



System Maintenance and Repair Costs

Photovoltaic (PV) systems are inherently low maintenance and experience few problems. However, problems have been known to occur and all systems require some maintenance. In the event of any kind of system damage, failure or malfunction, your first point of contact should be BEF or your local installer. By participating in the Solar 4R Schools program, BEF will provide replacement equipment at cost, assist with identifying qualified contractors, and provide technical support for the duration of the Owner Obligation Period as defined in the Host Contract, typically a period of 10 years.

The following document is intended to provide future system owners with an understanding of the maintenance requirements and potential repair costs of owning a small scale, (1-5 kW), grid-tied, PV array. The costs and time requirements will vary depending on the system size and specific equipment selected. All cost estimates are based on wholesale prices, which will vary over time as markets and technology change. Your project manager can provide more information about your specific project and equipment upon request.

Theft and Vandalism:

BEF will install modules with theft deterrent fasteners and make every attempt to install equipment in a way that limits accessibility or the possibility of theft or vandalism. It is the responsibility of the project owner to participate in the site survey, review the final system design, provide feedback about potential theft or vandalism issues, and understand the risks involved and potential replacement costs as outlined below. BEF does not warranty against theft or vandalism.

Environmental or accidental damage:

BEF will install equipment in a way that minimizes the probability of environmental or accidental damage. BEF tries to install PV arrays in locations not subject to damage from falling tree limbs, sporting activities, vehicle traffic etc. It is the responsibility of the project owner to participate in the site survey, review the final system design, provide feedback about potential environmental hazards, and understand the risks involved and potential replacement costs as outlined below. BEF does not warranty against environmental or accidental damage.

PV modules:

Warranty: Most PV modules come with a 20-year manufacturer warranty, which guarantees that modules will produce 80% of rated power output after 20 years.

Warranties vary by manufacturer. Many manufacturers also have a 10-year 90% Power Output Warranty and a 2-5 year Materials and Workmanship Warranty.

Expected life: 30+ years

Maintenance requirements: Wash twice per year, depending on soiling and rainfall

Potential Problems: Theft, de-lamination, hail damage, weather damage, degradation, soiling due to dirt, dust or bird droppings.

Preventative measures: BEF only installs high quality modules from reputable companies who will be around to uphold warranties. Modules are rated to withstand damage from hailstones up to 1 inch in size.

Expected replacement cost per module: \$3-4/watt (\$500-700 for a 170w module), Module cost has dropped dramatically over the past few years, and costs are expected to continue to fall for the foreseeable future.

Expected replacement labor required: Depends on racking system, typically, 2-3 hours for first module, 20 minutes for each additional

Inverter:

Warranty: Most inverters come with a 5 or 10-year warranty.

Expected life: 10+ years

Maintenance requirements: Maintain access to and clear space around the inverter. The inverter may require periodic (bi-annual) cleaning or dusting of cooling fins or the ventilation fan. See inverter Operation and Maintenance or Installation Guide included in your System Owners Manual.

Potential Problems: Manufacturer defects, overheating, grid surges, lightning

Preventative measures: BEF ensures all systems are installed per NEC requirements, including proper grounding, and manufacturers installation instructions and are not in locations exposed to excessive heat, such as in direct sunlight or small spaces.

Expected replacement cost: \$.40-\$.70/watt (\$1300- \$2500 for 1kW-5 kW inverter)

Expected labor for replacement: 5 - 8 hours

Data Monitoring System:

Warranty: The data monitoring equipment has a 5-year warranty. BEF will assist with replacement and repair, while monitoring service is being provided by BEF.

Expected life: 10+ years

Maintenance requirements: Maintain network connectivity

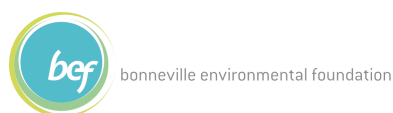
Potential Problems: Exposure to excessive heat and moisture, firmware updates, and major changes to network settings, such as IDF/MDF switch replacements, network architecture or firewall configuration changes

Preventative measures: BEF sites data monitoring equipment to prevent excessive heat and moisture exposure and works with network administrator for network connectivity

Remedies: If there are changes to the network, network settings may need to be updated to allow the system to send data. On-site firmware updates may also be required, but it's rare.

Expected replacement cost: \$300-500 for gateway

Expected labor for replacement: 2 - 5 hours **Firmware updates:** 2 hours



Racking:

Warranty: Depends on manufacturer, often no warranty is provided, nor necessary.

Expected life: 20+ years

Maintenance requirements: Check for loose bolts/fasteners every year, check for roof leaks during heavy rain.

Potential Problems: Roof penetration leaks due to expansion and contraction or improper sealing, corrosion, loose fasteners

Preventive measures: BEF ensures that all systems are designed and installed according to industry current best practices and manufacturers instructions.

Expected replacement cost: \$500-\$2000 per kW. It is unlikely racking will need to be replaced, but it may need to be repaired or penetrations re-sealed.

Expected Labor: Depends on issue, 5 - 40 hours per kW for repairs or replacement

Balance of Systems (Wiring, conduit, disconnects, fasteners, etc.)

Warranty: None.

Expected life: 20+ years

Maintenance requirements: Check annually for frayed or loose wires, UV degradation, and sealing around conduit entry/exit points to building, etc.

Potential Problems: frayed wiring, corrosion, UV degradation

Preventive measures: BEF ensures that all systems are designed and installed according to industry current best practices.

Expected replacement cost: \$50- \$500

Expected Labor: 3 - 10 hours per kW for repairs or replacement

Workmanship

Warranty: BEF requires a 5-year workmanship warranty from our installation contractors.

Potential Problems: Problems with system components as noted above.

Preventive measures: BEF thoroughly reviews all photovoltaic system installer qualifications, prior work and references and only hires experienced contractors and electricians. BEF also has a thorough commissioning process and installation documentation requirements, ensuring the highest standards in workmanship.