

INTEGRATION OF HOSTING CAPACITY ANALYSIS INTO DISTRIBUTION PLANNING TOOLS





Integration of Hosting Capacity Analysis into Distribution Planning Tools

Introduction

Distribution planners are being faced with a new reality – the vast majority of change to the distribution system is occurring due to the addition of distributed energy resources (DER). The result is a new set of challenges when planning and integrating DER. Just as capacity planning studies are performed for accommodating new load, hosting capacity planning studies are needed for accommodating new DER. To meet this challenge, the industry needs a system-wide method to plan for and integrate DER into the distribution system.

Providing safe, reliable, and affordable service to all customers is paramount. With the addition of DER, utility engineers must ensure it does not adversely impact power quality or reliability. Currently, techniques like interconnection screening simply do not give utilities the visibility they need into the potential impacts of DER across their distribution service territory. Furthermore, performing a detailed study requires a great deal of data and time. In lieu of these drawbacks, distribution engineers still need to understand: How much DER can be accommodated, what potential issues may arise over time, as well as where DER can be more optimally located to avoid infrastructure upgrades in order to better plan for and integrate DER. On top of these outcomes, distribution engineers are also faced with additional regulatory pressures to provide further information.

The New Reality

“The IOUs are required to define locational benefits and optimal locations for DERs...moving the IOUs towards a more full integration of DERs into their distribution system planning, operations and investment.

– CA PUC Code 769, Aug 2014

“The more efficient system will be designed and operated to make optimal use of cleaner and more efficient generation technologies and will encourage substantial increases in deployment of these technologies...DER will become integral tools in the planning, management and operation of the electric system.

– NY REV, Feb 2015

A critical aspect to help meet these challenges is to have a clearer understanding of the distribution system’s ability to host DER using available data, models, and tools utilities use today. This “hosting capacity” of a distribution system is the amount of DER that can be accommodated without adversely impacting power quality or reliability.

Hosting capacity can vary along a distribution feeder, across a range of feeders, and can change over time as the distribution system infrastructure changes and incorporates more DER.

With a tool developed around this critical aspect, more effective and efficient screening can be performed, better or worse locations for DER can be identified, and planners can better understand where and how DER impacts the entire distribution system. When combined with long-term DER forecasts, utilities can better evaluate where infrastructure upgrades are going to be required and incorporate this information into the overall strategic decision making process. In addition, once hosting capacity is determined it can be used as input to better understand where DER can bring value to the distribution system by providing services when and where they are needed.

State of the Industry

In the not-too-distant past, distribution planners had fewer interconnection requests and were able to analyze each DER application individually. More recently as applications have increased exponentially, utilities have begun employing fast-track methods like the “15% rule” for peak feeder load in order to process the large number of applications. These are intended to be conservative methods, but have taken the dependence on actual feeder characteristics out of the equation. Cognizant of the importance of factors that vary widely among feeders, some utilities have looked towards clustering feeders based upon topology and model/analyze a single (representative) feeder from each feeder “cluster.” Each of these methods seeks to overcome the intensive labor needs, complexity issues, and extensive data inputs required to perform a rigorous analysis on each individual feeder.

Table of Contents

Introduction 2
 Considerations for an Effective Method 3
 EPRI’s Streamlined Hosting Capacity Method 5
 Requirements for Successful Implementation 8
 Implementation in Distribution Planning Tools 9
 Conclusions 10
 References 10

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Integration of Hosting Capacity Analysis into Distribution Planning Tools

However, EPRI analysis has shown that percent-load screens and feeder clustering may not accurately reflect how much DER a feeder can host^{1,2}. Improved methods are needed that enable utilities to *effectively* and *efficiently* evaluate the entire distribution system with DER.

The industry has begun to explore new methods to consider these resources in the planning process. Most recently in California, the IOUs filed Distribution Resource Plans documenting different approaches. While each of these approaches have similar goals, the actual implementation varies considerably based upon the extent of data and models readily available for analysis.

Since 2014, EPRI has been working to develop, streamline, and validate newer methods for determining hosting capacity using readily available utility data and tools. These new methods build on the detailed work done with PV, and since expanded, to consider hosting capacity of any DER across a range of distribution impacts considered by utilities.

