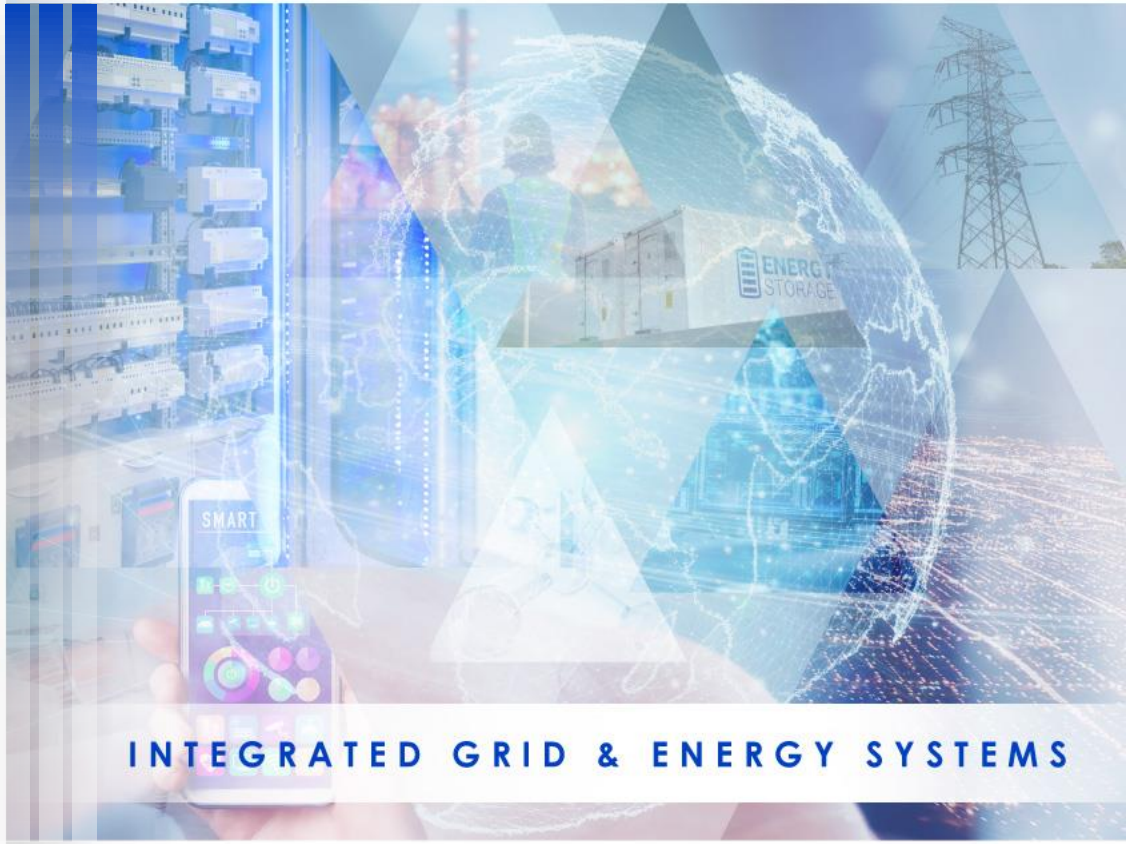
DRIVE Hosting Capacity Methodologies

Xcel Energy Stakeholder Meeting

Matthew Rylander, PhD
Advanced Analytics Lead, Distribution Ops & Planning
mrylander@epri.com

2020 June 2



Topics Covered

About EPRI

EPRI's DRIVE™ Tool

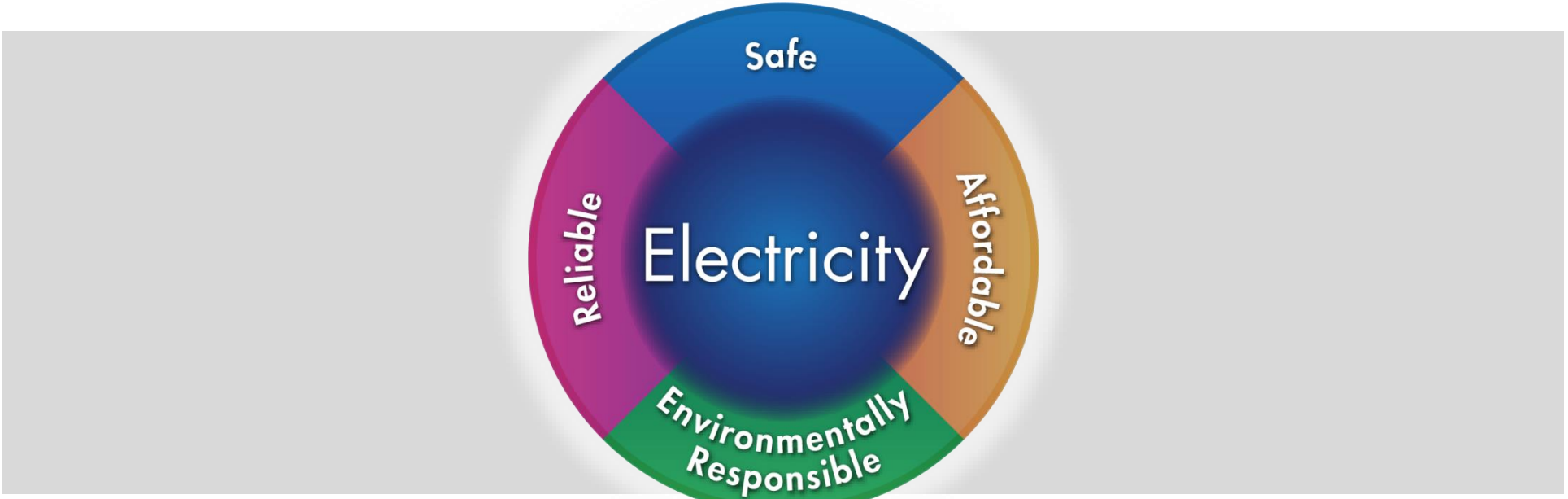
DRIVE™ Allocation Methods

Hosting Capacity Analytics

About EPRI

EPRI's Mission

Non-profit organization for advancing ***safe***, ***reliable***, ***affordable*** and ***environmentally responsible*** electricity for society through global collaboration, thought leadership and science & technology innovation



