High Penetration PV Impact Analysis

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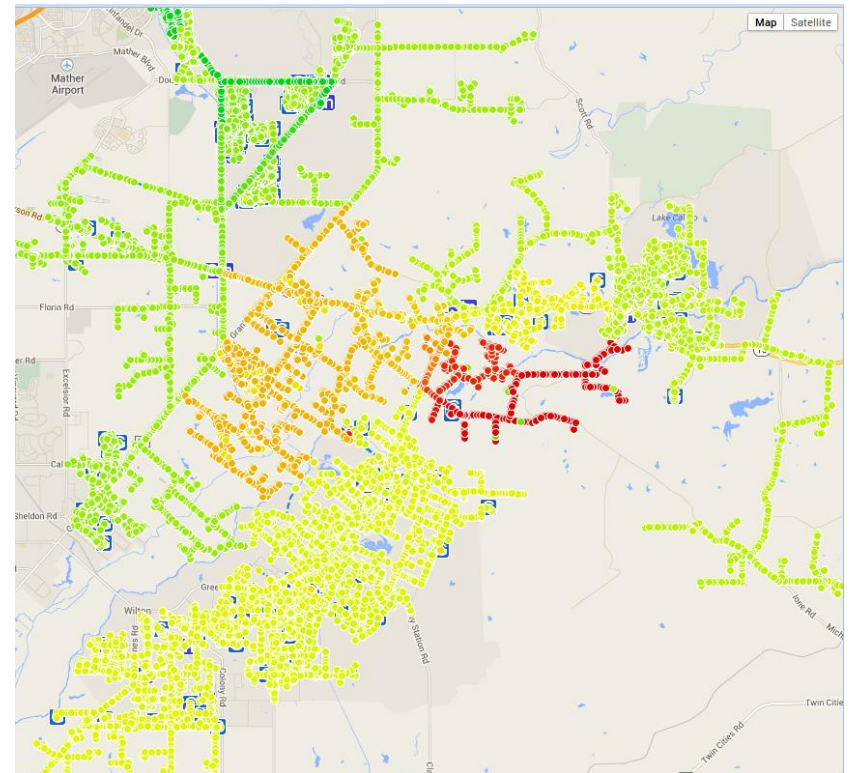**CTO, Advanced Grid Analytics**
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GRID EVOLUTION SUMMIT SEPA

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DER Impact

- Impact on voltages across the system
- Reverse power flow
- Voltage flickers and fluctuations
- Impact on regulating equipment operations
- Impact on fault currents
- Impact on protection schemes

PV Hosting Capacity

- Maximum hosting with no adverse impact
- Hosting capacity levels vary:
  - Feeder and feeder characteristics
  - Locations within a feeder
  - PV penetration types: distributed, centralized
- Approximate to very detailed analysis
- Detailed analysis requires very accurate and detailed distribution and PV models
- Modifications to a feeder may increase hosting capacity