This white paper will describe the streamlined hosting capacity method developed by EPRI, the implementation of that method in distribution planning tools, and the data needed to successfully use this method to determine distribution-wide hosting capacity.

Considerations for an Effective Method

In analyzing dozens of feeders across the U.S.³, one thing is abundantly clear – the amount of DER that can be accommodated without upgrading the system varies between distribution systems and on feeders within a system. The main factors that drive the amount of DER that can be hosted, without necessitating changes to the grid, are: 1) DER location, 2) feeder design and operation, and 3) DER technology.

These main factors can result in a wide range of feeder hosting capacity thresholds. The interactive effects are important because in some cases, increasing levels of DER can produce a positive collateral effect, while in others it does not.

DER Location

Location, location, location...

The hosting capacity for any feeder is not one single value but a range of values that depend upon a number of factors, mainly DER location. An effective method must consider all possible single, centralized locations along a feeder as well as the aggregate impacts of highly distributed DER. Also inherent to DER location is the consideration of phasing of the feeder at that location, i.e., connected to the three-phase main trunk or a single-phase lateral.

EPRI research has shown that significant levels of small DER spread throughout a single distribution feeder can have a considerable impact on the distribution system performance. This is often neglected in many studies. Likewise, the impact of large centralized DER has been shown to have a significant but widely varying impact depending upon where it is located along the distribution system³. Effective hosting capacity methods should consider a wide variety of location-based DER scenarios.

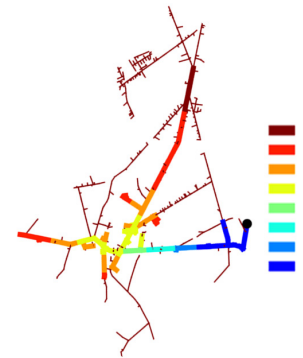


Figure 1 – The Location

Feeder Design and Operation

Distribution feeder characteristics also determine how much DER can be hosted. Voltage class, feeder topology, and load location are just some of the factors that determine what level can be accommodated and where. Additionally, the operation of the system, like voltage control schemes and radial/network topology, can have an impact on the amount of DER that can be accommodated and where.

The actual feeder design and operation includes a significant number of characteristics. These characteristics result in a dynamic interaction that must be examined in the power flow solution of the complete feeder model.

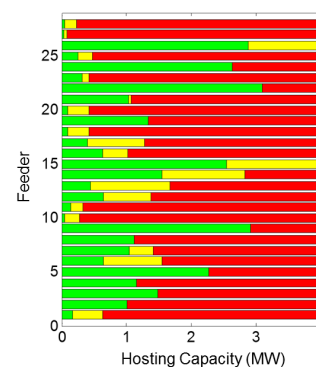


Figure 2 – The Feeder

¹ Alternatives to the 15% Rule: Final Project Summary. EPRI, Palo Alto, CA: 2015. 3002006594.
² Determining the Effectiveness of Feeder Clustering Techniques for Identifying Hosting Capacity for DER. EPRI, Palo Alto, CA: 2015. 3002005795.
³ Distributed Photovoltaic Feeder Analysis: Preliminary Findings from Hosting Capacity Analysis of 18 Distribution Feeders. EPRI, Palo Alto, CA: 2013. 3002001245.

DER Technology

The type of DER is another critical component since variable DER such as solar and wind have a vastly different distribution impact when compared to other forms of dispatchable DER such as energy storage. The differences primarily emanate from the ability, or lack thereof, to control the DER and when the DER is available. Care must be taken when considering specific technologies and how they interact with the grid.

Variable generation such as solar and wind are similar in that they are for the most part non-dispatchable resources. Even though they are both an intermittent resource their impact to the system is dependent on the time of day they provide power. Solar generation is constrained to daylight hours, while wind is not. The impact to the grid can also be vastly different based on their energy conversion technology. Inverter-based solar generation typically has a low fault contribution while wind generation is dependent on the turbine technology.

