Five Year Distribution Planning Stakeholder Meeting

Michigan Public Service Commission
Lake Superior Hearing Room
June 27, 2019
9 AM – 4 PM

MPSC
Michigan Public Service Commission

Meeting Agenda

9:00 a.m.	Welcome & Introduction	MPSC Commissioner Dan Scripps & Paul Proudfoot, Director, Energy Resources Division
9:05 a.m.	Overview of Commission Order U-20147, Web Page, Email Distribution List, Today's Agenda	Joy Wang, MPSC Staff
9:10 a.m.	Electric Power Research Institute (EPRI) Overview: Modernizing Distribution Planning	Bruce Rogers, EPRI
9:30 a.m.	ICF Overview: Key Learnings from Integrated Distribution Planning	Tom Mimnagh & Walter Rojowsky, ICF
9:50 a.m.	Break	
10:00 a.m.	Topic 1: Load and DER Forecasting	Speaker: Walter Rojowsky, ICF Q&A – All Speakers
10:30 a.m.	Topic 2: Hosting Capacity	Speaker: Jeff Smith, EPRI Q&A – All Speakers
11:30 a.m.	Lunch (local restaurants available)	
1:00 p.m.	Topic 3: Non-Wires Alternatives	Speakers: Walter Rojowsky, ICF, and Jeff Smith, EPRI Q&A – All Speakers
2:00 p.m.	Topic 4: Cost Benefit Analysis	Speaker: Tom Mimnagh, ICF Q&A – All Speakers
2:45 p.m.	Break	
3:00 p.m.	Holistic Integration and Open Q&A: Reviewing Today's Topics	All Speakers
3:30 p.m.	Discussion: Integrating Today's Topics into Michigan Distribution Planning, Stakeholder Process, Next Steps	MPSC Chairman Sally Talberg & Patrick Hudson, Manager, Smart Grid Section
4:00 p.m.	Adjourn	

U-20147: Commission Order

- Impetus for five-year distribution plans to allow comprehensive examination of distribution investments beyond 12 months.
- April 2018 — Commission required five-year distribution investment & maintenance plans from:
  - DTE,
  - Consumers, and
  - Indiana Michigan Power
- Aug 2018 — Technical conference with stakeholders
- Sept 2018 — Staff report with draft distribution planning framework
- Nov 2018 — Commission order on future guidance and next steps

U-20147: Nov. 2018 Commission Order

- Details guidance on second round of five year distribution plans.
- Asks the utilities to:
  - Present progress report on core goals of:
    - Safety,
    - Reliability, and
    - Resiliency
  - Include additional components discussed in order:
    - Address Staff report recommendations
    - Additional comments

Commission Order on Staff Recommendations

Staff Report Topics	Commission Decision/Recommendation	Today
1a. Dynamic System Load Forecasting	• Encourage continued discussion of forecasting methods to inform next iteration of distribution plans	✓
1b. Hosting Capacity Study	• Hold technical conference with utilities, stakeholders and experts to examine information needed to conduct such studies and its availability in Michigan.	✓
	• Interested in pilot balancing policy and technical issues that may need to be addressed to allow broader application of hosting capacity studies	
2. Customer Data Access and Enablement	• Addressed in other dockets (U-18485, U-18120).	
3. Non-Wires Alternatives	• Further discussions on criteria for alternative analyses warranted.	✓
	• Encourages development of more NWAs. Acknowledges opportunity pilot applications provide to inform policy and technical issues.	
	• Sharing of experiences and lessons learned related to NWAs in Michigan and other jurisdictions should be instructive for next iteration of distribution plans	✓

Commission Order on Staff Recommendations

Staff Report Topics	Commission Decision/Recommendation	Today
4. Cost Benefit Analysis	• Further discussion in future technical conference regarding common, yet flexible, cost-benefit methodology for alternatives.	✓
	• Especially interested in the planning and vetting of technology and communications solutions underpinning more modern grid. Cost-benefit analyses is a tool that can assist with examination of technology solutions.	✓
5. Replacement/Upgrade Criteria	• Staff recommendation not adopted.	
6. Workforce Adequacy Plans	• Focus on implementation considerations generally, with workforce as component, sufficient for next iteration.	

Commission Order – Other Comments

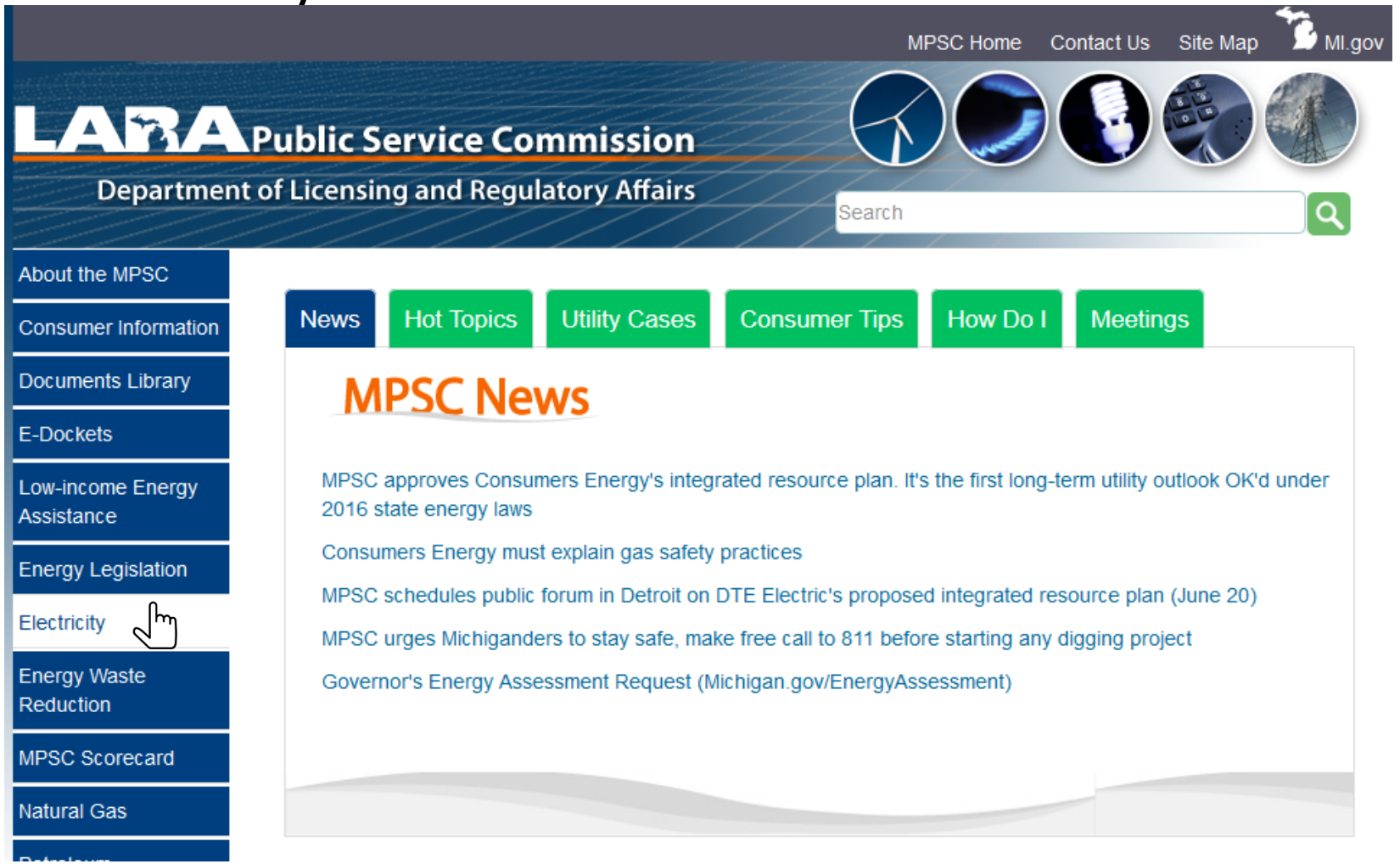
- Framework for next distribution plans to provide:
  - Focused discussion
  - Longer-term visibility than available in a rate case
  - Better understanding
- Framework as a guide, not prescriptive mandates
- Distribution planning cannot be conducted in a silo
  - Consider other issues
- Utilities should coordinate distribution planning efforts with Michigan Infrastructure Council (MIC)

Commission Order – Other Comments

- Recommends stakeholder discussions on:
  - Longer-term vision for grid architecture and performance expectations
  - Benefits of consistent information presentation
- Next five year distribution plans, consistent with order, due June 30, 2020
  - From Consumers Energy Co. and DTE Electric Co.