Our Members…

- 450+ participants in more than 40 countries
- EPRI members generate approximately 90% of the electricity in the United States
- International funding of nearly 30% of EPRI's electric utility research, development, and demonstration funding

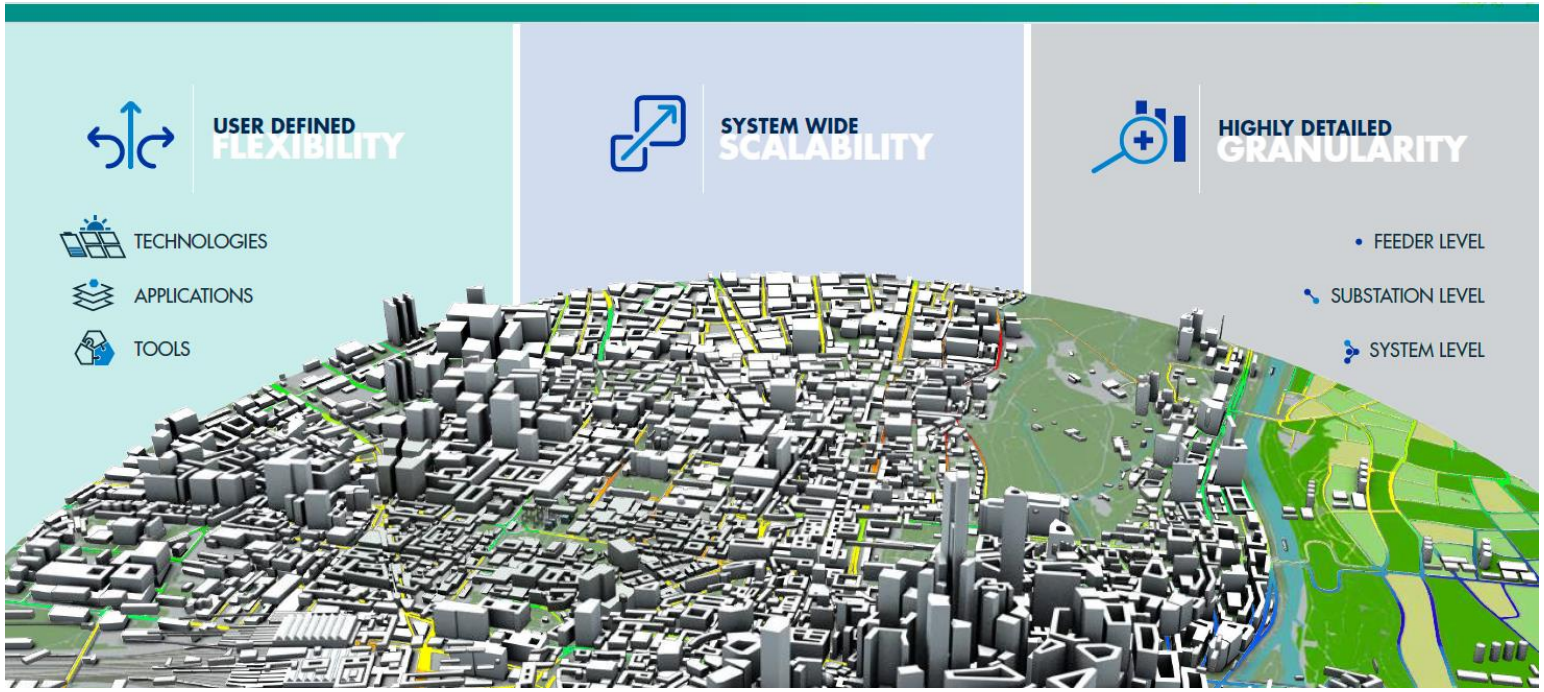
EPRI's DRIVE™ Tool

Distribution Resource Integration and Value Estimation Tool (DRIVE)

DRIVE

Enables planners to efficiently and effectively evaluate the technical impacts of DER on distribution systems

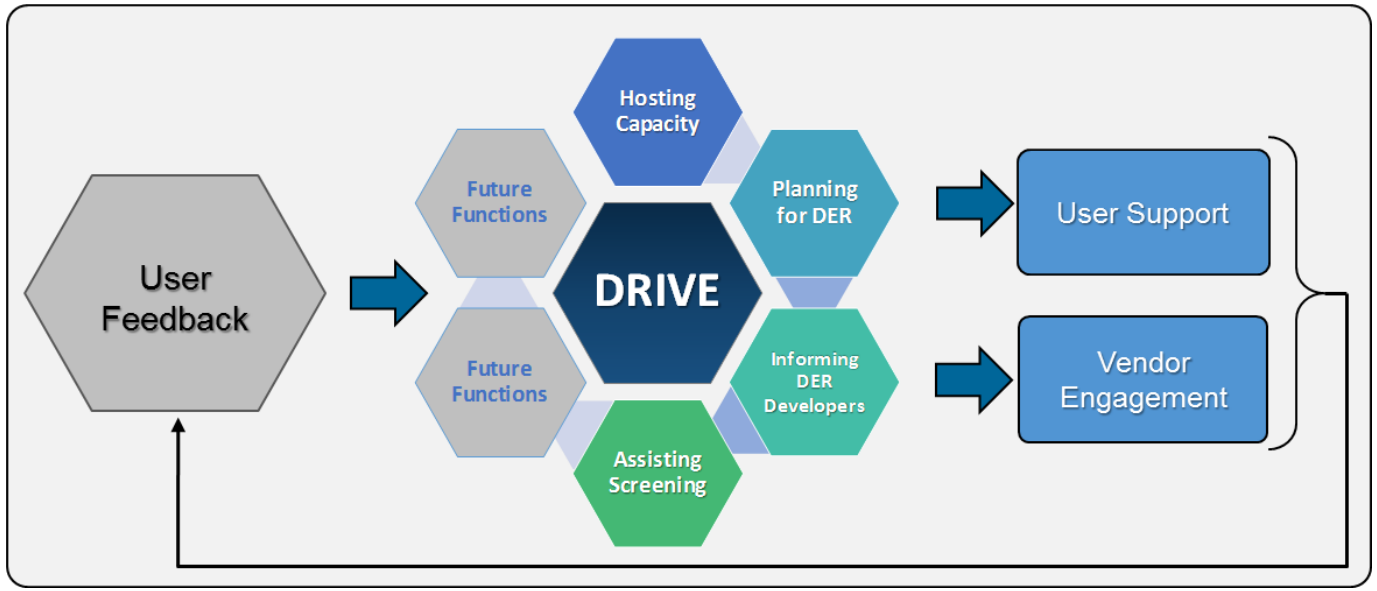
- Capabilities
  - Flexible
  - Scalable
  - Granular
- Applications
  - Hosting capacity
  - Locational value