High Penetration PV Impact Analysis

- Determine the impact of existing or short term forecasted PV
- Selected 'candidate' substations for analysis
- Selected impact at 50%, 100%, 150%, and 200% of feeder load (April 14th, peak irradiance)
- Used combined distribution + sub-transmission models
- Distributed PV pattern
- Midpoint PV pattern
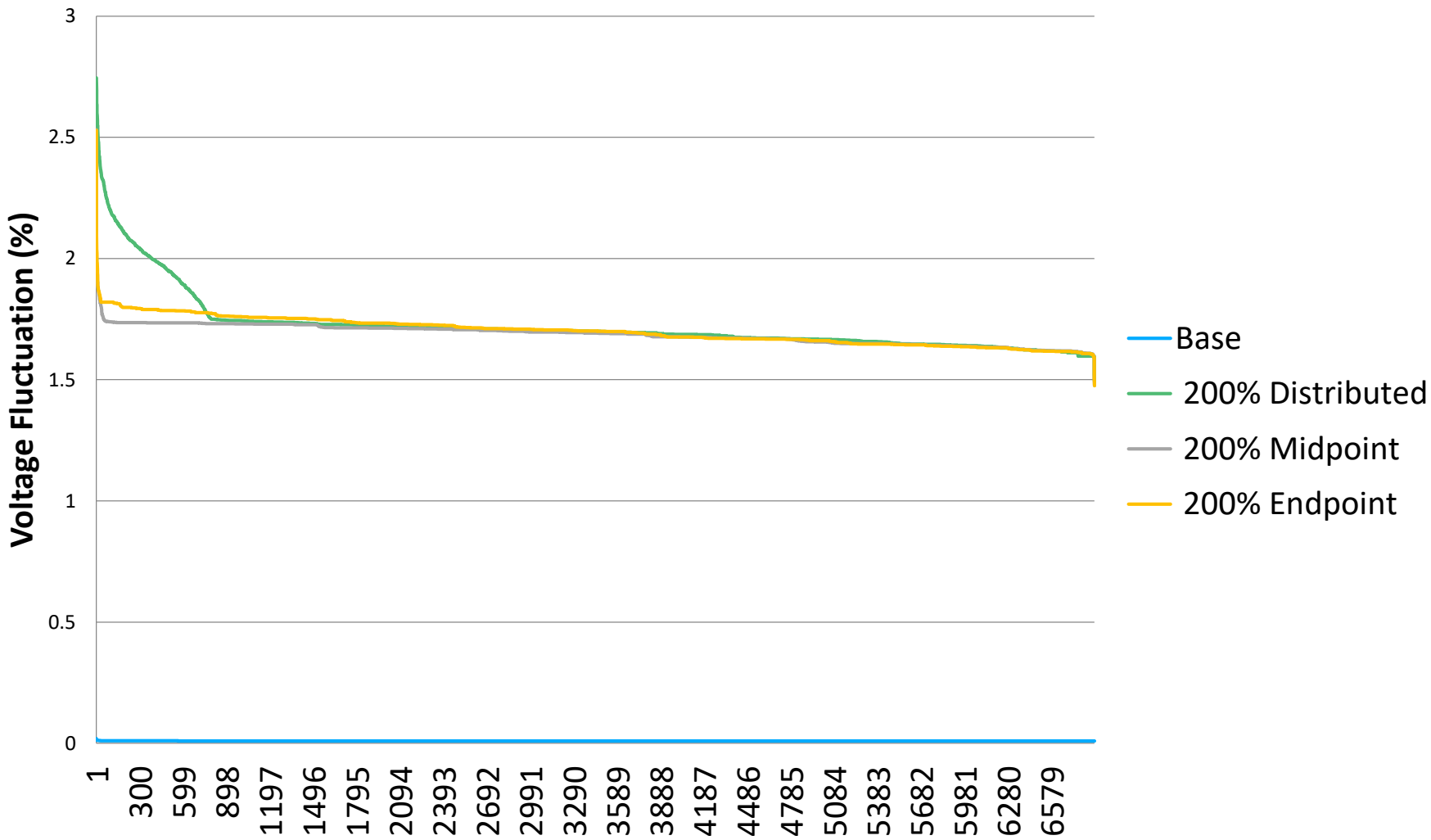- Endpoint PV pattern
- Feeder breaking point analysis

