an MFAH housing provider with over 120 properties and over 12,000 units across eleven states (MA, CT, NH, RI, OH, KY, MO, IL, FL, MD, MI) and the District of Columbia. POAH's goal for the portfolio screening process was to identify the maximum number of sites that are good candidates for solar development in order to capitalize on pooled project financing. Because POAH was interested in a holistic view of their portfolio's potential, we performed a policy analysis and pooled financial analysis in parallel with Urban Ingenuity to provide an overview of various options POAH has to develop solar on a portfolio-wide basis. We also utilized REopt to identify the optimal solar-plus-storage system size and financial outcomes for two representative POAH sites, with the goal of providing a workflow for POAH to utilize in future solar-plus-storage screening assessments. The sample projects showed a combined net present value of up to $398,643 and utility bill savings of up to $596,207. At least 100% of each building's common area load could be covered by solar PV in all scenarios. We also concluded that pursuing shared solar or some form of meter aggregation in lieu of only serving common area loads allowed for a larger system size and resulted in about two and a half times (2.5x) greater savings.

Steps for How MFAH Providers Can Conduct This Analysis In-House

MFAH providers can conduct the portfolio screening process on their own, with the following recommended steps.

1. **Site List and Associated Data Generation:** Using ENERGY STAR Portfolio Manager or an alternative database of buildings, synthesize a list of buildings in your portfolio. It may be useful to include information about past or projected roof replacement dates or building rehabilitation needs. Once the site list and associated data has been compiled, MFAH providers can follow steps 2-6 below to generate more detailed information about their portfolio. MFAH providers might also want to collect data on utility territories and rates, electric consumption, building metering structures, and HUD utility allowance mechanisms for each building in their portfolio. However, this supplemental data could be collected after the site list is narrowed by the policy screening and technical potential assessment to streamline data collection to the most promising sites. The Policy Workbook and Screening, Solar Technical Potential, Techno-Economic Analysis, and Financial Analysis steps can be performed linearly or in tandem, depending on the MFAH provider's needs.

2. **Policy Workbook and Screening:** Using the Policy Screening Workbook, users can assign policy environment values to their complete portfolio by state. State-specific policies can be added, removed, or edited based on the granularity of needs and the temporal evolution of policy landscapes. Buildings in the Positive and Positive/Neutral policy categories will be most amenable to MFAH solar development, although nuances of utility territories can be incorporated on a site-specific basis.

3. **Solar Technical Potential:** Property owners and managers can calculate rooftop PV system capacity and annual energy production on their own using NREL's PVWatts Calculator. The PVWatts Calculator is a web-based tool that uses NREL's typical meteorological year

(TMY) weather data and the System Advisor Model's PVWatts module to calculate annual energy production. The PVWatts Help Page provides an in-depth review of the calculator and instructions on how to get started, as well as details about the tool's data inputs, results, and default values, and links to additional technical references.

4. **Financial Analysis:** Steps 2–3 allow users to down-select buildings in their portfolio based on policy environment and technical potential. With this narrowed list, users have the option to analyze which financial mechanisms and business models may be best for their sites and/or portfolios. Using Urban Ingenuity's portfolio modeling tool, MFAH providers can evaluate the economics of multiple business models, including direct ownership, joint ventures to monetize tax credits, and third-party ownership. The matrix allows for comparison of the value of free energy, estimated SREC income, total benefit, upfront cost, ongoing costs, total net benefit, return on investment, and payback period. Depending on the MFAH provider's goals, a high-level, portfolio-scale financial analysis could be conducted in conjunction with the policy screen and technical analyses as a way to conduct an initial down-selection. Additionally, the decision-making matrix allows MFAH providers to explore how smaller, less economically viable projects can be supported if developed at the same time as more financially beneficial projects.

5. **Techno-Economic Analysis:** Property owners and managers can use NREL's web-based REopt tool to perform techno-economic analyses of selected sites in their portfolios. If an MFAH provider has already down-selected to their most promising sites, REopt can help them analyze those sites prior to conducting a more in-depth financial analysis. If there is still a large selection of sites to evaluate, based on the MFAH provider's bandwidth to perform the analysis, NREL suggests employing the following set of criteria to identify a subset of sites for REopt analysis:

    a. Physical suitability of roof or land for solar (given roof age, vintage, and potential obstructions)

    b. Availability of electricity usage and metering data

    c. PV system size >100 kW (based on available space for solar)

    d. High blended utility rate

    e. Sites representative of various utility territories.