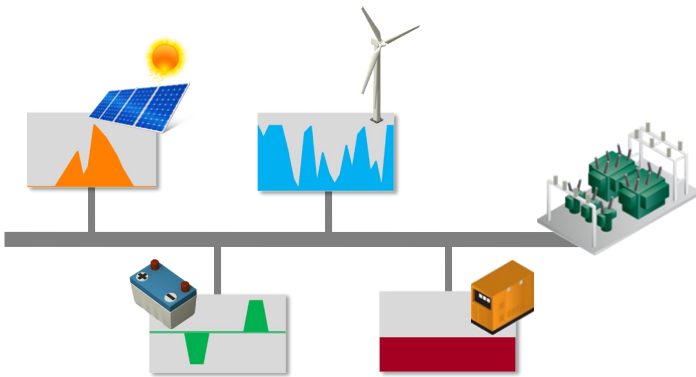


Figure 3 – The Technology

Energy storage is often considered as a solution to many intermittent resource problems, and although energy storage can provide such a solution, the technology comes with its own set of impacts that must be considered. The mode by which energy storage is used can have a widely varying impact to the grid. Such mode could be 1) unconstrained based on the resource owner’s discretion, 2) constrained based on the market use of the resource, or 3) utility-controlled based on the utility knowledge and control of the resource. Each mode presents its own set of impacts to the system and should be examined uniquely.

The impact of inverter-based technologies can change when advanced inverters that have additional grid support functionality are used. In some cases, this functionality can help reduce the impact of the intermittent resource by providing voltage support. However, advanced inverters don’t always reduce impact. Identifying the appropriate settings for operation is critical.

Impact to the system is also not only reserved to intermittent resources and energy storage. Other forms of generation such as fuel cells, microturbines, synchronous generation, etc., present unique considerations to the capacity planning process.

An effective method for determining distribution system hosting capacity for DER must take into account all of the factors listed above: location, feeder design, and DER technology. However the requirement doesn’t stop there. Overarching components for effective analysis across an entire distribution system requires additional considerations.

Distribution-Wide Applications

In order for any method of analysis to find distribution-wide application, additional criteria must be met. The method must provide enough granularity such that it can distinguish the important factors that most affect hosting capacity: location, feeder design and operation, and DER technology. Requirements do not stop there, however. The method must also be scalable in order to analyze entire distribution systems but also repeatable to consider individual feeder modifications. Transparent and proven methods should also be used in order to gain confidence. Lastly, the method must also be available such that readily accessible data and distribution planning tools can be utilized.

Granular	• Capture unique feeder-specific responses
Repeatable	• As distribution feeders change
Scalable	• System-wide assessment
Transparent	• Clear and open methods for analysis
Proven	• Validated techniques
Available	• Utilize readily available utility data and tools

Figure 4 – Fundamental Components for Distribution-Wide Applications



Integration of Hosting Capacity Analysis into Distribution Planning Tools

EPRI has specifically designed a new method that is rooted in all of the components listed above. This new streamlined method for analyzing feeders is intended to provide distribution planners with the necessary capability to effectively and efficiently analyze DER impacts across the entire distribution system.

EPRI's Streamlined Hosting Capacity Method

Developing a New Approach

Throughout 2012-2014, EPRI performed detailed analyses of distribution feeders to determine the impact and hosting capacity for PV. Based on the correlation of the distribution impacts from this detailed analysis^{4,5,6}, trends in the impact were observed in three areas:

1. The magnitude based on aggregate DER penetration
2. The dependency on feeder characteristics
3. The dependency on the location of DER

Trends from these results formed the basis for a streamlined method of determining, on a feeder-by-feeder basis, hosting capacity across a distribution system. EPRI's Streamlined Method determines distribution impacts more quickly without compromising accuracy. Utilizing the original detailed approach, the engineering time associated with analyzing a single feeder was on the order of weeks. However in the streamlined method, a single feeder can be analyzed in a matter of minutes through the newer methods and automated nature of the analysis. The streamlined hosting capacity method does not replace the detailed analysis however, but does provide an analysis method between interconnection screens and detailed analysis thus allowing utilities to efficiently evaluate impacts and determine whether a more detailed study is necessary.