https://youtu.be/n4papbQWp28

DRIVE User Group

- Provides a means for
  - Implementation & release of future enhancements to DRIVE
  - Support & forum for users
  - Application experience collaboration/sharing
  - Opportunities to message consistently across states

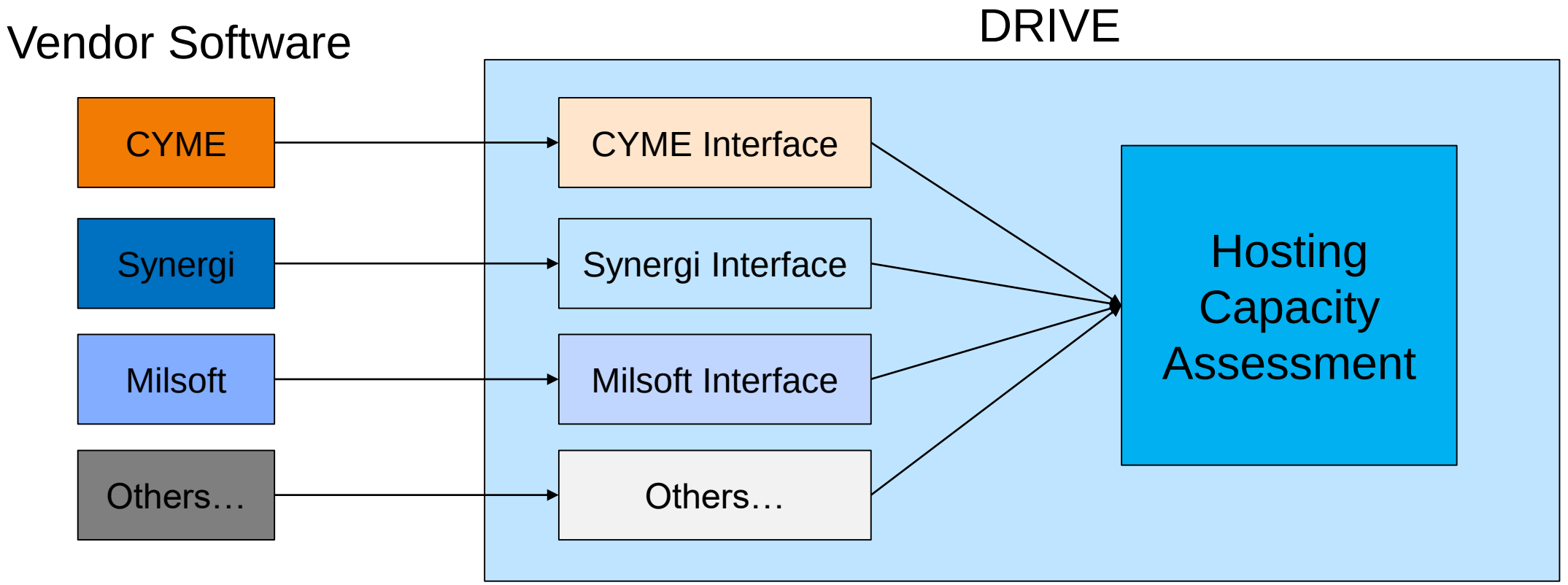


DRIVE Members

Over 35 utilities and planning tool vendors working together to apply and evolve hosting capacity in DRIVE User Group

DRIVE and Vendor Planning Tools

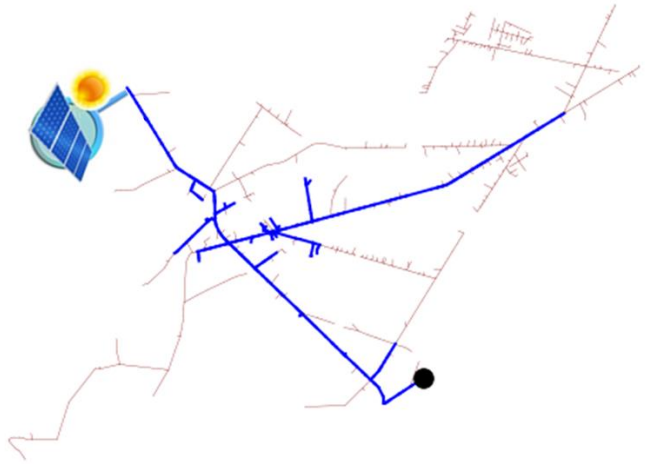
- DRIVE
  - Custom interface for each planning tool (CYME, Synergi, Milsoft, DEW, PVL, Powerfactory, etc)
  - Hosting Capacity Assessment