Accessing Five-Year Distribution Plans Website

- Go to the MPSC website at: www.michigan.gov/mpsc
  - Click on “Electricity” in the left sidebar



Accessing Five-Year Distribution Plans Website

- Click on “Workgroups” in the subcategories.

Accessing Five-Year Distribution Plans Website

- Click on “Five-Year Distribution Plans” under “Active Workgroups”.

Five Year Distribution Plans Website

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Five-Year Distribution Plans

Scope and Background

Michigan's aging distribution system is in need of significant investment to provide a safe, reliable and accessible distribution grid going forward all while maintaining reasonable rates for customers. In response the MPSC initiated a process to review the largest rate regulated electric utilities' distribution planning process as outlined below.

In the first quarter of 2017, the MPSC directed DTE Electric and Consumers Energy, through rate case Orders (as linked below), to develop and submit five-year distribution investment and maintenance plans. The intent of this directive was to increase visibility into utility distribution system needs and facilitate a comprehensive review of long-term distribution planning by the Commission, MPSC Staff, and other interested parties, with more transparency than one-year outlooks in contested rate case proceedings.

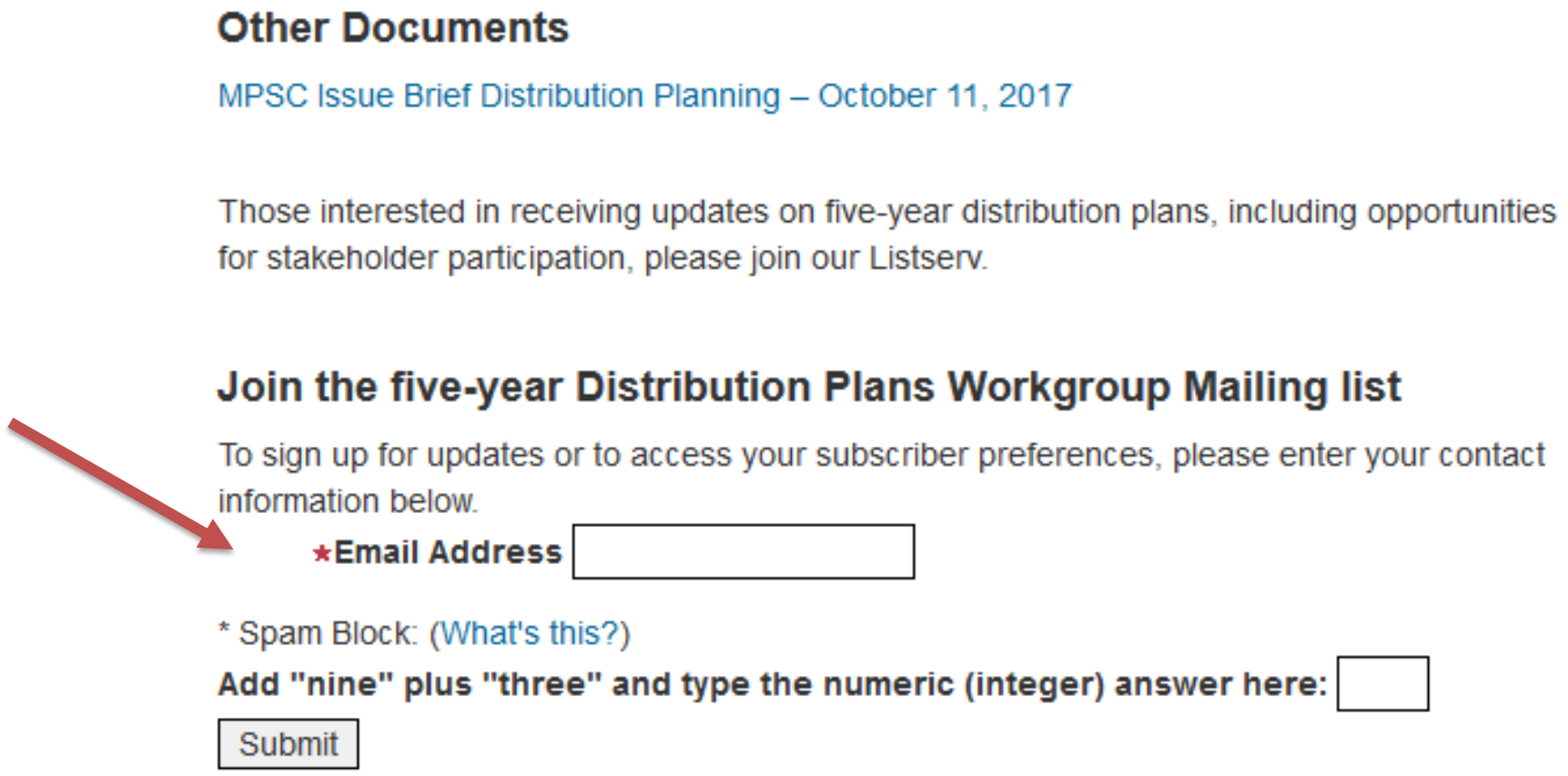
On April 12, 2018 in Case No. U-20147, the MPSC issued an order requiring DTE and Consumers to file their final distribution plans in that docket, asked for Staff and stakeholder comments on the final plan to be filed in the same docket, and required Staff to set up a technical conference to review comments. This technical conferences took place on August 7, 2018. In a November 2018 order, the Commission addressed the Staff's September 1, 2018 recommendations and provided other guidance on the next round of distribution plans which are scheduled for the second quarter 2020. Staff will continue to engage stakeholders on these topics.

Related Content

- Demand Response Aggregation
- MPSC Staff's Standby Rates
- PURPA Technical Advisory Committee (U-17973)
- Smart Grid (U-15278)

Email Distribution List: Stay Engaged!

- Scroll to the bottom of the website to enter your email to join.