Considering DER Impacts and Technologies

The streamlined hosting capacity method considers a wide range of impacts throughout each feeder based on what is commonly considered as part of a typical DER interconnection study. The four main categories are thermal, voltage/power quality, protection, and reliability/safety. Within each, there are a range of different outputs that result from the analysis of each impact shown in Table 1. Utilizing these outputs, the distribution planner can make a decision not only about interconnection impact, but also about how new systems might impact operation of the feeder over time.

Table 1 – Distribution Impacts Evaluated in Streamlined Hosting Capacity Method

Thermal	Power Quality/ Voltage	Protection	Reliability/ Safety
Substation Transformer	Sudden (fast) voltage change	Relay reduction of reach	Unintentional Islanding
Primary Conductor	Steady-state voltage	Sympathetic tripping	Operational flexibility
Service Transformer	Voltage regulator impact	Element fault current	
Secondary conductor	Load tap changer impact	Reverse power flow	

The method itself is DER technology neutral. While the primary focus for the original method⁷ was solar PV, the new method has since been enhanced to consider other distributed technologies as well. To date, the streamlined hosting capacity method can be used to analyze the following technologies:

- Solar
- Wind
- Energy storage (unconstrained)
- Fuel cells
- Microturbines
- Synchronous machine (gas turbine, diesel generator)

The specific technology determines how the analysis is setup to properly quantify the unique impacts of the particular resource.

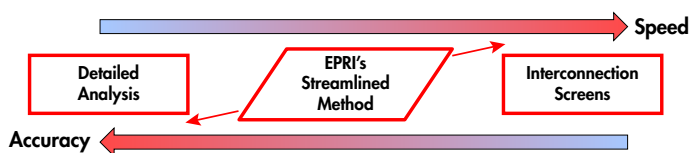


Figure 5 – Balancing Speed and Accuracy Between Different Approaches

⁴ Stochastic Analysis to Determine Feeder Hosting Capacity for Distributed Solar PV. EPRI, Palo Alto, CA: 2012. 1026640.

⁵ Distributed Photovoltaic Feeder Analysis: Preliminary Findings from Hosting Capacity Analysis of 18 Distribution Feeders. EPRI, Palo Alto, CA: 2013. 3002001245.

⁶ Alternatives to the 15% Rule: Modeling and Hosting Capacity Analysis of 16 Feeders. EPRI, Palo Alto, CA: 2015. 3002005812.

⁷ A New Method for Characterizing Distribution System Hosting Capacity for DER: A Streamlined Approach for PV. EPRI, Palo Alto, CA: 2014. 3002003278.

The Core Analytical Method

In developing the Streamlined Hosting Capacity Method, it was critical that it remain rooted in the feeder model which allows observation of how feeder characteristics interact with one another. The feeder model is analyzed with a series of loadflow and fault studies. The loadflow study provides voltages, element loading, load allocation, and connectivity of the model, while the fault study provides impedance/resistance/reactance data.

The DER assessments are then performed by applying various DER “scenarios.” These scenarios consider centralized (single-site) and distributed (multiple-site) DER locations. Thousands of scenarios are examined on all potential locations, or “nodes”, on the distribution feeder. A simplistic illustration of a small subset of scenarios is shown in Figure 6.

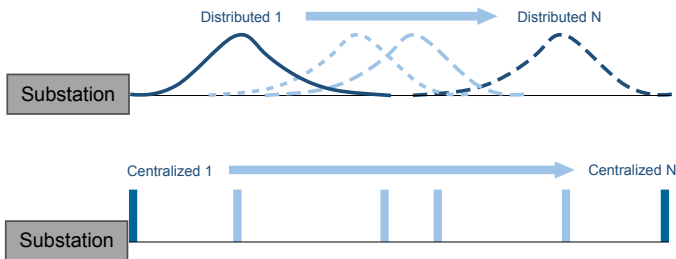


Figure 6 – Subset of DER Scenarios Analyzed in the Streamlined Analysis

These scenarios make up the basis of the DER impact analysis. Each scenario results in a node-specific hosting capacity for DER at a specific location. The node is a point on the feeder between two line sections. Depending on the model, this may resemble locations in the field where the feeder branches, is sectionalized, or locations of power poles. For Centralized DER, a scenario’s hosting capacity is based on DER at that location and does not consider DER at any other location on the feeder. For Distributed DER, a scenario’s hosting capacity is depicted at the node where the DER is “centered” on the feeder and only considers DER at other locations based on the applied DER distribution. For both Centralized and Distributed DER, there are as many scenarios simulated as there are nodes on the feeder. Each scenario results in a hosting capacity value and therefore there are two hosting capacities at each node – one based on Distributed DER and another based on Centralized DER. The number of hosting capacity values then scales linearly with the number of distribution impacts considered.

