Business & Technology Advisory

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Achieving Cooperative Community Equitable Solar Sources (ACCESS): Research on Potential Additional Benefits from Solar PV and Energy Storage to the Distribution Grid

Key Highlights

- NRECA and PNNL are working on ways to expand the benefits of deploying solar PV and energy storage systems to communities with fewer financial resources.
- Solar PV smart inverters have a promising potential of acting as grid assets to provide more grid support. The optimal sizing and control of these inverters could potentially contribute to distribution grid optimization.
- The benefits of using the PV smart inverters include peak load and line loss reduction, switching operation minimization, and distribution grid investment deferral.
- The objectives of a study by NRECA and PNNL are to identify the desired network impacts and to quantify the associated benefits.

What has changed?

National Rural Electric Cooperative Association (NRECA), through the Achieving Cooperative Community Equitable Solar Sources (ACCESS), project is working with multiple electric co-ops and industry stakeholders to research how to make solar energy affordable for communities with fewer financial resources and extend the benefits of solar development to low-and moderate-income (LMI) consumers.

Solar PV smart inverters can be employed to provide various ancillary services to the distribution grids that, if properly monetized, could capture additional benefits for the co-ops from the PV installations. Pacific Northwest National Laboratory (PNNL) is engaged with NRECA and the ACCESS project to study the proposed ACCESS PV projects to understand if and how these PV assets can be utilized to achieve additional benefits. PNNL is working with NRECA and the ACCESS project participants to identify a path forward for detailed investigation and demonstration of the benefits.

What is the impact on electric cooperatives?

The following information is based on a concept paper PNNL recently submitted to the U.S. Department of Energy (DOE) as the first deliverable for their scope of work related to the ACCESS project.

Potential Additional Benefits from Distribution Grid Services

The main purpose of solar PV systems is to generate electrical power by converting solar irradiance using arrays of solar photovoltaic panels. Energy storage systems (ESS) are often co-located with PV systems to mitigate the intermittency of solar energy. These PV and ESS assets contain modern smart inverters that, if sized adequately and equipped with appropriate control features, can control reactive power (Var) output which can in turn influence electric distribution network voltage. By doing so, these resources may help achieve certain desirable conditions in the networks (e.g., a desired voltage profile) that can help achieve additional benefits beyond harvesting the available solar energy. Some of those benefits are briefly illustrated in Figure 1:

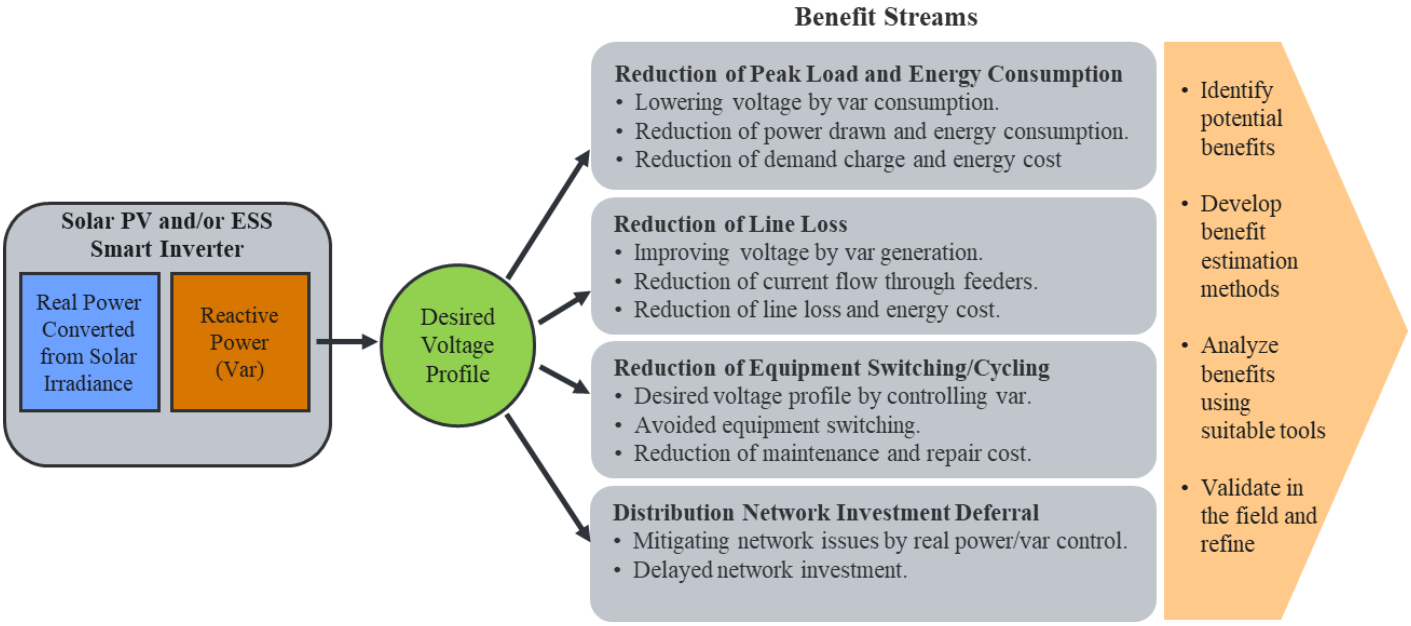

Fig. 1: Examples of additional benefit streams from smart inverters.

Approach and Tool for Evaluating Smart Inverter Benefits

The key to assessing additional benefits from smart inverters in solar PV and battery ESS installations is to monetize the positive network impacts or conditions that could be achieved by optimally operating the inverters for provision of various distribution network ancillary services. Basic steps of a monetization process are shown in Figure 1.

The core of a monetization approach is to:

(1) identify the desired and achievable network impacts, and

(2) estimate the revenues or the avoided costs associated with the impacts.

The benefit streams identified in Figure 1 are a few examples of avoided costs that could be achieved by creating desired voltage profiles across a distribution network. Detailed monetization approach will be case specific. For instance, the financial benefit of peak demand reduction will depend on the terms on which bulk energy is acquired from a supplier. Similarly, the avoided maintenance cost of voltage regulating equipment

will depend on how it is typically operated in the absence of smart inverters. Once the revenues or avoided costs are identified and the methods to estimate those are determined, a process (often in the form of a software tool) needs to be implemented to estimate the benefits using the pertinent data. Since the benefits are related to creating desirable distribution network impacts/conditions, the analysis of network behavior in the presence of smart inverters is of critical importance. A tool that can perform engineering and financial analyses in an integrated fashion would be beneficial for these applications. Figure 2 illustrates some desired features of such a tool.

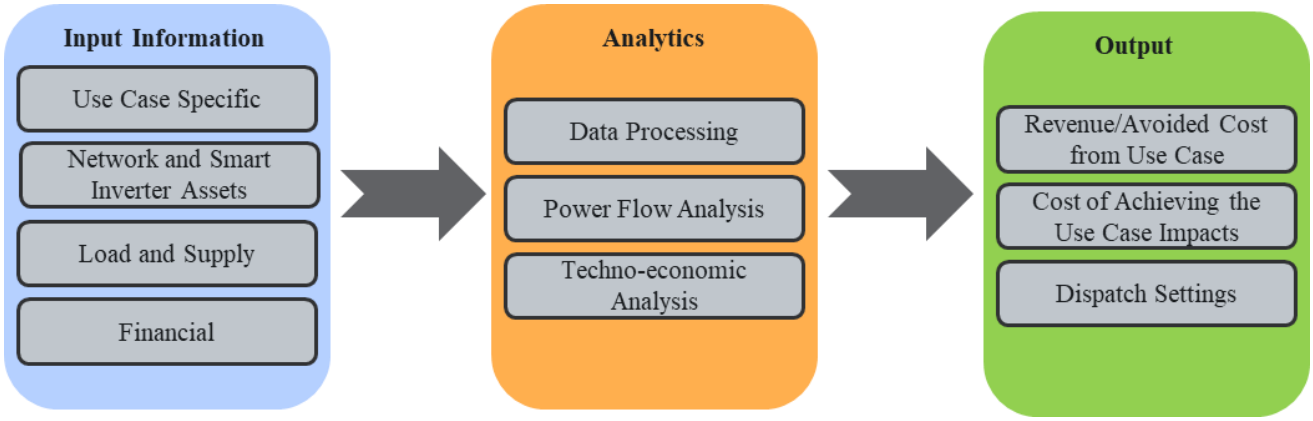

Fig. 2: Desired features of a tool for analyzing distribution network benefits from smart inverters.