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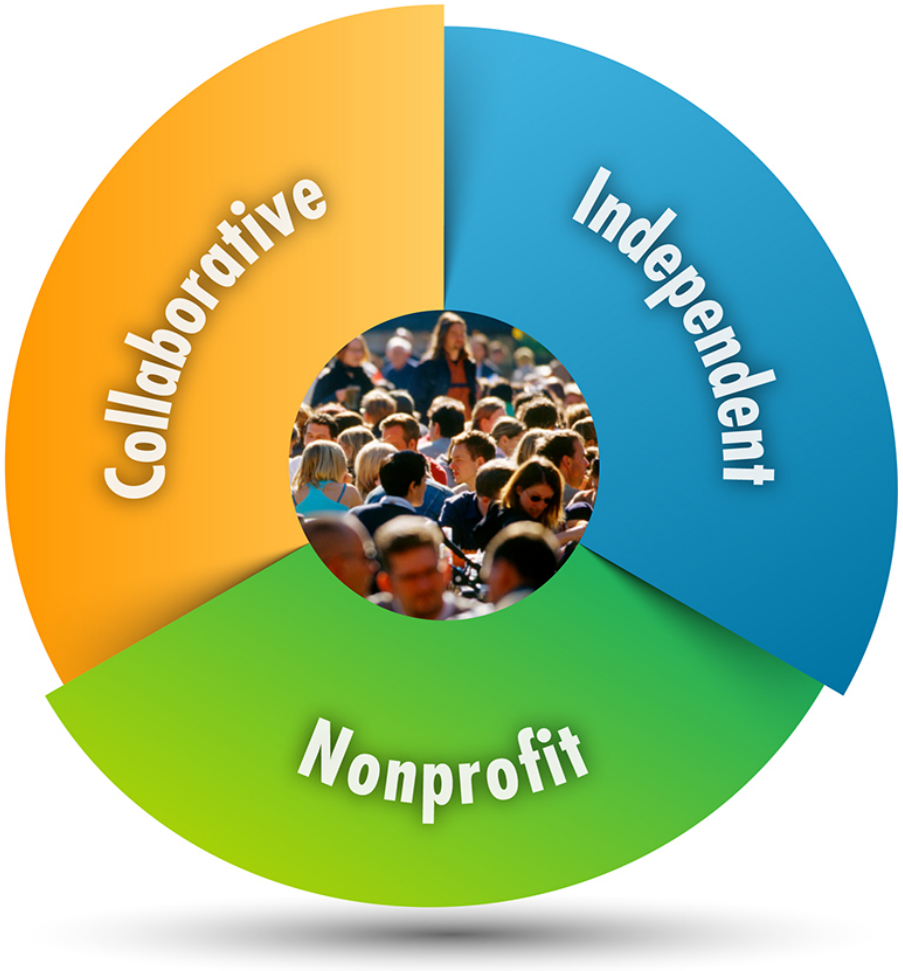
Overview – Modernizing Distribution Planning

Bruce Rogers
Technical Executive, Distribution
brogers@epri.com

MPSC Distribution Planning Stakeholder Meeting

6/27/2019 – Lansing, MI

About the Electric Power Research Institute



Independent

Objective, scientifically based results address reliability, efficiency, affordability, health, safety, and the environment

Nonprofit

Chartered to serve the public benefit

Collaborative

Bring together scientists, engineers, academic researchers, and industry experts

Traditional Distribution Planning Process

- Load and DER growth
- Load profiles
- Analysis timeframe
- System configuration
- Operating criteria & objectives

- Does grid meet projected load and DER growth
- Does grid maintain safety and reliability

- Type, location, size, and timing of projected need
- Identify conventional solutions

- Evaluate technical performance and estimate costs
- Determine preferred alternative

- Implement projects

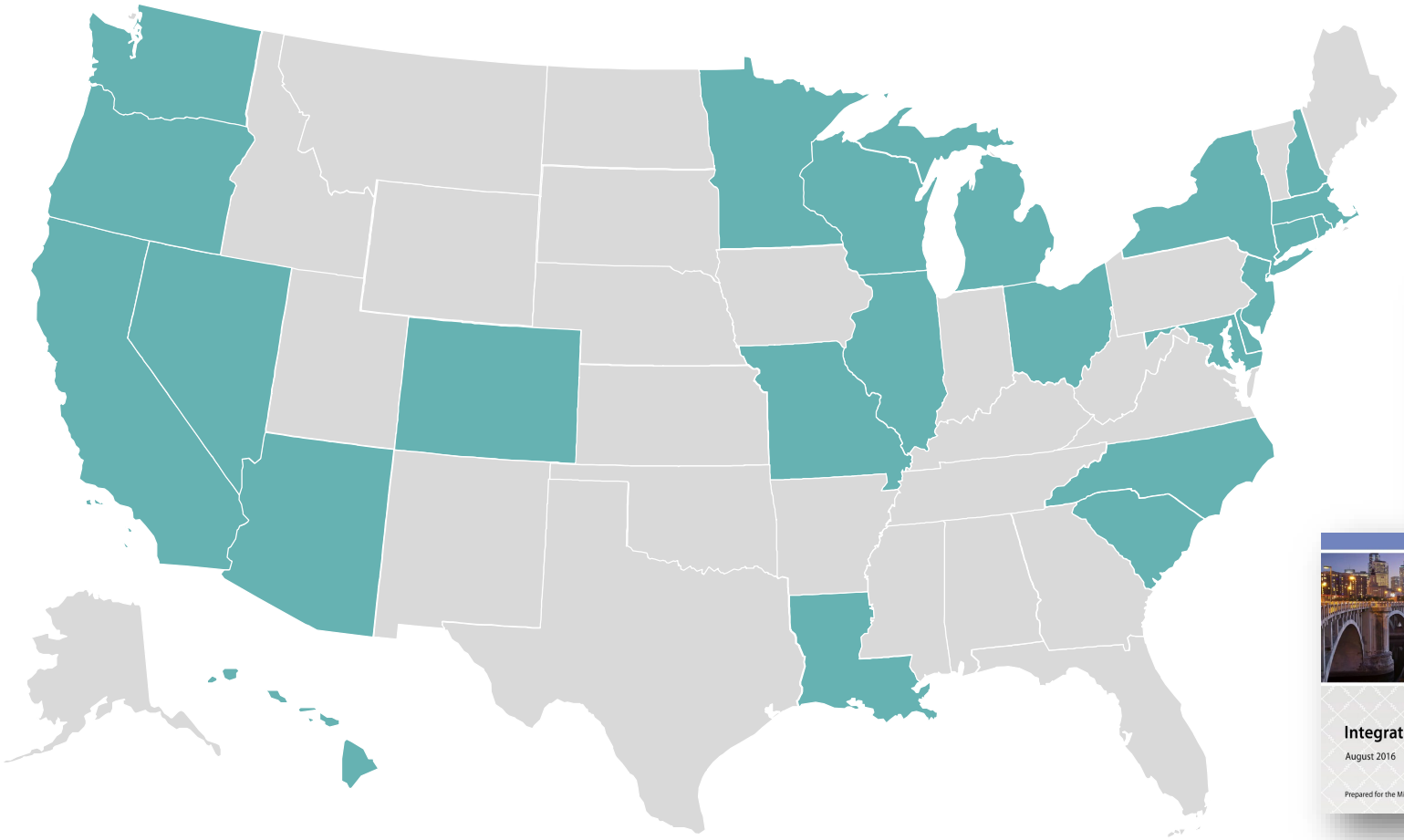
Process takes months

Safety – Reliability – Cost

Context for Change – Customer Resources

- Customers are adopting higher volumes of DER and multiple types.
- Utilities will need to understand how DER interact with the grid to integrate cost effectively.
- The grid may become more reliant on customer devices providing grid services.

