SOLAR UTILITY NETWORK DEPLOYMENT ACCELERATION

Four year DOE-funded project to reduce co-op barriers to utility-scale PV.

System cost templates and financing guides. Consolidated purchasing.

Template engineering designs for MW-scale systems.

Utility PV Field Manual, Multi-level Training and Outreach
The SUNDA Project

• While the scope of the project is for utility-scale, utility-owned PV systems, target applications include both Community Solar and PV as a generation asset.

• The four-year, DOE-funded project specifically does not address PPAs, but information that we provide can be useful in evaluating a PPA proposal.
Participants

- Fourteen co-op participants across the country have committed to an installation goal of 23 MW of PV systems ranging from 0.25 to 5 MW in size.

<table>
<thead>
<tr>
<th>Co-op</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anza Electric Cooperative</td>
<td>CA</td>
</tr>
<tr>
<td>Brunswick Electric Membership Corporation</td>
<td>NC</td>
</tr>
<tr>
<td>CoServ Electric</td>
<td>TX</td>
</tr>
<tr>
<td>Eau Claire Energy Cooperative</td>
<td>WI</td>
</tr>
<tr>
<td>Great River Energy</td>
<td>MN</td>
</tr>
<tr>
<td>Green Power EMC</td>
<td>GA</td>
</tr>
<tr>
<td>North Arkansas EC</td>
<td>AR</td>
</tr>
<tr>
<td>Oneida-Madison Electric Cooperative</td>
<td>NY</td>
</tr>
<tr>
<td>Owen Electric Cooperative</td>
<td>KY</td>
</tr>
<tr>
<td>Pedernales Electric Cooperative</td>
<td>TX</td>
</tr>
<tr>
<td>Sandhills Utility Services</td>
<td>NC</td>
</tr>
<tr>
<td>Sussex REC</td>
<td>NJ</td>
</tr>
<tr>
<td>Tri-State Generation &amp; Transmission Assn.</td>
<td>CO/WY/NE/NM/UT</td>
</tr>
<tr>
<td>Vermont Electric Cooperative</td>
<td>VT</td>
</tr>
</tbody>
</table>
Technical Tools – Template Designs

• The project has developed four template designs – these are fully documented drawing packages covering system design from 0.25 to 1.0 MW-AC.

• These designs will need to be modified for exact location (array tilt, row spacing, fitting to existing land), but cover 80+% of what needs to be done.

• Drawings in PDF form are available for download from SUNDA website – www.nreca.coop/SUNDA

• AutoCAD files are available to co-ops upon request.
**Figure Title:** Equipment Schedule for Specification

**General Notes:**

1. Refer to Equipment Schedule for Specification.

2. Refer to Electrical Diagram and Feeder Schedule for Specifications.

3. Provide lightning system as specified. System shall be a level system. All grounds shall be a level system. Grounding system shall be provided for grounding conductors.

4. The following systems shall be provided for grounding conductors:
   - Electrical system
   - Lightning system
   - Grounding system

5. Provide bonding and bonding equipment as specified.

**Legend:**

- MODULE
- CONCRETE PAD
- FEEDER LINE
- CONTRACTOR PROVIDED EQUIPMENT
- OWNER PROVIDED EQUIPMENT

**Legend Notes:**

- PV MODULES, PIPING, AND DUCTWORK
- CONNECTOR BOX
- MEDIUM VOLTAGE TRANSFORMER
- GROUNDED MEDIUM VOLTAGE FUSED DISCONNECT SWITCH
- EQUIPMENT PANEL
- FEEDER LINE
- CONTRACTOR PROVIDED POLE MOUNTED CABLES
- OWNER PROVIDED POLE, PINGS, AND DUCTWORK
- BACK OF MODULE TEMPERATURE SENSOR
- PERMANENT GATE
- TEMPORARY GATE

**General Notes:**

1. Refer to Equipment Schedule for Specification.

2. Refer to Electrical Diagram and Feeder Schedule for Specifications.

3. Provide lightning system as specified. System shall be a level system. All grounds shall be a level system. Grounding system shall be provided for grounding conductors.

4. The following systems shall be provided for grounding conductors:
   - Electrical system
   - Lightning system
   - Grounding system

5. Provide bonding and bonding equipment as specified.
1. Use corrosion-laden wires with helical washers on AC and DC feeders within inverters.
2. Proper labels to each incoming circuit in the inverter.
3. Proper liquid tight conduit wiring on extension of balance at each circuit termination for all conduits exposed to moisture.
4. Proper antidesiccant corrosion inhibitor for application on all listed components.
5. Proper corrosion-resistant bolts at all grounding electrical connections.

**Diagram:**

- **PV Single Line Diagram**
- **Scale:** None

**Equipment Schedule**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Solar Module</td>
<td>400</td>
</tr>
<tr>
<td>2</td>
<td>Inverter</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>DC Disconnect</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Transformer</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>AC Disconnect</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Battery</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Switchgear</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Photovoltaic System</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Metering Station</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Metering Station</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Metering Station</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Metering Station</td>
<td>1</td>
</tr>
</tbody>
</table>

**Notes:**

- [Diagram details and specifications]
Utility PV Field Manuals

- Three volume set available for download on the SUNDA website. Excellent reference material.
- Volume I – Financial; Volume II – Design and Installation; Volume III – Operations and Maintenance
Financial Tools – PV Field Manual

- PV Field Manual – Volume I
- Background material and detailed information on how to finance a utility-scale PV system
2.4.4.1 Tax Equity Partnership Structure

An ownership structure that creates a partnership for tax purposes between the project sponsor (with limited or no outside sources of taxable income) and a tax-equity investor capable of monetizing the tax incentives often is referred to as a "tax-equity flip." This structure has been used for years by renewable project developers having little or no tax appetite; it can be used in the context of developing utility-scale solar installations by electric cooperatives.