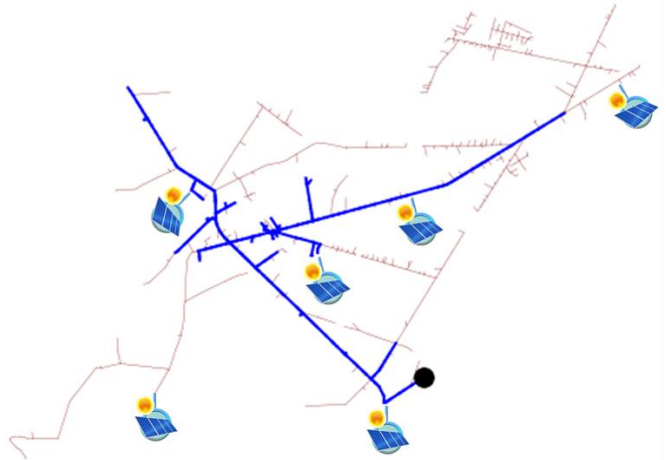


DRIVE Allocation Methods

DRIVE Methods to Allocate Generation

- Centralized
  - Location specific allocation
  - Feeder-wide impact observed
  - Hosting capacity describes what each location on the feeder can host
  - Resulting hosting capacity is independent of what other locations can host
  - Used to inform interconnection
- Distributed
  - Multiple location allocation
  - Feeder-wide impact observed
  - Hosting capacity describes what the feeder can host
  - Resulting hosting capacity is dependent on how the generation is distributed across the feeder
  - Used to inform planning

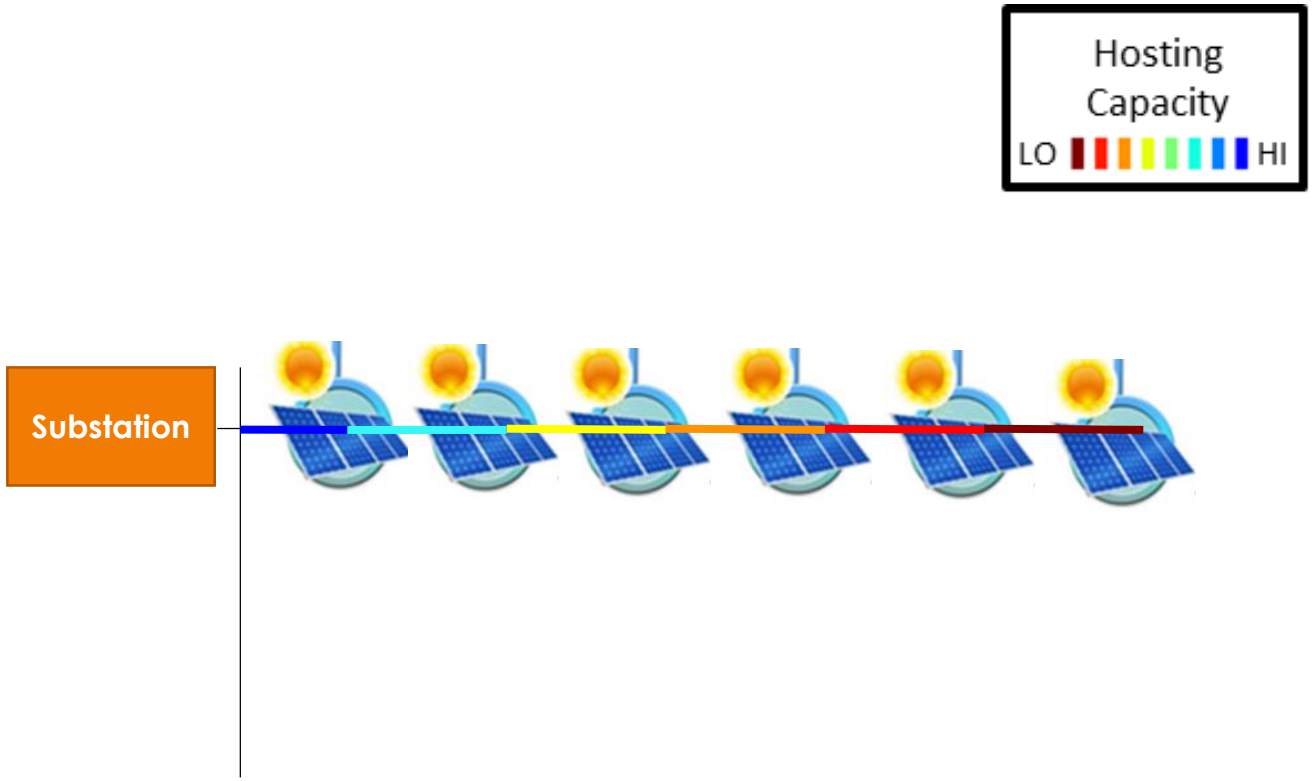




DRIVE UG has identified the need for two key forms of DER allocation.