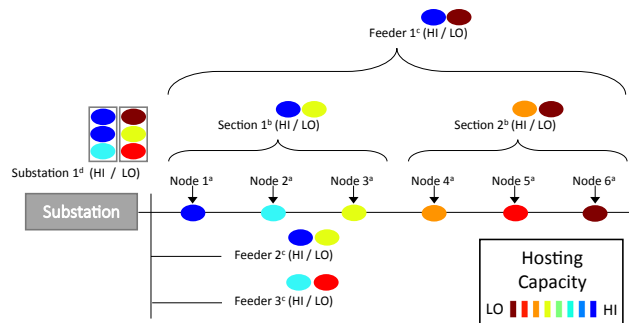
A simple feeder example in Figure 7 illustrates hosting capacity at the node, section, feeder, and substation. In this example, one dis-

Considering the Time-Varying Impacts of DER

When evaluating actual DER impacts there are two aspects that one must consider, both time and space (location). The OpenDSS was originally developed by EPRI engineers to take both of these aspects into account. Time is a one-dimensional characteristics that, when considered properly, can be bounded by choosing the appropriate loadflow studies. Space, however, is multi-dimensional and therefore cannot be effectively bounded or approximated. As a result, in order to better quantify impacts the core method calculates the primary driver, location, and bounds time.

tribution impact is considered for centralized DER. The six nodes are each independently examined for the amount of DER that can be accommodated at that location. The colors indicate the resulting hosting capacity. The section hosting capacity is then the range in node hosting capacity on that section. Again, the section’s HI/LO range is based on DER only at a single node along that section. Any DER on other sections will change the resulting hosting capacity. Similarly, the feeder hosting capacity is the range in node hosting capacity on the entire feeder. It is important to note that the feeder and section hosting capacity IS NOT the summation of individual node hosting capacities.

Each feeder can then be analyzed independently to determine their feeder hosting capacities. Aggregating further to the substation, one could determine the substations overall ability to accommodate DER. At the substation, the hosting capacity is the summation of individual feeder hosting capacities.



^a Node Hosting Capacity is dependent on DER at other nodes. That shown above is based on DER only at the specified Node.
^b Section Hosting Capacity is the HI/LO range in Node Hosting Capacity on that section.
^c Feeder Hosting Capacity is the HI/LO range in Node Hosting Capacity on the feeder.
^d Substation Hosting Capacity is the HI/LO range representing the summation of HI and LO Feeder Hosting Capacities.

Figure 7 – Example of Node, Feeder, Section, and Substation Hosting Capacity for Centralized DER and One Distribution Impact



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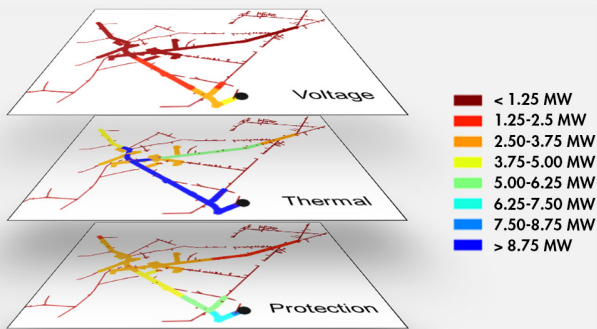


Figure 8 – Node Hosting Capacity for Three Distribution Impacts

One of the most effective methods to convey results is through visualization. Maps illustrating hosting capacity can easily be created through feeder models. Figure 8 shows a detailed hosting capacity solution for centralized DER and three distribution impacts. The hosting capacity is shown at the node, thus the color at the node depicts the amount of DER that could be accommodated at that location and nowhere else on the feeder. Each distribution impact can have a significantly different hosting capacity.

