Planning for a Distributed Disruption: Innovative Practices for Incorporating Distributed Solar into Utility Planning

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NREL Benchmarking Distribution Grid Integration Costs Under High Distributed PV Penetrations

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Project Overview

Context

- Analysts project that distributed solar photovoltaics (DPV) will continue growing rapidly across the United States.
- Growth in DPV has critical implications for utility planning processes, potentially affecting future infrastructure needs.
- Appropriate techniques to incorporate DPV into utility planning are essential to ensuring reliable operation of the electric system and realizing the full value of DPV.

Approach

- Comparative analysis and evaluation of roughly 30 recent planning studies, identifying innovative practices, lessons learned, and state-of-the-art tools.

Scope

- Electric infrastructure planning (IRPs, transmission, distribution).
- Focus on the treatment of DPV, with emphasis on how DPV growth is accounted for within planning studies.

Key Points Relevant to Benchmarking Distribution Grid Integration Costs

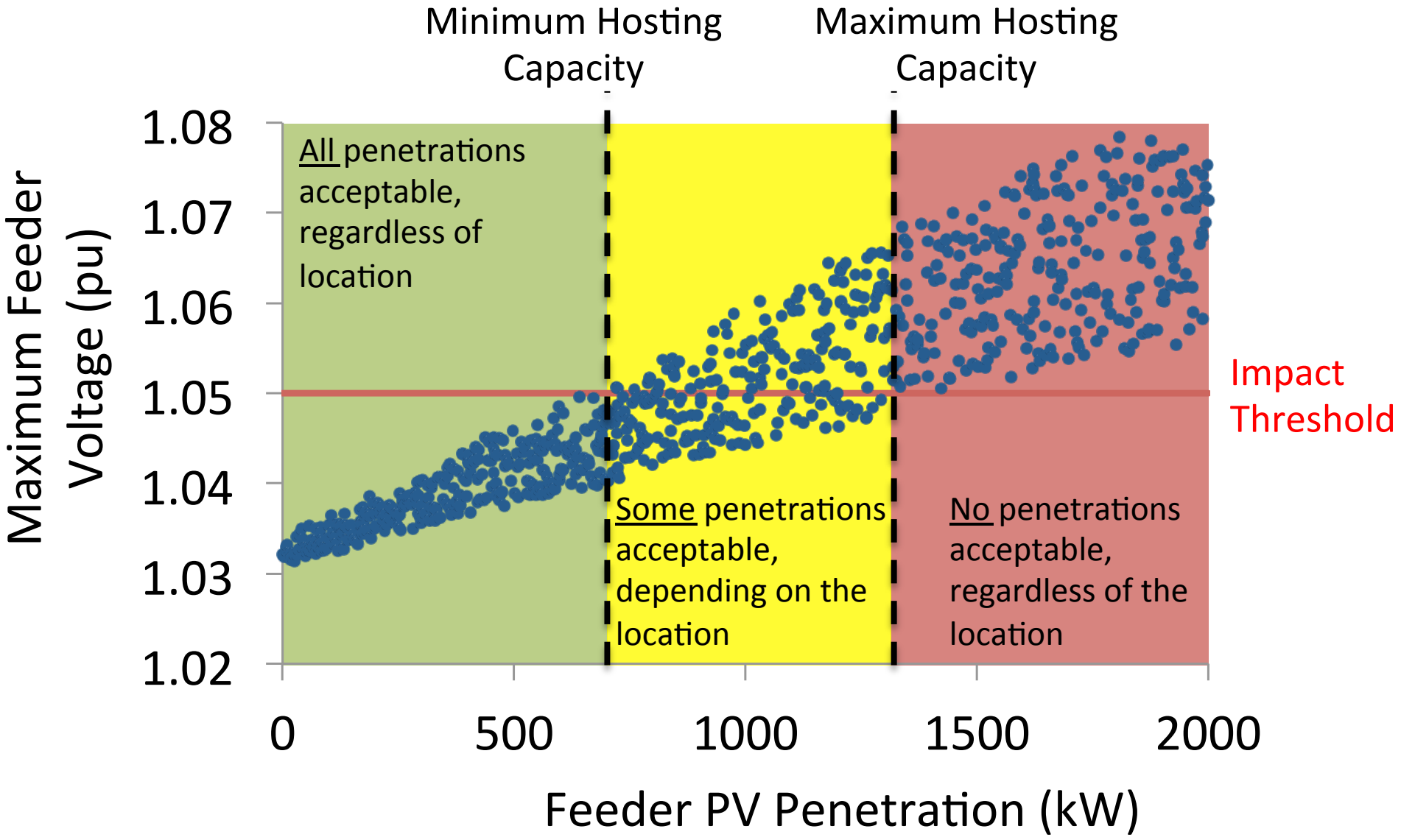
- Many states are interested in modernizing the distribution grid, DER integration is one of many overlapping objectives
- Distribution integration costs are intertwined with hosting capacity, build on that growing body of work but be aware of its limitations
- Studies that estimate the cost of proactively upgrading the distribution system to accommodate DER beyond the hosting capacity are probably most relevant, though we found few examples of such studies