Tax-equity flip models differ by financial institutions and developers of renewable projects as follows:

- Whether or not leverage (debt financing) is used
- Whether and when a buyout option is offered to sponsor organizations
- Whether or not an independent developer is involved in the project
- What cash flows and tax attributes are allocated, to whom, when, and in what proportion

The structure and allocation depicted below is specifically tailored to the needs of tax-exempt electric cooperatives and is based on proven models that actually have been deployed. A graphical depiction of the relationships involved in the tax-equity structure is summarized in Figure 7.
Financing Options

- **Simple loans** – via CFC, RUS or other lending institutions. This is the simplest option and may be best for small systems where transaction costs might exceed tax benefits.
- **New CREBS financing** – Rebate on loans to provide equivalent of tax incentives to rural non-profits.
- **Tax-Equity Flip** – Complex arrangement that allows co-ops to recover some of the tax incentives such as Investment Tax Credits (ITC) and Accelerated Depreciation (MACRS). May be lowest cost, but transaction costs are high.
- **Tax Equity Lease** – Specialized lease / purchase option available if a taxable entity can participate. Similar benefit to Tax-Equity Flip.
Financing Example – Tax Equity Flip

- This is a financing arrangement where the co-op partners with a taxable entity and shares the tax incentive benefits.
- Ownership is primarily by investor but “flips” after tax benefits have been exhausted.
- A limited version is available through NRCO.
- Other consolidated vehicles may become available – stay tuned.
- Note that the ITC is reduced at the end of 2016 and project schedules are already getting crowded, so start planning now.
SUNDA Financial Screening Tool

• Spreadsheet-based tool which combines performance estimation, cost estimation and financial / cash-flow analysis in one tool.
• Model is targeted at SUNDA-scale systems (0.25MW – 5.0 MW)
• Financial model shows results for three financing options, along with estimates of community solar member participation costs for each option.
• Model is currently being tested, will be available on SUNDA website by mid-May.
• Contact us for analysis in the interim.
SUNDA Financial Tool - Demo
Purchasing Tools

- SUNDA has worked with the NRECA National Discounts Program to provide pre-negotiated purchasing discounts on PV modules, array racking and inverters. These are available to ALL co-ops – not just SUNDA participants.
- Current vendors include: Suniva (modules), REC Americas (modules), Advanced Energy (inverters), GameChange Racking (support structures)
- Details available on the SUNDA website under “Implementing Solar”
Training and Outreach Tools

- **Web Portal** – [www.nreca.coop/sunda](http://www.nreca.coop/sunda)
- **Online Webinars and Technical Resources** – under “Evaluating Solar”
- **Upcoming Training Sessions** – check website for details
- **Communicators Toolkit** – helping coops communicate with members about solar options
- **Upcoming Solar Conferences**
  - Solar Power Southeast, April 8-9, Atlanta, GA
  - SEPA USC San Diego, April 27-29, San Diego, CA
  - Solar Power International, September 14-17, Anaheim, CA
  - Renewable Energy World (w/ PowerGen), December 8-10, Las Vegas, NV
SUNDA Web Portal

- www.nreca.coop/sunda
- One-stop shop for everything SUNDA:
  - Project updates
  - PV Field Manuals
  - Template drawings
  - Financial tools
  - Webinars
  - Outreach materials
Thank you from the SUNDA Team

- Dale Bartholomew
- Paul Carroll
- Mike Casper
- Andrew Cotter
- Doug Danley
- Thomas Kirk
- Tosha McCloud
- Craig Miller
- Diane Rhodes-Michaely
- Debra Roepke
- Tracy Warren

www.nreca.coop/sunda
RESERVE SLIDES
## 250kW AC System

<table>
<thead>
<tr>
<th>Cost Model</th>
<th>Levelized Cost ($/MWh)</th>
<th>Turnkey from EPC</th>
<th>Co-op does part of construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight Loan (2%)</td>
<td>$95.16</td>
<td>$91.28</td>
<td></td>
</tr>
<tr>
<td>NCREBS (~4.5%)</td>
<td>$92.71</td>
<td>$88.95</td>
<td></td>
</tr>
<tr>
<td>Tax-Equity Flip (~8.5%)</td>
<td>$90.48</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

## 1MW AC System

<table>
<thead>
<tr>
<th>Cost Model</th>
<th>Levelized Cost ($/MWh)</th>
<th>Turnkey from EPC</th>
<th>Co-op does part of construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight Loan (2%)</td>
<td>$78.76</td>
<td>$73.89</td>
<td></td>
</tr>
<tr>
<td>NCREBS (~4.5%)</td>
<td>$76.80</td>
<td>$72.08</td>
<td></td>
</tr>
<tr>
<td>Tax-Equity Flip (~8.5%)</td>
<td>$75.22</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>
Snapshot of PV Costs Today

- **Residential System:** $0.20 to $0.11/kWh
  - 5-10KW
  - The installed cost is $3.89 per Wp.
  - Net cost after ITC and MD credit is approximately $2.26/Wp

- **Utility Owned Systems:** $0.12 to $0.06/kWh
  - 1MW +
  - Net installed cost at $1.58 per Wp at 1MW*
  - Net installed cost at $1.18 per Wp at 10MW**

Scale matters, as do incentives