Centralized Hosting Capacity

Interconnection Use-Case



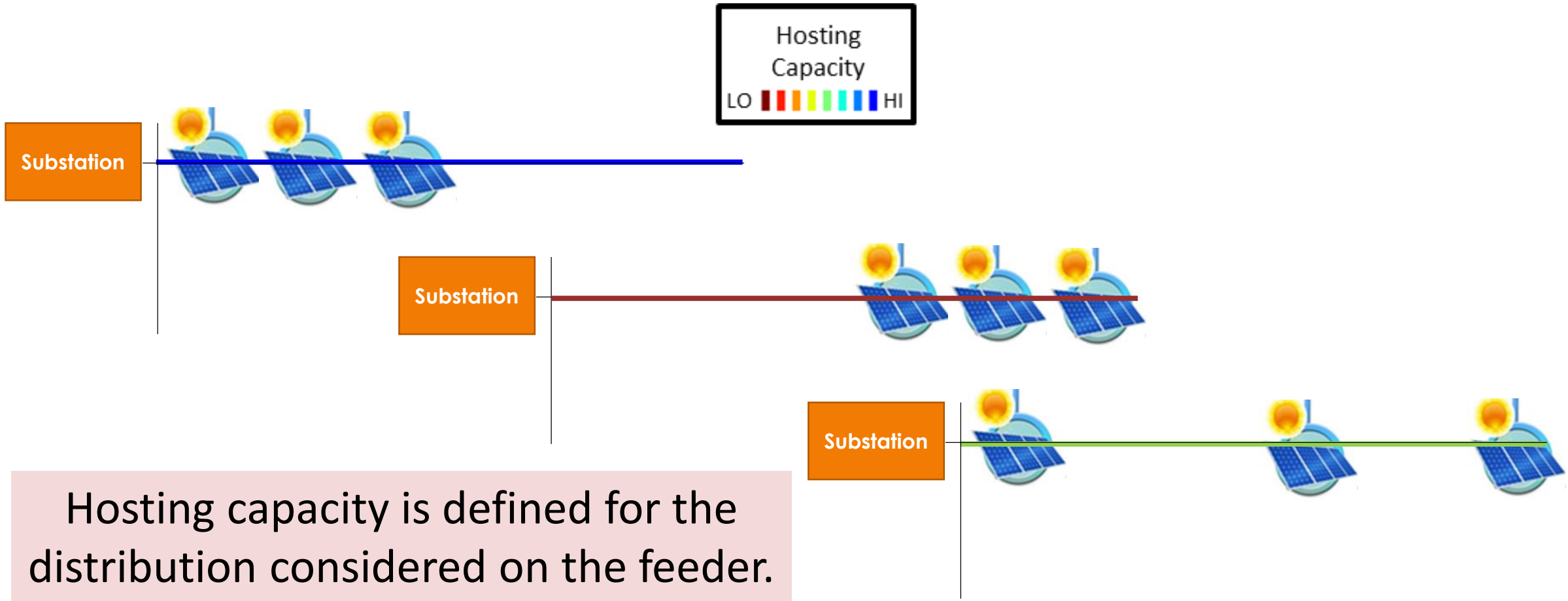
Hosting capacity is defined for the analyzed location.

A section's hosting capacity is the range in hosting capacity between the locations analyzed.

Distributed Hosting Capacity

Planning Use-Case

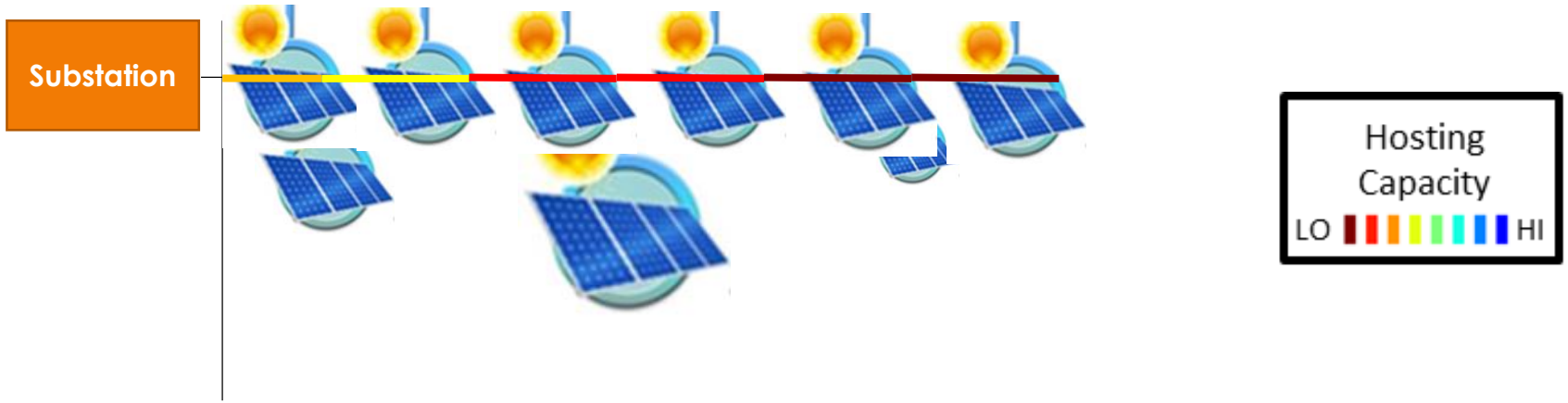
- At existing customer location (Previously defined as ‘Distributed Small’)
- At three-phase locations (Previously defined as ‘Distributed Large’)



Hosting capacity is defined for the distribution considered on the feeder.

Combining Distributed and Centralized Allocations

- Members of the DRIVE UG requested this update in Version 2.1
  - First – allocate forecasted amount of load/generation
  - Second – complete Hosting Capacity analysis with one previous methods
- Combined planning and interconnection use case
  - Reserves hosting capacity for forecasted load/generation
  - Requires accurate forecast if used for interconnection