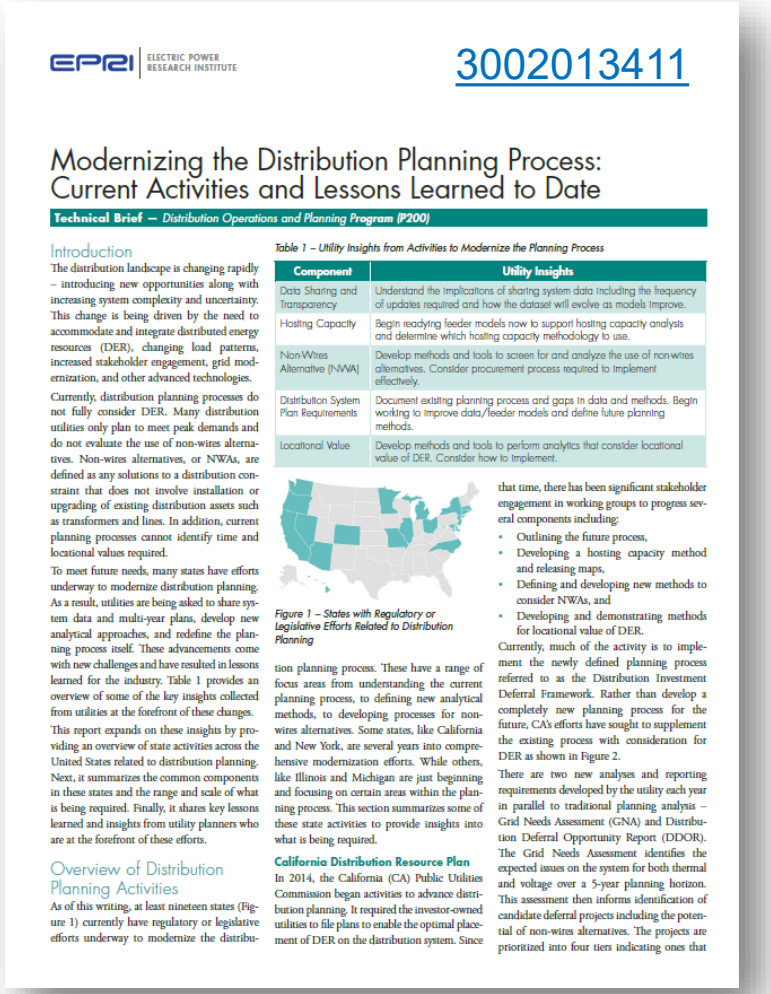
Context for Change – Legislative/Regulatory Action



24 states pursuing action on future distribution planning requirements

Most Common Actions Under Consideration

- Distribution system plan requirements
- Data sharing/transparency/consistency
- Integrated distribution planning
- Non-wires alternative requirements and consideration of DER
- Hosting capacity
- DER Locational value



EPRI | ELECTRIC POWER RESEARCH INSTITUTE

3002013411

Modernizing the Distribution Planning Process: Current Activities and Lessons Learned to Date

Technical Brief – *Distribution Operations and Planning Program (P200)*

Introduction

The distribution landscape is changing rapidly – introducing new opportunities along with increasing system complexity and uncertainty. This change is being driven by the need to accommodate and integrate distributed energy resources (DER), changing load patterns, increased stakeholder engagement, grid modernization, and other advanced technologies.

Currently, distribution planning processes do not fully consider DER. Many distribution utilities only plan to meet peak demands and do not evaluate the use of non-wires alternatives. Non-wires alternatives, or NWAs, are defined as any solutions to a distribution constraint that does not involve installation or upgrading of existing distribution assets such as transformers and lines. In addition, current planning processes cannot identify time and locational values required.

To meet future needs, many states have efforts underway to modernize distribution planning. As a result, utilities are being asked to share system data and multi-year plans, develop new analytical approaches, and redefine the planning process itself. These advancements come with new challenges and have resulted in lessons learned for the industry. Table 1 provides an overview of some of the key insights collected from utilities at the forefront of these changes.

This report expands on these insights by providing an overview of state activities across the United States related to distribution planning. Next, it summarizes the common components in these states and the range and scale of what is being required. Finally, it shares key lessons learned and insights from utility planners who are at the forefront of these efforts.

Overview of Distribution Planning Activities

As of this writing, at least nineteen states (Figure 1) currently have regulatory or legislative efforts underway to modernize the distribution planning process. These have a range of focus areas from understanding the current planning process, to defining new analytical methods, to developing processes for non-wires alternatives. Some states, like California and New York, are several years into comprehensive modernization efforts. While others, like Illinois and Michigan are just beginning and focusing on certain areas within the planning process. This section summarizes some of these state activities to provide insights into what is being required.

Table 1 – Utility Insights from Activities to Modernize the Planning Process

Component	Utility Insights
Data Sharing and Transparency	Understand the implications of sharing system data including the frequency of updates required and how the dataset will evolve as models improve.
Hosting Capacity	Begin readying feeder models now to support hosting capacity analysis and determine which hosting capacity methodology to use.
Non-Wires Alternative (NWA)	Develop methods and tools to screen for and analyze the use of non-wires alternatives. Consider procurement process required to implement effectively.
Distribution System Plan Requirements	Document existing planning process and gaps in data and methods. Begin working to improve data/feeder models and define future planning methods.
Locational Value	Develop methods and tools to perform analytics that consider locational value of DER. Consider how to implement.

Figure 1 – States with Regulatory or Legislative Efforts Related to Distribution Planning

California Distribution Resource Plan

In 2014, the California (CA) Public Utilities Commission began activities to advance distribution planning. It required the investor-owned utilities to file plans to enable the optimal placement of DER on the distribution system. Since that time, there has been significant stakeholder engagement in working groups to progress several components including:

- Outlining the future process,
- Developing a hosting capacity method and releasing maps,
- Defining and developing new methods to consider NWAs, and
- Developing and demonstrating methods for locational value of DER.

Currently, much of the activity is to implement the newly defined planning process referred to as the Distribution Investment Deferral Framework. Rather than develop a completely new planning process for the future, CA's efforts have sought to supplement the existing process with consideration for DER as shown in Figure 2.

There are two new analyses and reporting requirements developed by the utility each year in parallel to traditional planning analysis – Grid Needs Assessment (GNA) and Distribution Deferral Opportunity Report (DDOR). The Grid Needs Assessment identifies the expected issues on the system for both thermal and voltage over a 5-year planning horizon. This assessment then informs identification of candidate deferral projects including the potential of non-wires alternatives. The projects are prioritized into four tiers indicating ones that

States moving toward more holistic planning processes

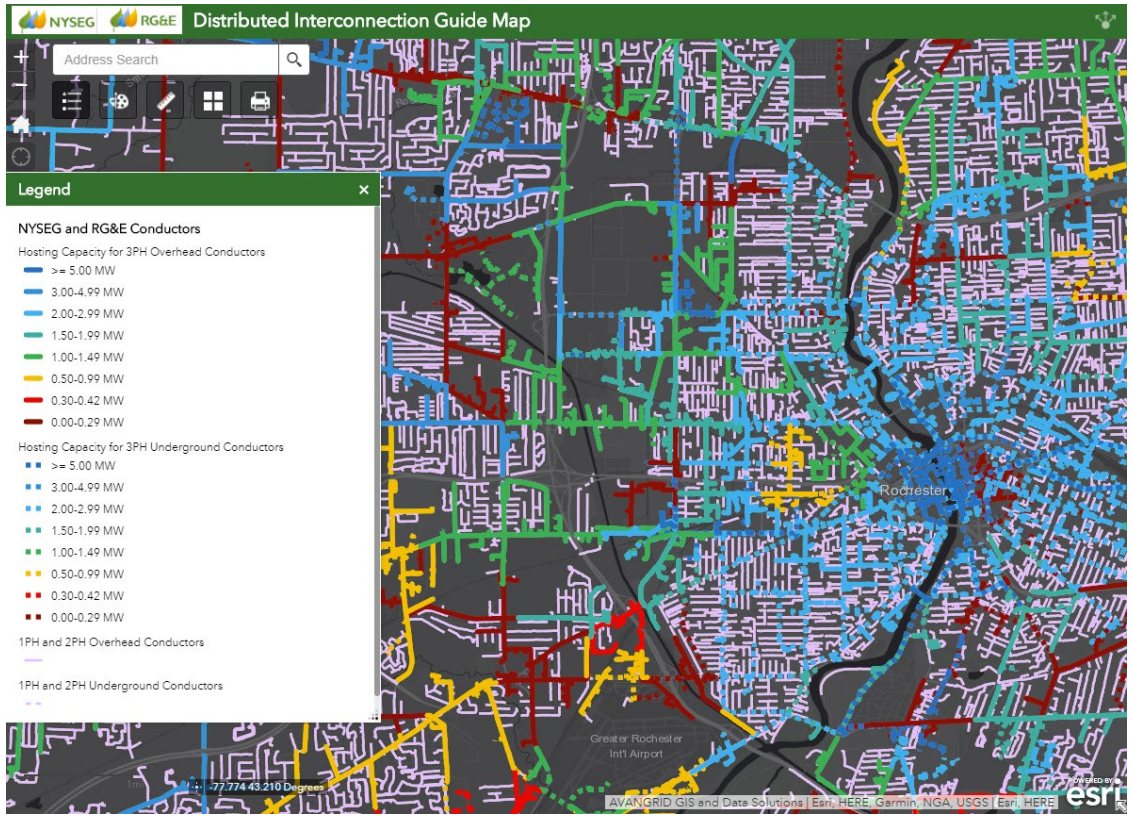
Data Sharing/ Transparency

- Post spreadsheets or maps sharing system data
- Update frequency varies depending on state