The node hosting capacity is ultimately the lowest based on all criteria considered. Figure 9 shows an example where the node hosting capacity reflects all issues chosen in the analysis for Centralized DER. The feeder hosting capacity then depicts the lowest hosting capacity from the node-based results. The entire feeder is shaded the

same color to portray that DER penetration above that level may be problematic at some location on the feeder. There are many locations shown in the node-based results that can accommodate higher levels of DER, but any penetration less should not be problematic.

Feeders served out of the same substation transformer can have many different hosting capacities as shown in the feeder hosting capacity results. Out of seven feeders served from the substation transformer, one falls into the highest hosting capacity range while two fall into the lowest. The substation hosting capacity is the summation of all the individual feeder hosting capacities. All feeders served from the substation transformer are shaded the same color to represent the substations ability to accommodate DER. Again, the value shown in the example depicts the worst-case scenario that occurs on all feeders served. Alternatively, the best-case scenario can be portrayed for feeder and substation hosting capacity.

Applications

The Streamlined Hosting Capacity Method enables distribution planners to systematically analyze impacts of DER across an entire distribution system. Table 2 summarizes some of the potential applications for the results produced from such an analysis.

Table 2 – Potential Applications of the Streamlined Method

System-Wide Distribution Planning	<ul style="list-style-type: none"> • Determine DER impacts and hosting capacity on a feeder-by-feeder basis across the entire distribution system • Calculate capacity for accommodating new loads • Evaluate impacts on grid reconfiguration (operational flexibility) • Evaluate impacts and solutions realized through new technologies such as smart inverters
DER Hosting Capacity	<ul style="list-style-type: none"> • Improve screening techniques that effectively account for the proposed DER and associated grid capacity at that location • Identify locations that can minimize the upgrades necessary to accommodate DER • Provide better visibility to the specific issues that arise, where, and how often they might occur throughout the distribution system • Improve visibility into feeder- and substation-level capacity for accommodating DER • Inform transmission studies
Economics	<ul style="list-style-type: none"> • Provide technical basis for cost benefit assessments – Integrated Grid • Provide starting point for analysis of Energy, Asset Deferral, Mitigation

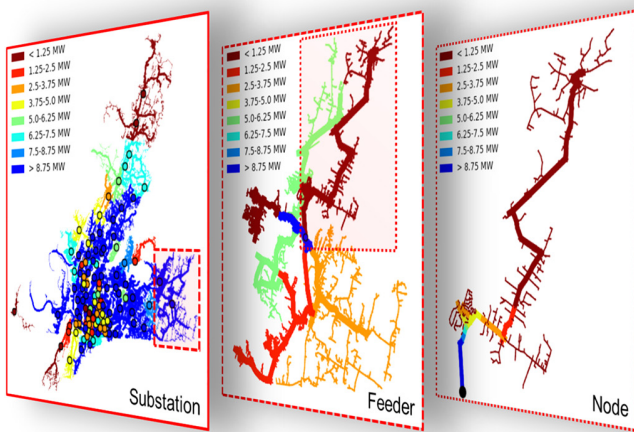


Figure 9 – Node, Feeder, and Substation Hosting Capacity



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Requirements for Successful Implementation

The data requirements behind the streamlined method are typically found in models distribution planners use today. However, not all utilities have models of their entire distribution system and that can pose a challenge when needing to analyze a service territory.

Individual Feeder Modeling

The vast majority of data needed to perform the streamlined analysis are found within typical distribution feeder models. Valid electrical feeder models include feeder medium voltage lines and regulation equipment, customer loads modeled as they are in the field (location and phase), and substation equivalent impedance. Additional data that may or may not be readily available include non-peak solutions for the feeders as well as effective models of regulation equipment (settings, etc).

Distribution-Wide Modeling

In order to perform this type of analysis across an entire distribution system, a large amount of data is required. The main challenge in successfully executing this analysis is if the entire system is not modeled or if the existing models do not accurately represent the current state of the system.

The Distribution System is Vast

An entire distribution service territory often consists of multiple large planning areas where substations and feeders have widely varying design and control parameters. Within each planning area, utilities may have 10's to 100's of substations that connect and deliver energy from the transmission to serve 100's to 1000's of different distribution feeders. Each of these feeders are outfitted with equipment for providing both voltage control and system protection with custom settings to enable the utility to serve all customers in an efficient and reliable manner.