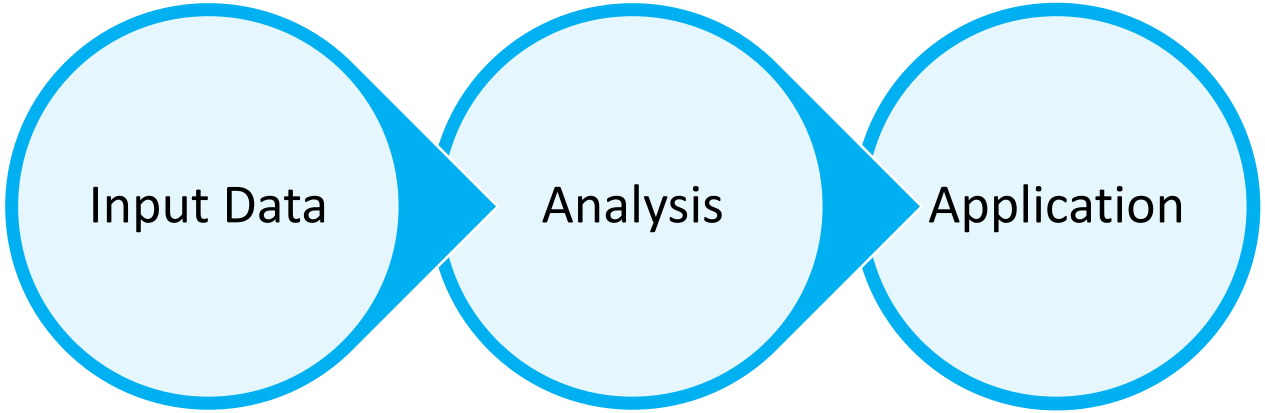
Summary

- Centralized Allocation
  - Identifies the amount of generation that can interconnect at a particular location
  - Interconnection use-case because a single generator could connect near-term
- Distributed Allocation
  - Identifies the aggregate amount of generation that can be interconnected across the feeder
  - Planning use-case because aggregate generation will take time to interconnect
- Combined Centralized and Distributed Allocation
  - Interconnection and planning use-case
  - Could be used for planning to “set aside” a certain amount of hosting capacity for smaller roof-top projects interconnected over a planning horizon
  - Hosting capacity results for interconnection use-case would rely on the forecasted load/generation

Hosting Capacity Analytics in Tools

Hosting Capacity Process

Hosting capacity is a complex process that combines the collection of input data and the selection of analytical parameters that ultimately define how the results can be applied.



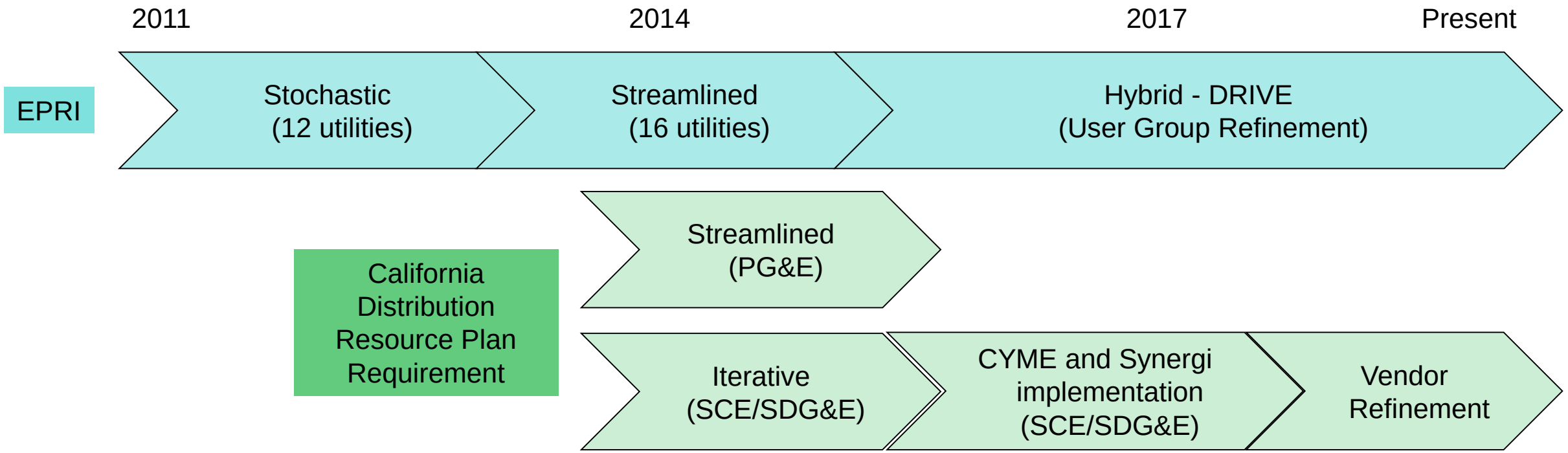
Hosting Capacity Process has been refined based on input from utility, DER stakeholders, tool vendors, and regulatory processes

Evolution of Analytics Happening in Parallel

Input/Data	Utility dependent based on data/model availability, application of interest, impact factors considered		
Analysis	DRIVE implemented with any vendor tool	ICA implementation in CYME	ICA implementation in Synergi
Applications	Range from informing developers, interconnection, to planning		

The analytics and tools have evolved separately to meet the needs of the process but have been designed by tool developers and in some cases, by utility user groups like DRIVE

