Hosting Capacity Analysis for **DEVELOPERS**

NREL's dynamic hosting capacity analysis can help you better understand the thresholds at which new distributed photovoltaic (DPV) systems will trigger upgrades to the electrical distribution system.

Often, potential costs associated with distribution system upgrades are uncertain and can pose a financial risk to DPV projects. Currently, the need for these upgrades is usually identified during the interconnection study process and the system that triggers the violations is responsible for the full cost of the upgrades.

There are several potential options for reducing the cost associated with this process, including:

- Understanding how system impacts and hosting capacity are influenced by the location of the DPV system and siting the system in a low-cost location,
- Using autonomous advanced inverter functions—for example, volt-var control—as an alternative to grid upgrades to mitigate system impacts, or
- Utilizing a flexible interconnection approach as an alternative to grid upgrades, wherein the real and reactive power output of the DPV system may be adjusted by the utility in a coordinated fashion as necessary during constrained periods to avoid system violations.

The pros, cons, and other considerations for interconnecting using autonomous advanced inverter functions or flexible interconnection are detailed in the table on the reverse of this factsheet.

What NREL's hosting capacity analysis could do for you:

- Understand the different interconnection options that could be available and their costs and risks, including how these costs and risks could change as other DPV or DER systems are deployed nearby
- Understand the drivers of upgrade costs, including how these drivers are influenced by PV location, inverter settings, and inverter sizing
- Understand how different penetration levels of DPV may be contributing to the need for distribution upgrades to help inform your discussions with regulators and utilities about cost-allocation schemes.

PV developers may want to give careful consideration to how curtailment risk may evolve as penetration levels of DPV and other DERs increase under different principles of access and how a robust curtailment risk framework can be developed. NREL hosting capacity analysis project is currently working on these topics.

	Static HC • Fit and forget • Worst case static snapshots	Uncoordinated Dynamic HC • Local autonomous control • No inverter communications • Probablistic screens	Coordinated Dynamic HC • Communications-based • Resolve multiple DERs and multiple constraints • Curtailment risk
Interconnection Solutions	• Traditional firm interconnection approach	• Firm interconnection with autonomous advanced inverter functionalities (for example, under IEEE 1547-2018 or CA Rule 21)	• Flexible interconnection, where curtailment risk is accepted by the PV developer as an alternative to paying for traditional distribution upgrades
Pros	• No risk of curtailment	• The use of advanced inverter functionalities may avoid the need for traditional grid upgrades and associated questions around cost allocation • Limited research on curtailment risks, but these will likely be low • Can economically apply to both large and small DPV systems	• The use of flexible interconnection may avoid the need for traditional grid upgrades and associated questions around cost allocation • Particularly beneficial when expensive upgrades are anticipated (e.g., upgrading or installing new transformers if thermal overloading impacts are identified)
Cons	• When upgrades are required, they may be expensive	• Potential risk of curtailment, although this may be low and oversizing the inverter (high kVA rating to kW rating) can help to avoid curtailment risk in this scenario	• Involves installation of communications infrastructure, monitoring, and software, so this solution is currently only cost-effective for large PV or aggregated small PV systems • Less predictable curtailment than with pre-defined autonomous functions
Types of Analysis Involved	• Traditional interconnection study process	• Interconnection study process may also involve a time-series analysis • Analysis of curtailment risk may or may not be necessary	• Interconnection study process may also involve time-series analysis • Assessment of curtailment risk involving quasi-static time-series simulation, ideally over a 1-year period or longer • Robust uncertainty framework, including consideration of how curtailment risk may evolve as penetration levels increase

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