Feeder	36_17_33351
Substation	SHERMAN
Operating Voltage (kV)	13.20
Summer Rating (Amps)	466.00
Peak Amps 2016	167.00
2016 Peak %	35.84
Peak Amps 2017	181.62
2017 Peak %	38.97
2016 Peak (MVA)	3.82
2017 Peak (MVA)	4.15
Historical Feeder Load Curve	More info
Forecasted Feeder Load Curve	More info

Hosting Capacity

- Methodology and tool definition
- Analysis on all feeders or subset (> certain voltage), node and feeder level
- Post results through spreadsheets and/or public maps (primary application)
- Frequency of updates quarterly to annually
- Discussion of use for screening in some states
- Questions on consideration of smart inverters, all types of DER



Example Hosting Capacity Map using DRIVE™
www.epri.com/DRIVE

Non-Wires Alternative

- Required to consider non-wires alternatives (always to >$2M) in annual process
- Posting public maps on locations
- Defining suitability criteria
- Defining procurement process – timelines, cost, etc
- Developing screening process

Distribution System Plan Requirements

- Document and share the current planning process
- Define changes to process, methods, tools to better incorporate DER in planning
- File distribution investment plans to ID planning methods
  - Annual grid needs assessments, 5-year capital investments

Locational Value

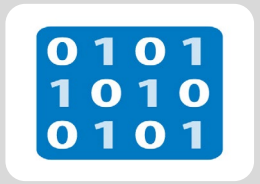
- Working groups to develop methods/tools for locational value
- Demo projects of methods to test location specific values
- Replacement of NEM with value of DER – methodology to identify zones

Distribution Planning – Rapidly Changing Landscape

DER accommodation & integration

Changing load patterns

Increased stakeholder engagement

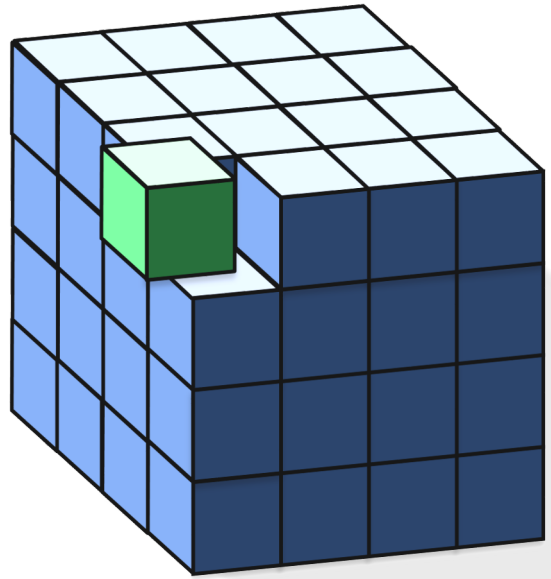


Rapidly advancing controls

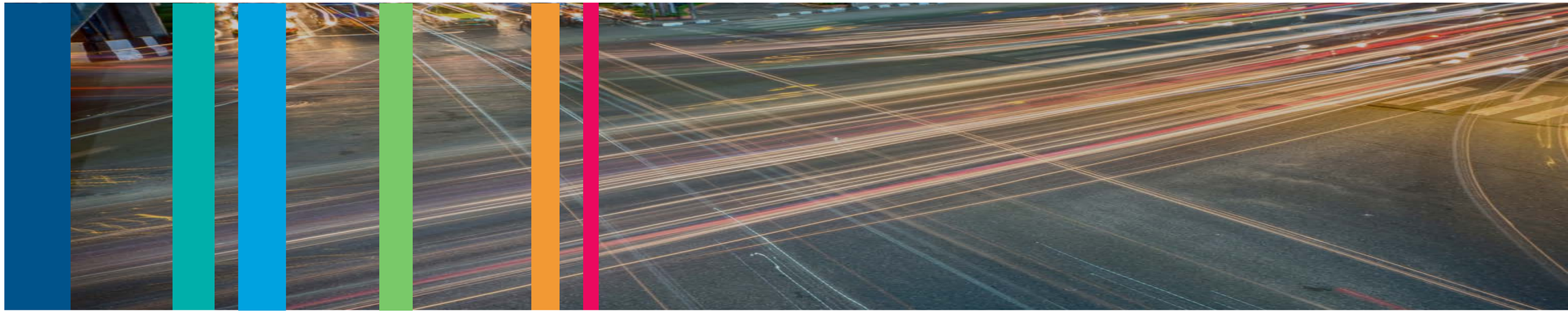
- Increased complexity
- Increased uncertainty
- Changing objectives and reporting needs
- New opportunities

Today's Tools Only Answer a Piece of the Puzzle

- Singular focus on system peak
- Static representation of system conditions
- Manual feeder by feeder analysis for full system
- Manual time intensive alternatives assessments
- Emerging technologies and resources not adequately modeled
- Cannot identify time and locational values
- Limited support for coordination with transmission planning/IRP



New processes, methods, and tools are needed



ICF Overview: Key Learnings from Integrated Distribution Planning

Lansing, MI
June 27, 2019

ICF: We Make Big Things Possible

Energy

Health

5,000+
EMPLOYEES

Environment

Transportation

1 BILLION+
IN REVENUES

Global presence with more than 65 offices, headquartered in the Washington, DC area

Today’s Featured ICF Speakers

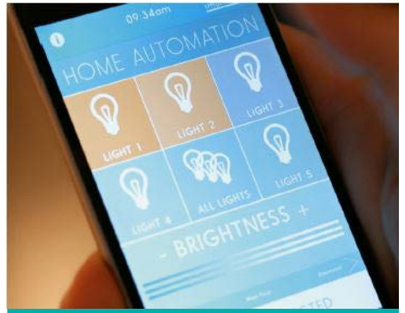
Tom Mimnagh is a Senior DER Project Advisor in ICF’s Energy Markets team. In this role he is responsible for supporting client objectives as the industry plans for increases in DER technologies. Tom has 33 years of experience in the Utility industry, the last five of which involved supporting Utility interface with New York’s REV proceeding.

Walter Rojowsky is an ICF Senior Manager whose work focuses on Integrated Distribution Planning, Non-Wires Alternatives, and Resiliency. Walter has 19-years of experience working in the electric T&D space, both in the US and abroad. Walter’s work has included helping utilities with distribution system plans, NWA pilots, and internal change initiatives in planning and operations.