Answering the following general/broad questions and follow-up discussions will help to specify the potential benefit streams for a given co-op, which of these benefit streams show potential for detailed analysis and field demonstration, and how those benefits could be achieved.

Questions to Help Specify the Smart Inverter Benefit for a Given Co-op

Q1. What are the ratings and technical features of the proposed PV system?

Q2. How was the location and size of the PV system determined?

Q3. What are the proposed operating strategies of the PV system?

Q4. What is the ownership structure, business model, and compensation structure of the PV project?

Q5. What are the financial incentives related to the PV project?

Q6. What are the types of loads and their proportions in the area relevant to the PV system location?

Q7. How is voltage regulated in the area where the PV system in located? Are there any network operation challenges?

Q8. Who supplies bulk energy to the co-op and on what terms? What are the applicable charges and penalties?

What do our cooperatives need to know about it?

Possible Adaptation of the PNNL Tool for Cooperatives

PNNL developed a ***proof-of-concept*** version of a similar tool[1] that ***could*** be customized for use in the ACCESS project. The tool if adapted, will be designed to have abilities to process various input information including:

1. use case (e.g., voltage control) specifics;
2. network model (suitable for detailed power flow analysis) and asset information (e.g., inverter capability curves);
3. load and power supply profiles; and
4. financial data (e.g., retail tariff, wholesale electricity price).

The tool will perform network time-step power flow analysis and use case specific techno-economic studies. Then, it will generate financial analyses results related to the benefit and cost of a use case, and the optimal asset dispatch settings that will lead the desired impacts in the network under the use case. Sensitivity analysis may need to be performed to characterize the use cases under various scenarios.

Once the benefits are theoretically analyzed, field demonstrations will be needed to understand the practical aspects, including the effectiveness of the control algorithms, and challenges of achieving the additional values. Analysis of technical and financial data collected during the demonstration phase would be used to refine the PV operation strategies.

Note that the detailed analyses and field demonstrations of the benefits may be beyond the scope of ACCESS, depending on the complexity, cost, and time.

Exploring Smart Inverter Benefits at ACCESS Participant Electric Co-ops

NRECA is engaging a wide group of industry stakeholders in the ACCESS project, to ensure broad perspective on the opportunities and challenges associated with solar programs serving rural communities. See the sidebar to the right for details, and visit our website: https://www.cooperative.com/programs-services/bts/access/Pages/default.aspx

The ACCESS team, including PNNL, has engaged the ACCESS Leader co-ops in due diligence to gather information about each co-op's PV systems, location and size of the systems, financial incentives related to the project, and other information that will inform the final research project.

ACCESS Team and Participants

- **Internal NRECA Team** for Project Management and Expertise
- Two (2) Key **Financial Organizations** Serving Co-ops
- Six (6) **Leader Cooperatives** from across the country with Solar Projects Underway or In Planning
- Twenty-seven (27) **Industry Stakeholders** Providing Diverse Perspective
- Unlimited **Affiliate Cooperatives** Staying Informed and Lending Their Input

To join as an Affiliate Cooperative, please contact our team at: SolarAccessProject@nreca.coop

[1] https://www.osti.gov/servlets/purl/1597957

NRECA America's Electric Cooperatives

One of the final products from the ACCESS project will be a technical report and guide (with set of related questions) which captures the findings and observations from the industry stakeholders, includes the focused conversations with co-ops, guidelines on estimating the benefits, and proposes next steps for a DOE field validation in rural America. This report and guide will be available to all NRECA member co-ops, as part of the tools and resources developed and available to assist electric cooperatives in their quest to successfully deploy solar projects to benefit LMI consumers.

For More Information about the ACCESS project and how to participate:

- Our ACCESS Team: SolarAccessProject@nreca.coop
- Our ACCESS Website: https://www.cooperative.com/programs-services/bts/access/Pages/default.aspx
- Adaora Ifebigh, **ACCESS Project Manager**, Senior Manager R&D Engagements: Adaora.Ifebigh@nreca.coop

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