Within each feeder there are 10's to 100's of service transformers that deliver power from the medium voltage down to a more usable, low-voltage service level. These transformers distribute this service through multiple secondary systems that connect each service transformer to individual residences, commercial buildings, and industrial complexes.

Therefore, customers located at the very "edge" of the grid – the typical distribution utility can have from 100,000s to 1,000,000s – are served by a vast and diverse number of feeders, substations, planning areas, and ultimately an entire distribution service territory.

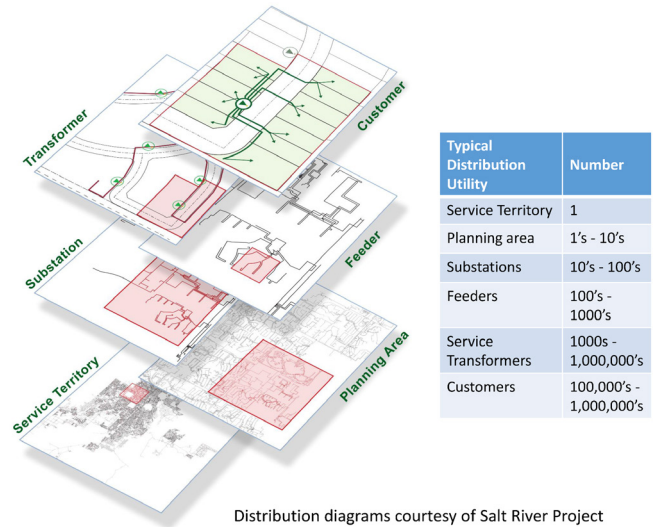


Figure 10 – Characteristics of a Typical Distribution Service Territory

Challenges with Distribution-Wide Modeling

Utilities may or may not have models of the entire distribution planning area. In some cases, models aren't needed for traditional planning purposes with one-way power flow. In such cases, it is not uncommon for utilities to rely on other means for planning that utilize rules-of-thumb combined with other data repositories such as GIS, asset documentation, and customer information systems.

In some cases only a limited number of distribution models are available. This typically occurs as an artifact from model development on an as-needed basis. Often times this has been initiated because of the need to evaluate a proposed DER interconnection. This can be a time-consuming exercise. Utilities are now in the process of documenting the system in a more detailed fashion in light of these needs.

As the grid is modernized, available and valid data has become more prevalent but it still remains a difficult and time consuming process

Historically, utilities have not found it necessary to model all of their distribution feeders to reliably and cost-efficiently serve all customers. As the need for better understanding of grid-edge impacts from DER arises, utilities are increasingly recognizing the need for such models and are working to improve the development and maintenance of models throughout the entire distribution system. Distribution models are a necessity when the desire is to analyze an entire distribution system.



Integration of Hosting Capacity Analysis into Distribution Planning Tools

to incorporate into planning models. One aspect of this difficulty in modeling is the overabundance of data and knowing what is pertinent to the feeder model.

A Moving Target

When distribution-wide models are available, maintaining databases of current field conditions can be quite challenging since the distribution system is constantly changing.

Over time, distribution feeders change due to planned upgrades, maintenance, outage restoration, etc. Additionally, new DER is being added on an ongoing basis. Maintaining system models is an ongoing process. Capturing the existing “status” of DER in addition to the traditional distribution assets will be key to creating valid distribution models. Utilities are in the process of documenting the system in a more detailed fashion and developing accurate system models in the process.

Committing Time and Resources

One of the previously mentioned goals of the streamlined method was to be efficient, thus very little time commitment is needed, if any, on the part of the utility engineer to perform the analysis. If valid distribution feeder models are available in current planning tools, a feeder hosting capacity analysis requires less than five minutes of computer time. However, as noted previously, as the distribution system changes over time, so should the underlying models. Therefore, maintenance of the distribution planning models to ensure they are up-to-date is an important aspect that can require additional time.