ICF's Energy Practice

Distributed Energy Resources

Grid Modernization



Demand Side Management Implementation

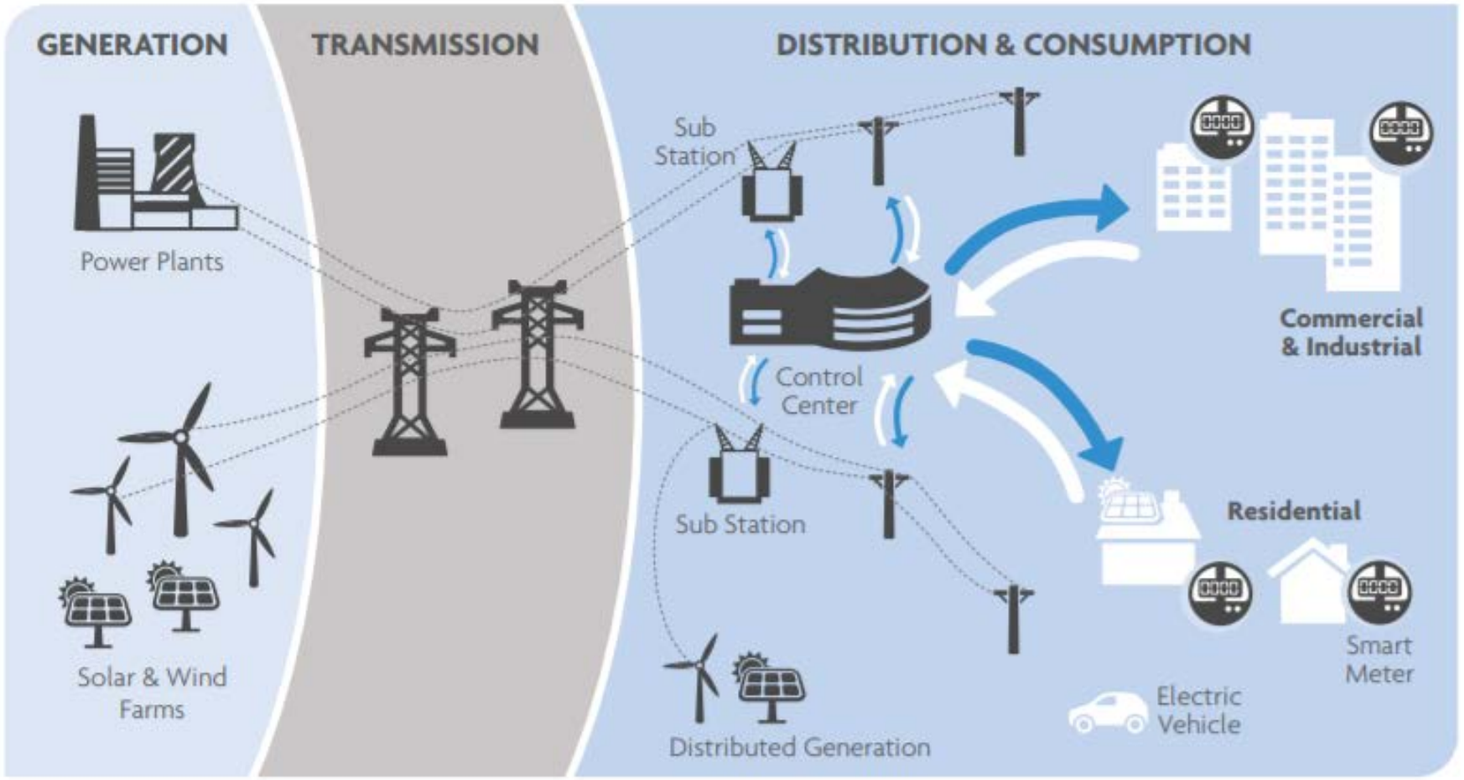
Customer Engagement & Recruitment

Strategic & Regulatory Support

Power Markets

Fuels Markets

Grid Evolution, From One-way To Multi-directional Network



Source: More than Smart

Utility roles and models are changing – a more distributed future presents new challenges and opportunities

DER Drivers of Growth

Declining costs

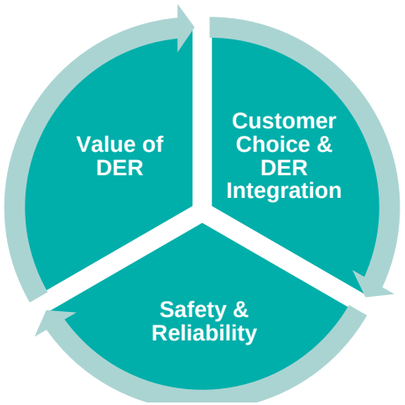
Incentives/policies

Changing customer preference and expectation

Possibility to provide grid services

Evolving Distribution Grid

- Plan and operate the system to **enhance safety, reliability, resilience and security,** including replacement of aging infrastructure and modernization of the grid.
- **Support customer choice and integration of DER** through interconnection process improvements, enhanced information sharing, and new products and services.
- **Align the value of DER** to the realization of benefits for all customers through the use of DER-provided services to meet system needs.



Align implementation of changes to pace of DER adoption & customer value

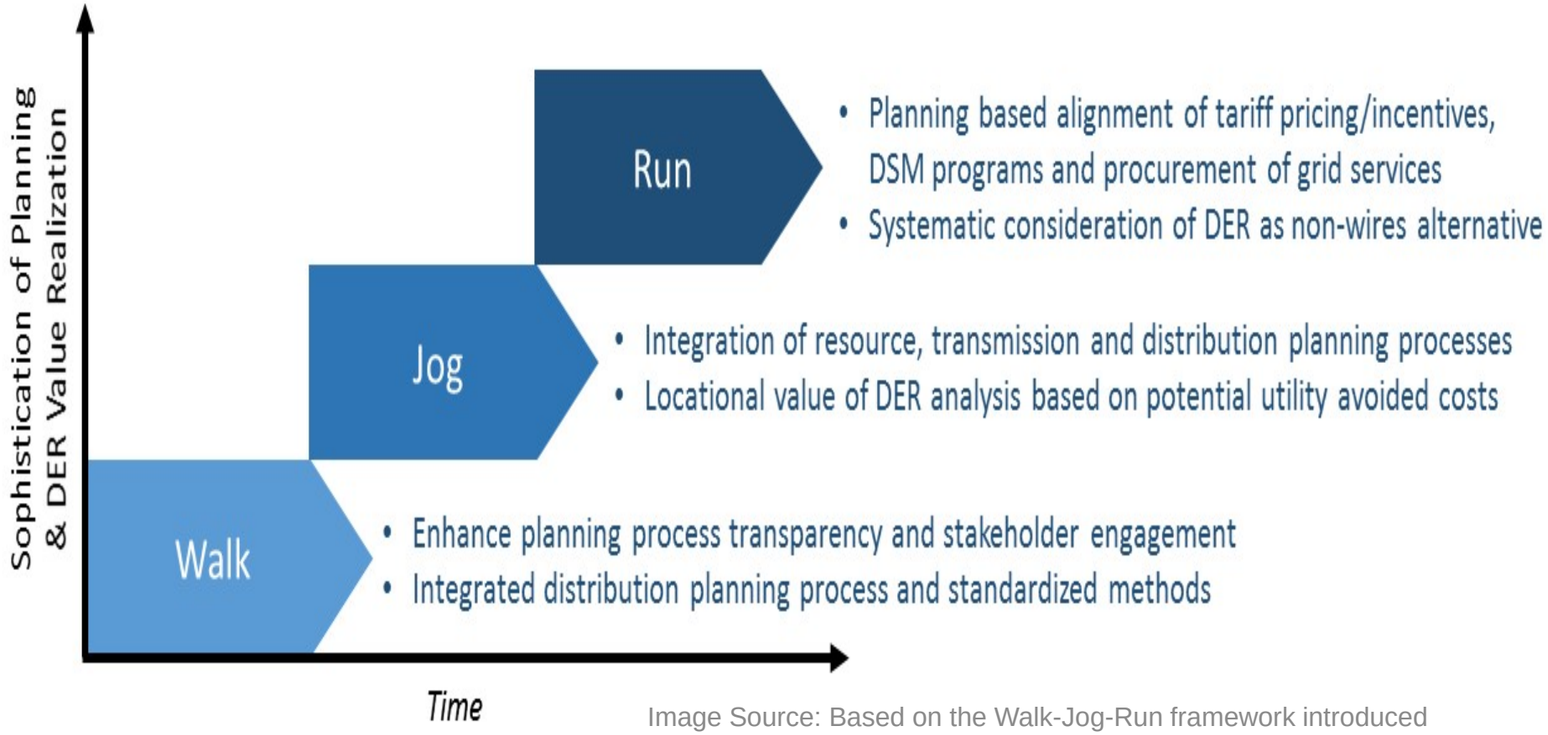


Image Source: Based on the Walk-Jog-Run framework introduced in the More than Smart Working Group

