**EPRI Supplemental project on forecasting solar PV adoption**

**Background and Objectives**

Residential rooftop solar photovoltaic (PV) systems may offer benefits to the operation and performance of electric systems and to society in general. Electricity produced from a clean renewal energy source, close to where it is consumed, reduces central generation requirements (and their emissions) and produces additional delivery system savings that can benefit all customers.

PV also changes the physical nature of the electricity supply delivery network by introducing two-way flow of power through a system built to move power from central generation to distributed end-use customer loads. EPRI research has shown that even a relatively small amount of PV feeding power into some distribution circuits can interfere with the reliable and efficient operation of the system. Other circuits can accommodate a high level of PV adoption. Utilities must be able to distinguish circuits according to their ability to support PV and identify what remedial actions are required when the threshold is reached.

The EPRI Integrated Grid (IG) initiative has developed a framework for establishing investments and operational changes required to most effectively accommodate distributed energy resources (DER), like PV. It employs a hosting capacity analysis that identifies the PV accommodation threshold for individual circuits by evaluating the effects of increasing levels of PV adoption rates. This method can be used to screen all of a utility’s distribution circuits in the absence of a forecast of where PV is most likely to be interconnected.

If reliable estimates of PV adoption were available, hosting capacity studies could be applied locally, and therefore more efficiently. Additionally, system planning, operation, and investment decisions could be made with greater certainty if utilities had a method for reliably determining the scope and extent of where PV adoption is most likely to occur.

This project seeks to develop methods for forecasting PV adoption to a high level of geographic granularity. By building on past EPRI research that developed market forecasts for new customer offerings, the project intends to create a PV adoption model that equates the likelihood of a customer adopting PV with system features (e.g., electricity supplied to the premise and to the grid, purchase vs. lease financing, upfront costs, $/kWh sales, system lifetime) and customer characteristics (demographics and premise traits). This provides a means for forecasting of market shares for PV systems defined by bundled features, and the contribution of each feature to overall system value to the customer. EPRI proposes to extend this capability by developing a PV market size model that maps preferences into a defined geographic area/market and indicates the likely location of a high penetration of PV adoption.

**New Learnings**

Utilities and their regulators need to be able to estimate the level and rate of residential PV adoption in order to anticipate how the electric system will be impacted, and undertake system refinements to accommodate residential PV while preserving system reliability. The forecast methods that this project seeks to develop will help to maximize the benefits to society of locally-generated electricity by assisting utilities in identifying where issues are most likely to arise. The ability to forecast the location and concentration of residential PV helps utilities accommodate investment needs—and meet them at least cost—while also informing strategic planning and program development.

**Tasks**

Task 1. Establish key PV system features

EPRI intends to conduct a discrete choice experiment (DCE), an approach to elicit from study participants their stated preferences for product or service alternatives, defined by a common set of attributes, through the administration of survey. The survey responses are then used to estimate a choice or preference function that forms the basis for the forecasting model. Establishing the appropriate PV system features and customer characteristics to be assessed in the study is a key element to ensure model robustness. EPRI plans to work with the project funders to establish the PV system features that will be subject to the study, which may also be extended to community solar if funders agree, as well as the customer characteristics to be included as additional preference explanatory variables.

Task 2. Design and test the DCE instrument

The experimental design involves constructing choice sets, comprised of PV system features that are presented to participants via the survey, to elicit their preferences. EPRI proposes to develop the DCE experimental design and conduct tests to verify that survey respondents understand what is asked of them and respond as the DCE methodology intends.

Task 3. Conduct market pulse activities

EPRI plans to conduct ongoing activities to promote communication and interaction about the factors that likely influence PV adoption, such as federal and state policies, technology advances, financing arrangements, rooftop availability, field marketing and merchandising practices. EPRI proposes to construct a customer survey instrument (distinct from the DCE survey) that utilities can field themselves, or conduct other market research activities to gauge customer familiarity with and understanding of PV technology and investment opportunities. Results shall be conveyed to funders via speaking engagements, webcasts, topical white papers, and other means for exchanging information in a timely and effective manner.

Task 4. Administer a DCE survey to a representative sample of customers

EPRI plans to administer the DCE survey to a sample of residences constructed from the collective residential population of the markets that funders elect to include in the study. EPRI will identify alternative methods for the administration of this survey and work with funders to determine which to employ.

Task 5. Develop PV adoption and market size software tool

Using the DCE survey results, EPRI plans to develop a software tool that project members can use to forecast PV adoption levels and market size in their service territories. The tool’s underlying models include the PV Adoption Model and the PV Market Size model. The PV Adoption Model is based on econometric models that use the DCE survey results to estimate consumers’ stated PV preferences. Once parametrized, the model associates preference weights to PV system features and customer characteristics. The PV Market Size model incorporates the preference function from the PV Adoption Model to develop the structure for predicting how many consumers in a specific service territory (market size) are estimated to adopt PV among individual offerings. The structure will also associate varying customer characteristics with stated end-use preferences to facilitate target marketing.

Task 6. Final report and application training

EPRI proposes to 1) prepare a report that describes the research undertaken and the results obtained and 2) conduct a knowledge transfer training session regarding the overall project findings, as well as the use of the software tool.

**Current Status of PV Adoption Study**

EPRI is developing methods for forecasting solar PV adoption. The focus is on identifying the most important PV system features—those that will drive adoption by residences—and the key customer characteristics associated with adoption. Learnings will provide insights into what factors cause PV adoption to accelerate or languish. EPRI will prepare for each participating utility a solar PV adoption model tailored to its residential customer population that will provide reliable and actionable estimates.

A survey has been administered to customers of participating utilities to collect data on preferences for PV solar features, from which customer preference and adoption models are being developed.

A static, snapshot-in-time market size model (a choice model that associates system attributes and demographics with likelihood of adoption) is being estimated from the pooled survey responses that were collected. As part of this process, the EPRI project team is collecting utility service territory-specific census demographic data. The Solar PV Adoption Tool (the software tool that is the project’s primary research deliverable) will utilize the pooled data choice model to estimate how PV attributes and other determining factors influence residential customers’ inclination to install a rooftop system or join a community solar collaborative. For each funder, the tool will ultimately be customized by adding market census demographic data that affect preferences. This will result in differences among market projections even when the PV features are the same. In addition, a test of differences among the markets is being conducted to determine if market-specific preference shifters are warranted. A shifter will adjust the base model choice estimates up or down by a specified amount.

Milestone Timeline

* The beta version of the Solar PV Adoption Tool, which incorporates dynamic influences on adoption that transpire over time, available by October. A webcast has been scheduled for October 27th to demonstrate the model and solicit feedback for refinement.
* A Solar PV Adoption Tool, tailored to each project service area, will be developed in tandem with EPRI Software Testing staff, and is scheduled for release by early-2017.
  + A user’s manual and tutorial will be packaged with the software tool.