Implementation in Distribution Planning Tools

Rather than developing a new software tool, EPRI developed the methodology with the fundamental component to be available in existing distribution planning tools. Using tools distribution planners are familiar with today, the method leverages the existing data set to provide a much needed new functionality. Distribution planners are enabled to use this tool on an as-needed or regular basis to analyze individual feeders or the entire distribution system.

There are three main parts to implementing this method into commercial tools:

1. Standard interface to utility tools: The method is rooted in the feeder model and takes into consideration the full range in feeder design and operation. By systematically examining each

model’s power flow solutions and short-circuit responses, feeders can be properly characterized.

2. Core Methodology: The feeder design and operation data attained in Part 1 is analyzed and processed through a wide range of scenarios that incorporate what matters most when planning for DER. This analysis provides the node-specific impact assessment. This node-specific assessment can then be aggregated up to the feeder, substation, and system level.
3. Reporting: The impact results from Part 2 are then interpreted and conveyed through visual outputs.

To date, through the support of various utilities, the streamlined hosting capacity method has been successfully applied to work with:

- CYME (using self-contained study files as well as Access databases),
- Synergi (using Access databases), and
- Milsoft (using models exported into OpenDSS).

Additionally, EPRI is currently working on implementation in PowerFactory.

CYME, Synergi, and OpenDSS use the Python COM interface to apply the method within current versions of the software. Working alongside utility partners, the implementation has been customized for use based on specific database structures and data sets. Utility partners in this [supplemental project](#) to date include: Tennessee Valley Authority, Southern Company, Salt River Project, Xcel Energy, Central Hudson, and Eskom.

In total, upwards of 3,000 feeders have been analyzed with a goal of providing the tool such that the remainder of each utilities distribution system can be analyzed. Once implementation is complete, the method and tool compatible with the distribution planning software will be made available through EPRI program membership. The timeline of execution is shown in Figure 11.

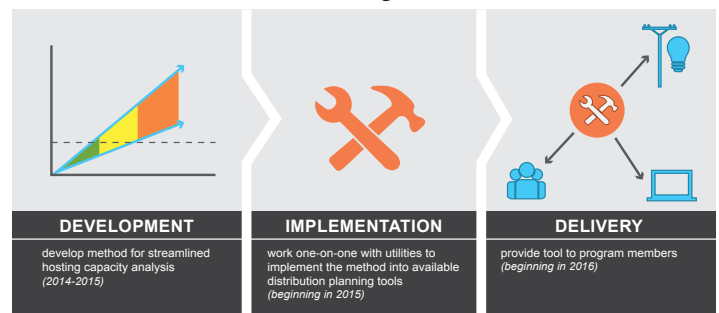


Figure 11 – Plan for Development, Implementation, and Delivery



Integration of Hosting Capacity Analysis into Distribution Planning Tools

Ongoing Work

With this process in mind, EPRI plans to continue expanding the core methodology over the next few years to add additional functionality/capability. The main areas of growth identified thus far include:

- Incorporation of existing DER in hosting capacity analysis
- Expansion of energy storage analysis to consider constrained and utility controlled modes
- Ability to consider the use of solutions to effectively increase hosting capacity, such as
 - smart inverters
 - storage
 - feeder operation
 - infrastructure upgrades
- Ability to consider a combined portfolio of DER technologies
- Improved evaluation of the localized secondary impact from DER
- Incorporation of expected customer DER adoption
- Implementation of similar techniques to determine the true value of DER

Conclusions

Effective and efficient means for evaluating the impact of DER is a necessary aspect of distribution engineering today. Instead of requiring specialized analysis and skillsets, new methods are needed that utilize existing distribution planning tools, can be performed by existing distribution planning personnel, and use readily available data that most distribution planners have on hand.

EPRI has developed such a methodology and is working alongside utilities and vendors alike to implement this method within existing distribution planning tools. This is a first, but crucial step towards effectively integrating DER into the distribution system by considering it in the planning process.

The utility will continue to plan and operate the grid as they always have: efficiently, safely, and reliably. New technologies connecting to the distribution system will continue to evolve. In the end, the normal planning functions and tools used by utilities today will be needed; but they need to evolve, in order to reflect this new landscape of the “distribution system of things.”

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Power System Studies

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