Renewables Penetration

- DTE DG: 11.8 MW solar across 1,675 sites, system size 1-20 kW (DG Program Report, FY 2017)
- DTE IRP increases renewable goals through solar builds and voluntary green pricing programs (between 465 MW and 715 MW)
- GTM Solar Forecast for MI: Projected CAGR, 2019-2023
  - Non-Residential Solar: ~30%
  - Residential Solar: ~48%

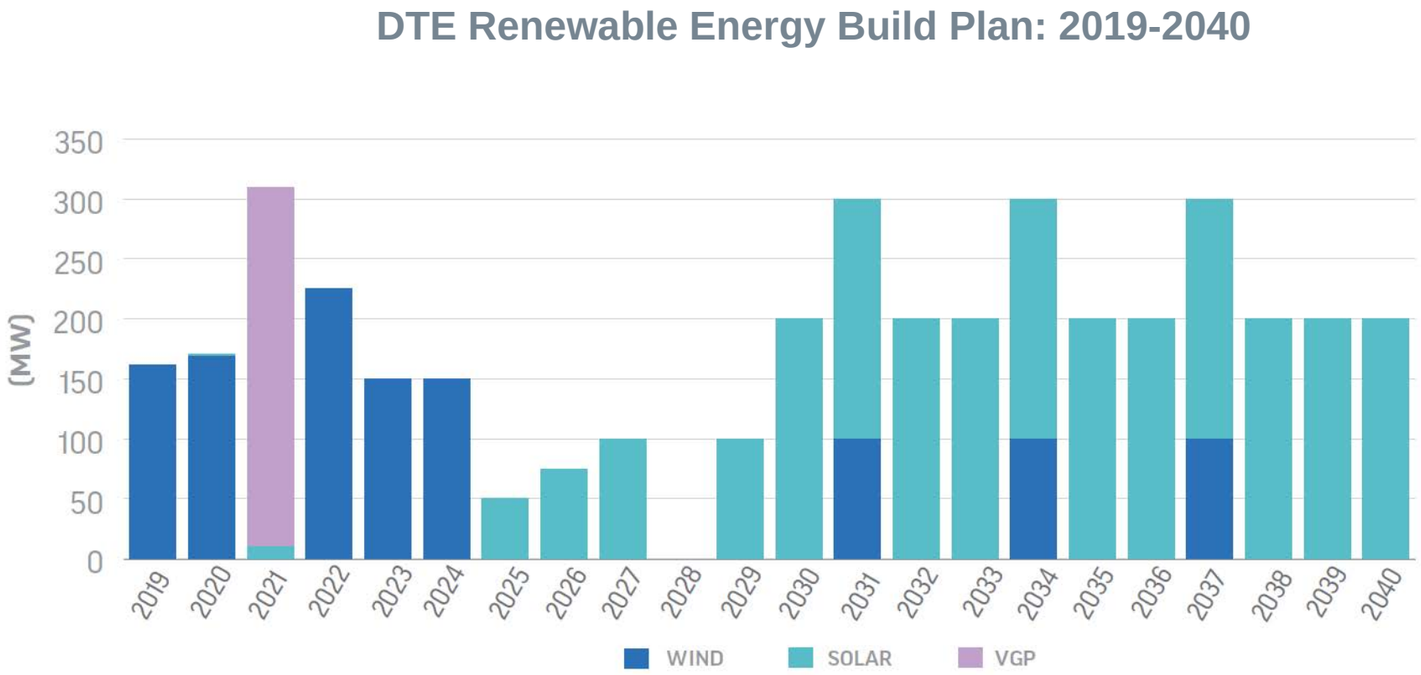
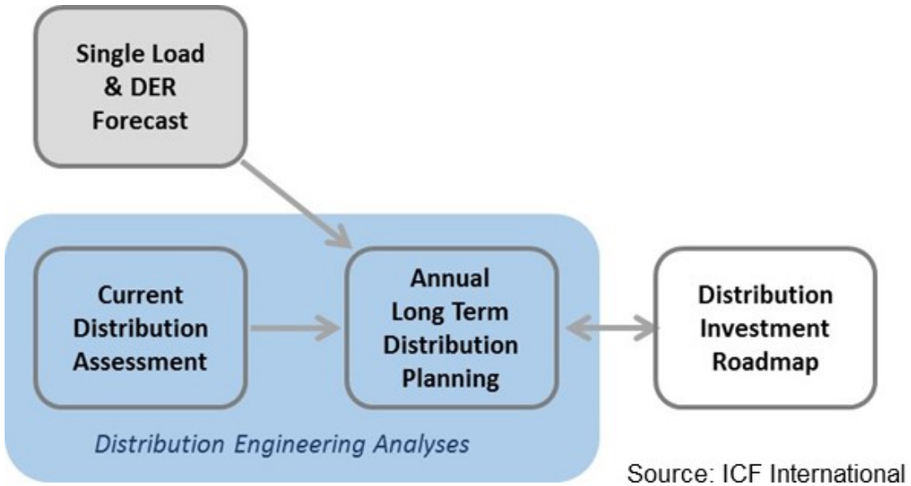


Image and Data Source: 2019 Integrated Resource Planning Report (CaseU-20471)
Data Source: GTM GTM Solar Markets Insight Report Q4, 2018