State Objectives in Modernizing the Distribution Grid

Objectives	CA	DC	FL	HI	IL	MA	MN	NC	NY	OR	TX
Affordability	●	●	●	●	●	●	●	●	●	●	●
Reliability	●	●	●	●	●	●	●	●	●	●	●
Customer Enablement	●	●	●	●	●	●	●	●	●	●	●
System Efficiency	●	●	●	●	●	●	●	●	●	●	●
Enable DER Integration	●	●	●	●	●	●	●		●	●	●
Adopt Clean Technologies	●	●	●	●	●	●		●	●	●	●
Reduce Carbon Emissions	●	●	●	●				●	●	●	●
Operational Market Animation	●	●		●		●	●		●		

Source: DOE's *Modern Distribution Grid - Volume III*

Impact of DPV on T&D Investments: Hosting Capacity Analysis



Source: Adapted from EPRI 2015

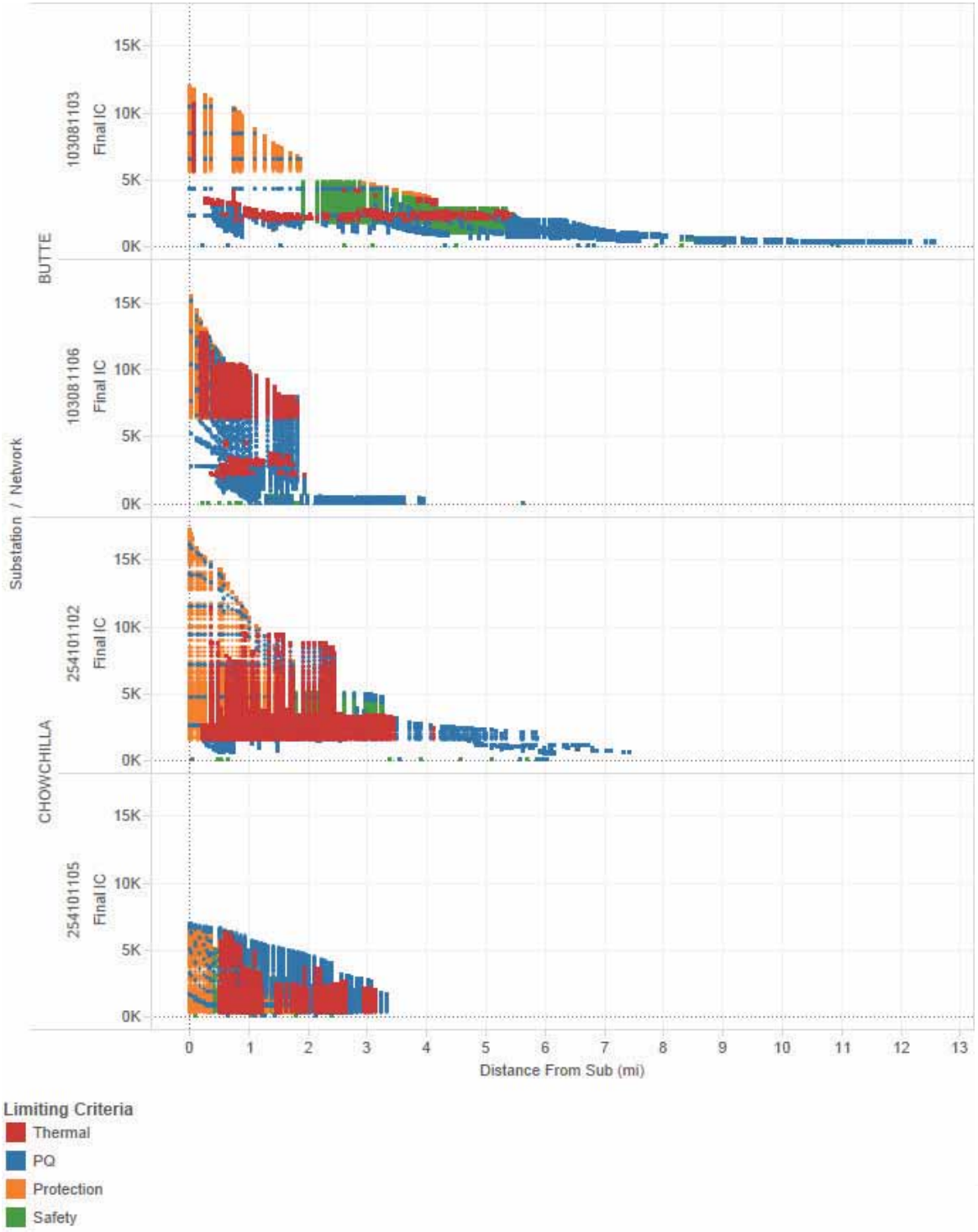


Figure 54: Final IC over Distance Colored by Limiting Criteria (Allow Tx Reverse Flow)