    The REopt Web Tool User Manual provides an in-depth review of the tool, a description of intended users and use cases, and instructions on how to get started. The user manual also contains details about the tool's data inputs, results, and default values, and links to additional technical references.

6. **Next Steps:** Identify the key next steps to pursue construction for a selected list of sites, such as an in-depth review of existing incentives, a refined and targeted financial analysis, and partnership development or stakeholder engagement. MFAH providers can apply to the NCSP Technical Assistance Program to receive additional support at no cost at any stage in the process.

Conclusion

While MFAH providers and their tenants can benefit greatly from community solar development across their portfolios, administrative barriers can make it difficult for building owners and managers to identify which buildings may be amenable to solar. The portfolio screening framework provides a starting point for organizations looking to deploy community solar to evaluate this opportunity across their portfolios. By helping organizations identify all candidate sites or priority sites, this framework and screening process can help reduce some of the more common barriers faced by MFAH providers in their pursuit of more environmentally sustainable and resilient buildings.

Appendix A. Portfolio Screening Approach Table

Step	Guiding Question	Step Details	Results	Tools
1. Data Gathering	What does my portfolio of MFAH buildings look like?	Create a list of all buildings in the organization's portfolio, including each site's street address and state. Pull data from portfolio manager if applicable. If applicable, collect site-specific information for the following data fields: • Utility territory • Utility rate/cost of electricity • Annual electric consumption • 15-minute interval electric consumption, if available • Building metering structure (master-metered or individually-metered) • HUD utility allowance mechanism	Identification of total number and geographic distribution of sites in portfolio	
2. Policy Screening	What does the policy environment look like in the states or cities where I have properties?	The policy screening workbook assigns one of four values to each state: • Positive • Neutral/Positive • Neutral/Limited • Limited Assign each site's value according to state the site is located in. Prioritize sites located in Positive and Neutral/Positive states.	Priority site list narrowed by policy environment	Policy Screening Workbook
3. Solar Technical Potential	Is there good rooftop solar potential where I have properties?	Using NREL's system modeling tools, such as PVWatts, calculate maximum PV system size and annual generation for each site selected in Step 2.	Priority site list narrowed by policy environment and solar technical potential	PVWatts
4. Financial Analysis	What business models are available for one site? How can we finance building solar on multiple sites within our portfolio?	**For single-site business model evaluation:** Assemble data points to evaluate financing options for rooftop or community solar for a single site. Using Urban Ingenuity's decision-making matrix, evaluate the economics of multiple business models, including direct ownership, joint ventures to monetize tax credits, and third-party ownership. The matrix will allow for the comparison of: • Value of free energy • Est. SREC income • Total benefit • Upfront cost • Ongoing costs (O&M) • Total net benefit • Return on investment • Payback period (years)	Matrix of business models and financing options available at single sites and/or for a full portfolio approach	UI Portfolio Modeling Tool

		For portfolio analysis and pooled financing: Identify your goals for a portfolio of projects (e.g., do you want to own your assets? What business models make the most sense to you?) Construct a pool of sites within your portfolio. Information from previous steps can be used to inform which geographies and sites are best suited for solar development through a pooled approach. Input data from each site into a model to evaluate different business models for the pool of projects in order to maximize economic outputs and benefits to tenants.		
5. Techno-Economic Analysis	Does it make simple economic sense to build a solar system at one of those locations? How could a solar PV system increase resilience at these sites?	Using NREL's REopt tool, determine optimal system sizes, electricity generation, total life cycle cost of electricity, net present value, capital cost, and other metrics for each site on the prioritized list from Step 3. Scenarios could include economic vs. resilience objectives, different financing mechanisms, maximum vs. optimal system sizing, and sensitivities on cost and other inputs.	1. Detailed results for each prioritized site (from Step 3) of where solar and/or battery storage can provide cost savings, resilience benefits, and emissions reductions 2. Prioritized list of sites where solar and/or battery storage can provide cost savings, resilience benefits, and emissions reductions	REopt Web Tool
6. Implementation	How do we get to construction?	Identify the key next steps, pitch to third-party investors (as appropriate), and address outstanding needs to get from this evaluation to construction.	Final list of ideal sites for solar development with corresponding financing options, business models, and energy capacity estimates	

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NREL/FS-6A20-81206 • August 2022