Background Hosting Capacity Analytic Evolution



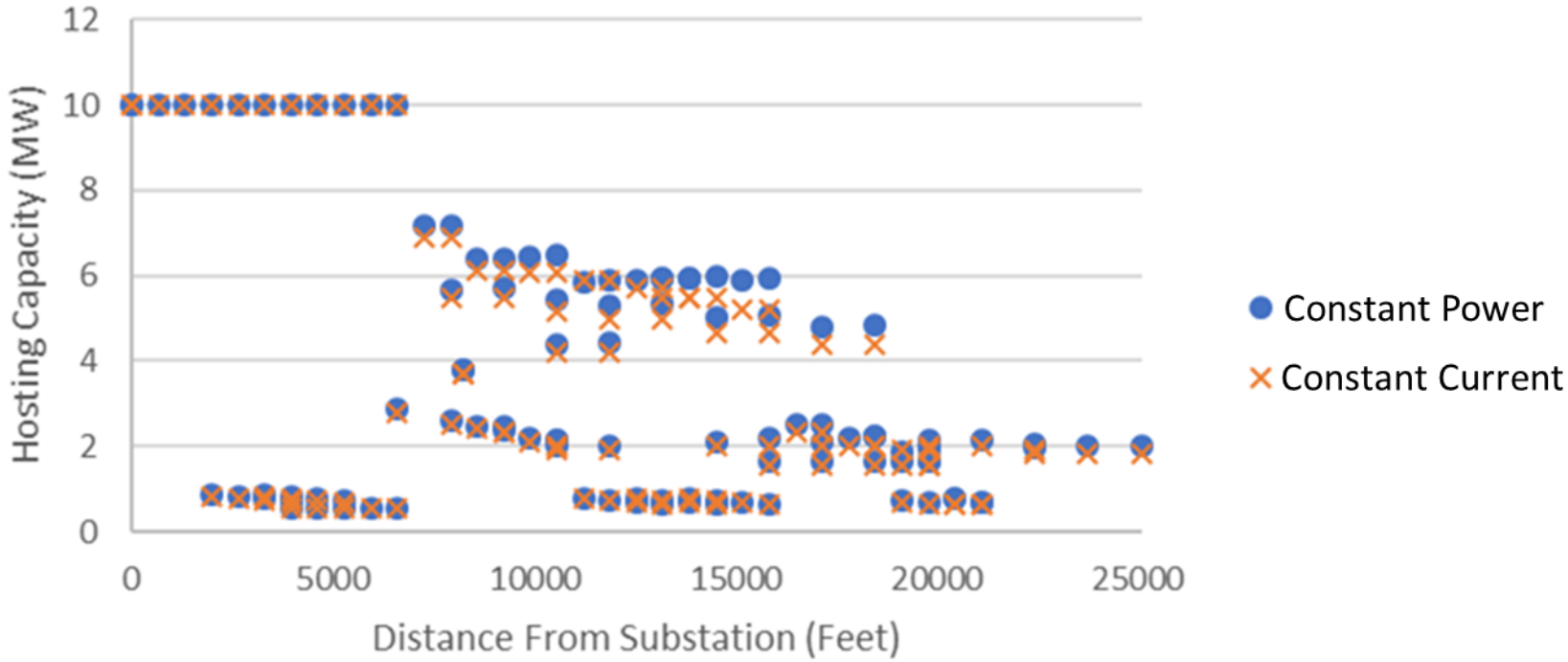
Refinement includes: How the analysis iterates between penetration levels, what impact factors are considered, what options are brought out to the users, etc.

Hosting Capacity Criteria

Criteria	Description	DRIVE	Synergi
Primary Over-Voltage	Inspects voltage magnitude with respect to voltage limit	X	X
Primary Voltage Deviation	Inspects the change in voltage due to all DER becoming suddenly active	X	X
Regulator Voltage Deviation	Inspects the change in voltage with respect to bandwidth at a regulated node	X	-
Thermal for Generation	Inspects the current flow through utility equipment with respect to thermal ratings	X	X
Additional Element Fault Current	Inspects the addition of fault current created by generation	X	-
Breaker Relay Reduction of Reach	Inspects the deviation in breaker fault current caused by generation	X	-
Reverse Power Flow	Inspects protection and thermal issues due to reverse power flow into the substation	X	X
Unintentional Islanding	Inspects safety and reliability issues if generation does not disconnect during islanding conditions	X	-

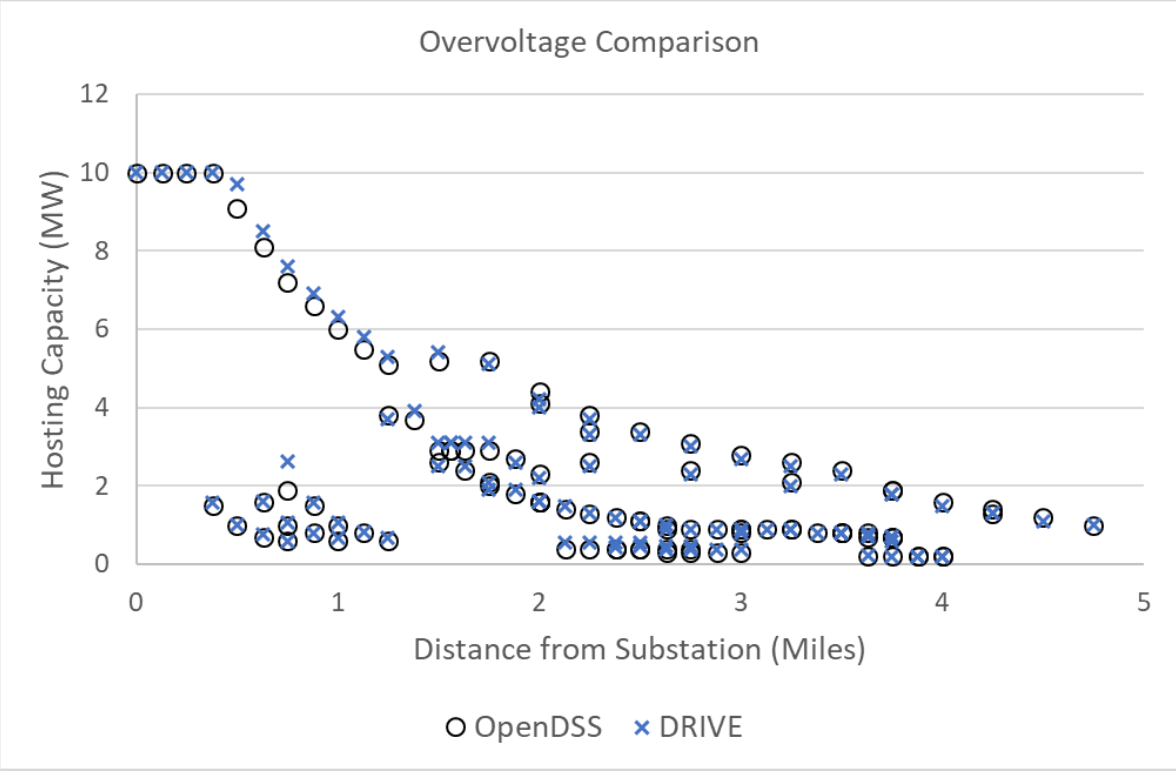
Ongoing Comparison to Identify Differences