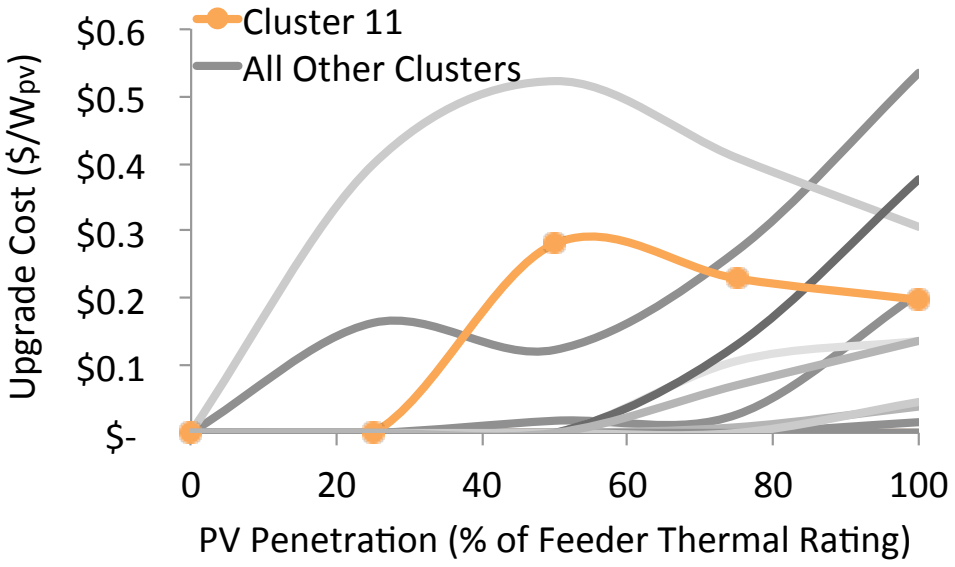
PG&E Hosting Capacity Analysis

- Vertical axis shows hosting capacity at a particular node on a distribution line
- Horizontal axis shows the distance of the node to the substations
- Color shows the limiting criteria for the hosting capacity at that node

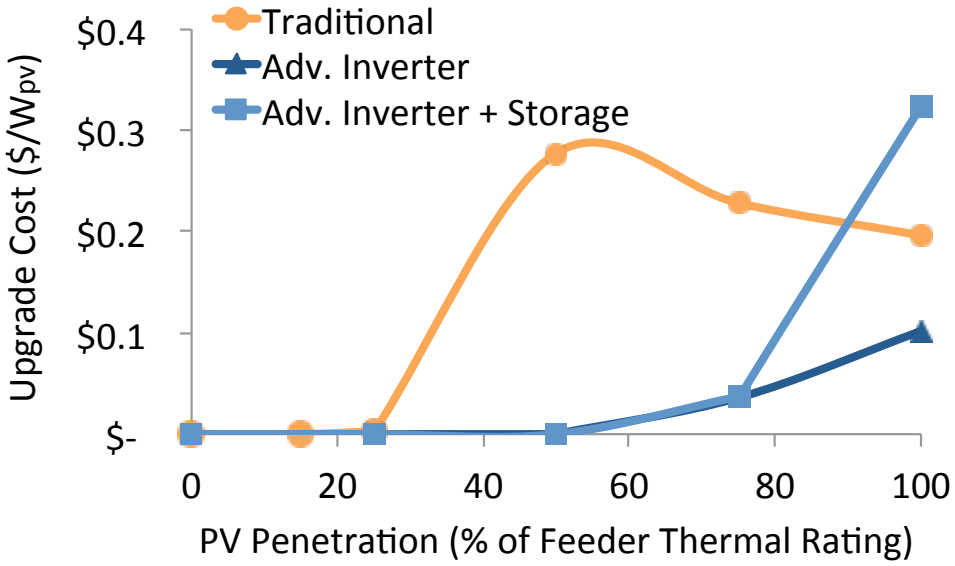
Source: PG&E's Demo A and B Reports

Impact of DPV on T&D Investments: Proactive Planning for DPV

Costs to Increase the Hosting Capacity of Fourteen Representative Feeders with Traditional Grid Upgrades



Costs to Increase the Hosting Capacity of Cluster 11 Comparing Traditional Grid Upgrades to Emerging Options



Source: Adapted from Navigant 2016a