Results

Voltage Fluctuation: SUBZ18 with Distributed PV
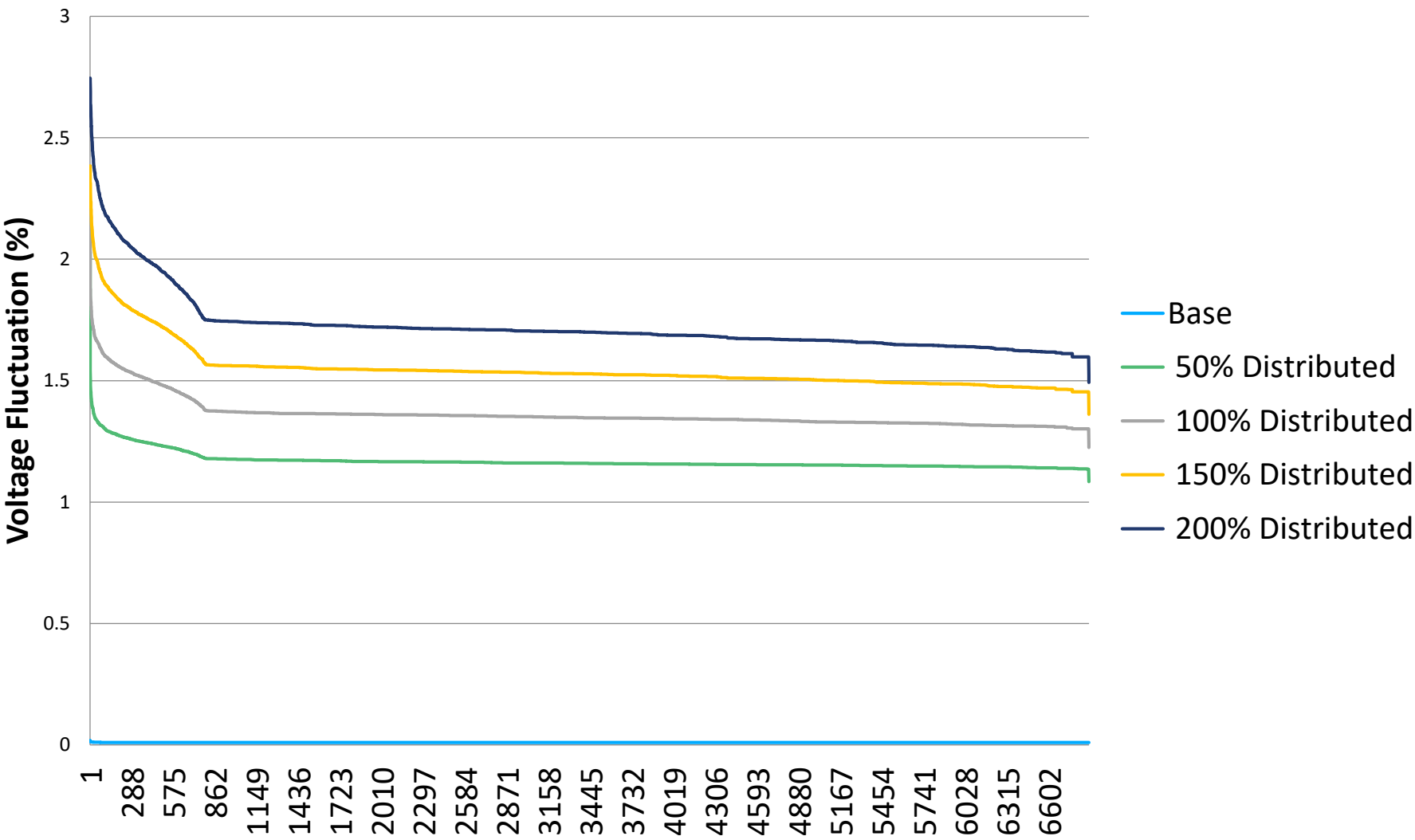
Results

Voltage Fluctuation: SUBZ18 with 200% PV Penetration

Breaking Point Analysis

Breaking point PV generation for substation SUBW20

Feeder	Distributed PV (MW)	Midpoint PV (MW)	Endpoint PV (MW)
W201201	4.5	2.2	3
W201202	4.32	2.7	3

Breaking point PV generation for substation SUBX12

Feeder	Distributed PV (MW)	Midpoint PV (MW)	Endpoint PV (MW)
X121201	6.5	3.3	3.8
X121202	4.3	3.6	3.6
X121203	2.5	1.63	1.7
X121204	5.03	2.94	3.35
X121205	4.66	3.39	4.23
X121206	3.75	3.48	3.48

Breaking point PV generation for substation SUBY12

Feeder	Distributed PV (MW)	Midpoint PV (MW)	Endpoint PV (MW)
Y121201	3.27	2.45	2.45
Y121202	1.5	2.05	2.05

Breaking point PV generation for substation SUBZ18

Feeder	Distributed PV (MW)	Midpoint PV (MW)	Endpoint PV (MW)
Z181201	1.54	4.05	3.47
Z181202	2.55	2.83	2.83
Z181203	4.91	3.44	2.94

Takeaways

- As the DER penetration gets to higher levels it is critical to analyze their impact on the electric system.

- The hosting capacity varies from substation to substation, feeder to feeder, location to location, and also penetration patterns.

- Upgrading few assets and setpoints pushed out the breaking point.

- Detailed location-based hosting capacity analysis may be the best way to define what the true hosting capacity of the system.