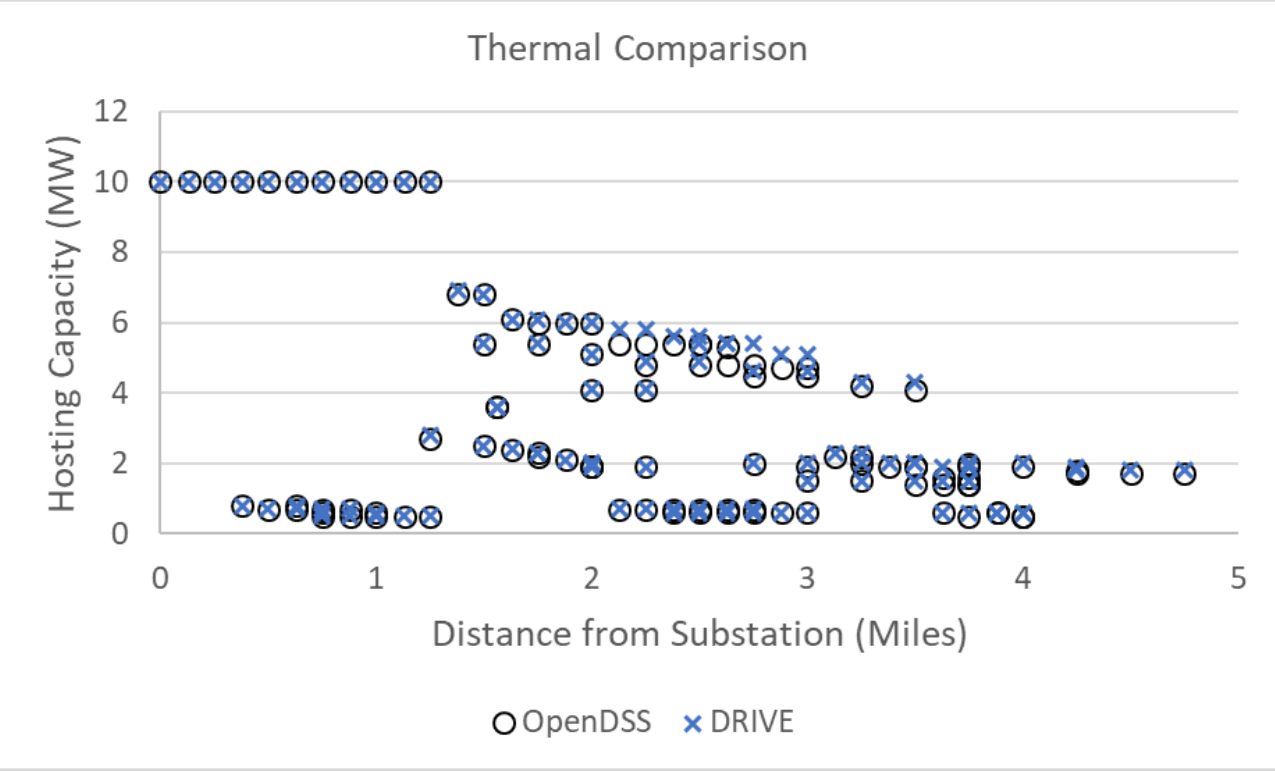
- Future resource characteristic when determining thermal hosting capacity
  - Constant current
  - Constant power



DRIVE Validation

- Validation is done routinely by EPRI as the tool evolves with comparisons to detailed analyses





Xcel's Internal Analysis vs. DRIVE

Table 4: DRIVE Results Compared to Synergi Results

Feeder	DRIVE Min Hosting Capacity (MW)	DRIVE Min Threshold Violated	Synergi Min Hosting Capacity (MW)	Synergi Min Threshold Violated	Difference in Min Values (MW)
MGN211	0	Primary Over-Voltage	0.09	voltage limit	0.09
ALB021	0.3	Primary Over-Voltage	0.38	voltage limit	0.08
RRK064	0.7	Primary Over-Voltage	0.72	voltage limit	0.02
SCL322	0	Primary Over-Voltage	0.00	voltage limit	0
LSP022	0.2	Primary Over-Voltage	0.05	voltage limit	0.15
WOB021	0	Primary Over-Voltage	0.06	voltage limit	0.06
BRO021	0	Primary Over-Voltage	0.04	voltage limit	0.04
PAT313	0	Primary Over-Voltage	0.07	voltage limit	0.07
PAT312	0	Primary Over-Voltage	0.00	voltage limit	0
CLC221	0.2	Primary Over-Voltage	0.01	voltage limit	0.19
WAT081	0.6	Primary Over-Voltage	0.00	voltage limit	0.6
CHI311	0.2	Primary Over-Voltage	0.00	thermal loading	0.2
DND062	0.28	Thermal for gen	0.45	thermal loading	0.17
NOF061	0	Primary Over-Voltage	0.00	voltage limit	0
ALT021	0	Primary Over-Voltage	0.07	voltage limit	0.07

Summary of Analytics in Tools

- Analytics are one part of the hosting capacity process
- Hosting capacity analytics in software tools leverage cutting edge algorithms to address the complexities of the process
- Analytics need to evolve through vetted research and utility guidance, giving it transparency
- Results need to be validated to detailed studies by software developers

Ongoing validation and comparison of methodologies is needed as analytics in tools evolve.

Together...Shaping the Future of Electricity