SolarServer
Global Solar Industry Website

Advanced Inverters – Recovering Costs and Compensating Benefits

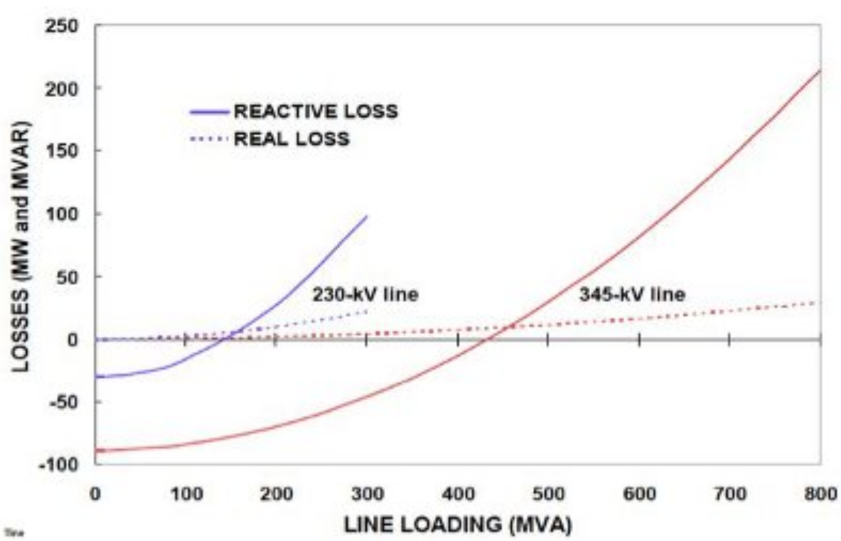
By Clean Coalition Executive Director Craig Lewis

Advanced inverters will increasingly be required for distributed solar generators across the country. Georgia Power's latest interconnection agreement, for example, requires that small solar generators use advanced inverters to provision reactive power. Similarly, a group of Western utilities recently endorsed advanced inverters as an effective and affordable tool to regulate voltage and is working to make them mandatory for all new solar facilities within their service territories. While there is clear recognition that advanced inverters offer grid benefits, how to fairly allocate their costs and compensate their benefits is a topic of hot debate.

Currently, a number of utilities seek to frame advanced inverters as simply a tool to resolve voltage problems caused by solar facilities. Under this argument, many utilities believe solar generators should be responsible for shouldering the costs of using advanced inverters for voltage control. If solar developers must bear these costs without sensible compensation for the extensive additional benefits that advanced inverters provide, then many distributed solar projects will become unviable – even when these projects offer immense net benefits to ratepayers.

Objective experts recognize that advanced inverters enhance overall power system reliability. An Oak Ridge National Laboratory report found advanced inverters to provide substantial benefits to all grid users by provisioning local reactive power, reducing blackouts caused by transmission failures, and other grid issues not related to the integration of renewables. The reactive power capabilities of advanced inverters enable distributed voltage control, which significantly outperforms centralized voltage control.

Reactive power suffers far greater line losses than real power, and those losses increase as a line is more heavily loaded (see graphic below). Distributed reactive power from advanced inverters improves power system efficiency by minimizing reactive power line losses and reducing line congestion.



Transmission line absorption of reactive power by Oak Ridge National Laboratory (2008)

The Clean Coalition, in accordance with the Oak Ridge National Laboratory's findings, is working to ensure that advanced inverters are treated as a cost-effective tool to optimize power quality, system reliability, and ratepayer economics through distributed voltage regulation. Given the system wide benefits, utilities should handle the costs of advanced inverters just as they handle the costs of traditional voltage control solutions, such as capacitor banks and synchronous condensers.

Although it is less expensive to use advanced inverters than to install and maintain capacitor banks or synchronous condensers, the costs can be significant for residential-scale generators. A bigger issue for any sized solar generator is that, under standard interconnection configurations, in order for an inverter to provision reactive power, it might need to curtail a portion of real power production (and lose the associated revenue) when solar resources are around their peak (see below).

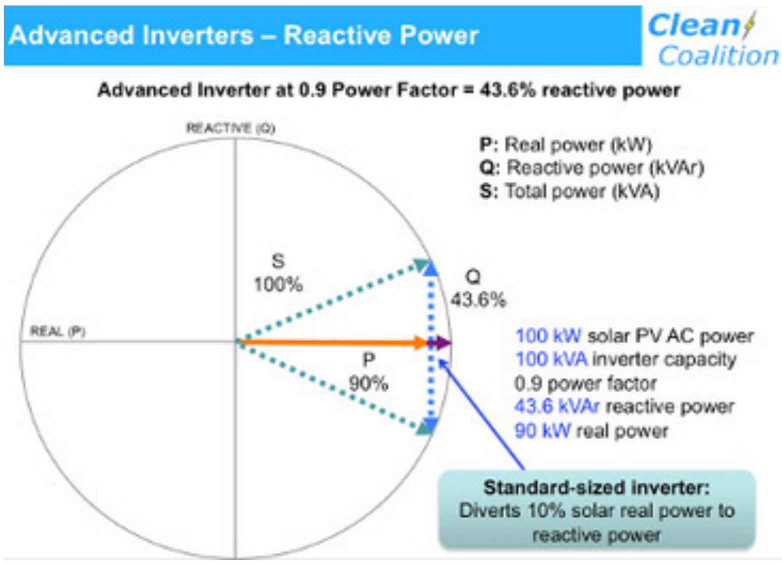


Image: Clean Coalition

According to joint research by the Clean Coalition and University of California at Berkeley, installing an oversized inverter makes economic sense if reactive power will be regularly needed during a generator's peak production hours. For example, a 100 kW solar facility with a 10% oversized inverter (110 kW inverter capacity) set at a 0.9 power factor can provision 46 kVAr of reactive power even when the solar facility is producing a full 100 kW of real power.

In comparison, a 100 kW solar facility with a standard-sized inverter (100 kW inverter capacity) set a 0.9 power factor may need to divert up to 10 kW of real power output to deliver 44 kVAr of reactive power. Therefore, a 10% oversized advanced inverter, set at a 0.9 power factor, can provision reactive power totaling almost 50% of the inverter's operating capacity while never curtailing real power production (see below).

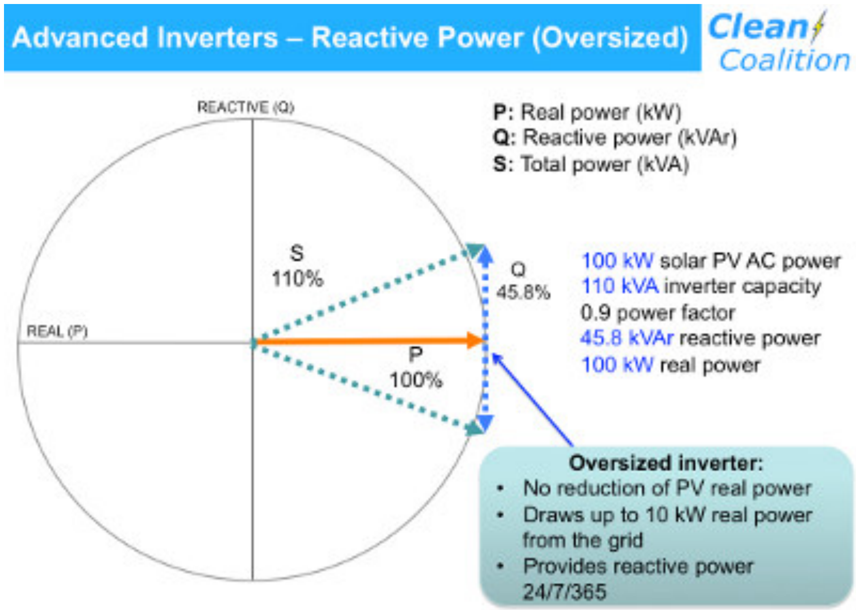


Image: Clean Coalition

There are three obvious ways to fairly allocate the costs and compensate the benefits of advanced inverters. One option is to pay distributed generators for kVAh (total power) or a combination of kVArh (reactive power) and kWh (real power) – instead of the simplified compensation method today that only compensates for real power on a kWh basis.

Another option is to reimburse generators for the costs of providing voltage regulation services, including increased capital expenditures from oversizing inverters and/or lost revenue from curtailment. The third way is for utilities to own and control the advanced inverters of independently owned generators, in the same manner utilities own and control capacitor banks for voltage regulation.

This last option avoids the complexities of estimating the full costs and benefits of reactive power and provides utilities with increased capital expenditure opportunities in the distributed energy future while allowing the utilities to fully control the reactive power provisioning. In the utility ownership scenario, solar generators sell simple DC power at the point it enters the inverters and utilities would have constraints on annual inverter downtime, etc. – similar to annual activation limits in demand response programs.

Once a fair pathway is agreed upon for cost recovery and benefit compensation, ratepayers will benefit from the widespread adoption of advanced inverters for distributed generation. This affordable solution will improve grid integrity throughout the power system.

About the Author

Craig Lewis is the executive director of the Clean Coalition, a nonprofit organization whose mission is to accelerate the transition to local energy systems through innovative policies and programs that deliver cost-effective renewable energy, strengthen local economies, foster environmental sustainability, and provide energy resilience.