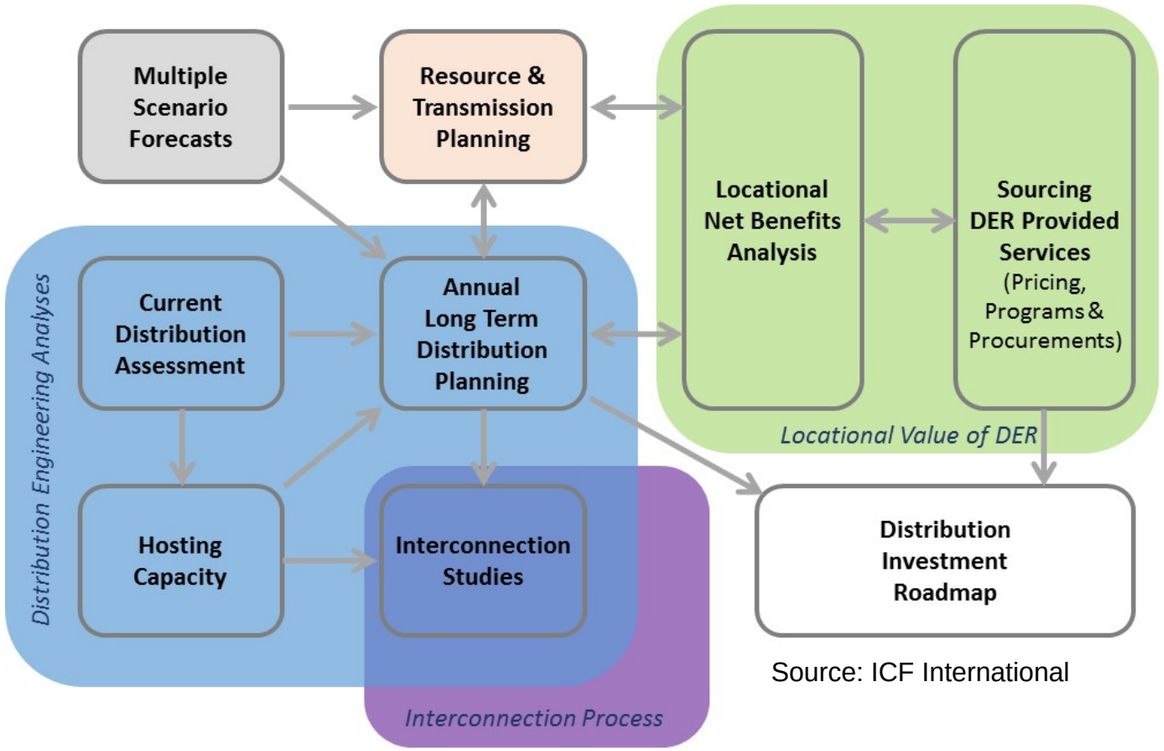
Integrated Distribution Planning

Traditional Distribution Planning



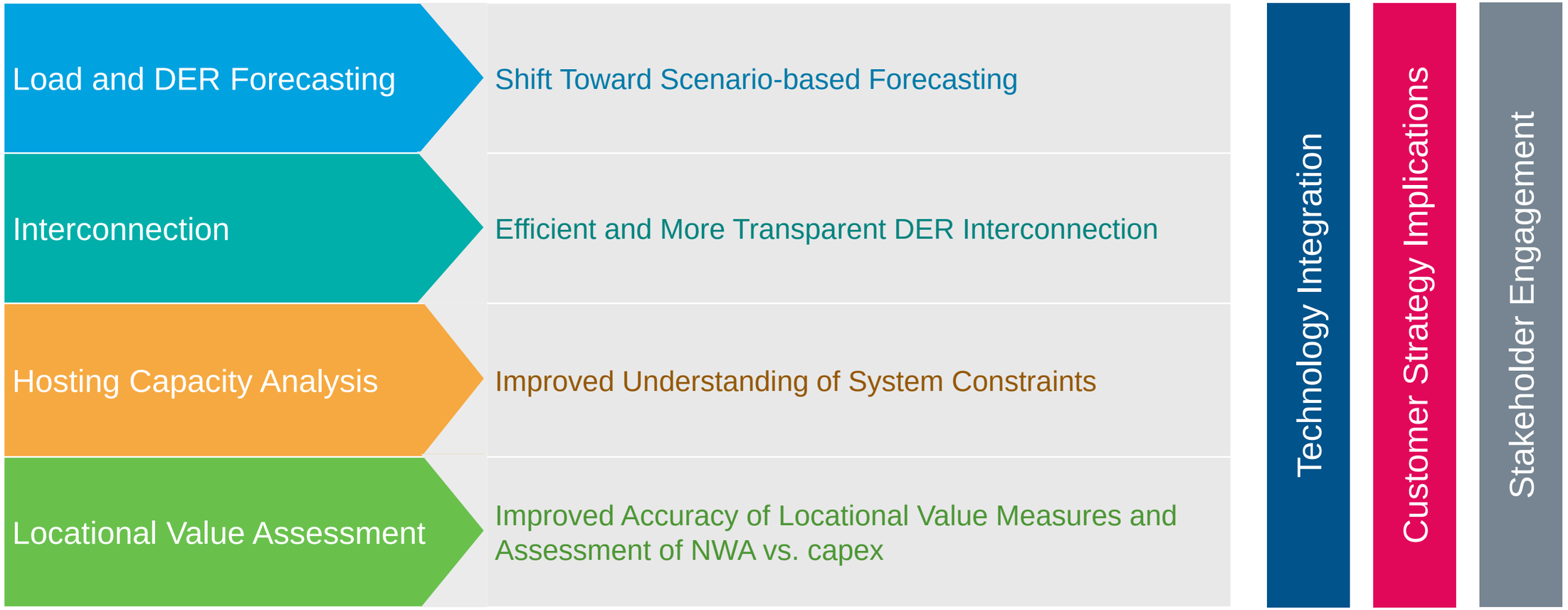
Source: ICF International

Integrated Distribution Planning Framework



Source: ICF International

Integrated Distribution Planning Elements

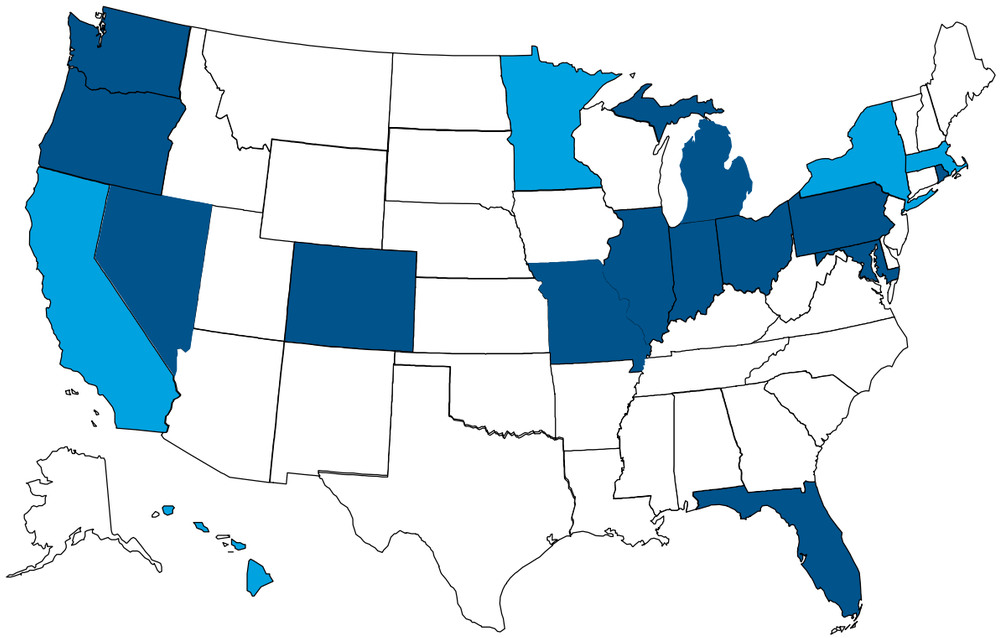


Source: ICF

Illustrative Internal Touchpoints

Source: ICF

Overview of National IDP Activity



States Gaining Momentum

States with Advanced Practices

Planning Approaches	States With Advanced Practices					Other States' Approaches										
	California	Hawaii	Massachusetts	Minnesota	New York	D.C.	Florida	Illinois	Indiana	Maryland	Michigan	Ohio	Oregon	Pennsylvania	Rhode Island	Washington
Distribution system plan requirement[1]	√	√	√	*	√					√	√					
Grid modernization plan requirement	√	√	√	√	√											
Incentives reflecting locational value	√				√											
Hosting capacity analysis requirement	√	√		√	√											
Non-wires alternatives requirements	√				√										√	
Standardized calculations / processes	√				√											
Storm hardening requirements							√			√						
No planning requirement but proceeding underway[2]						√		√				√	√		√	√
Requirement to summarize current practice				√	√					√						
Voluntary distribution or grid modernization plans supporting surcharge/rider cost recovery								√	√			√		√		
Improved alignment / linking processes	√			*											*	*
Required reporting on poor-performing circuits and improvement plans							√	√				√		√	√	

√ is used to indicate the planning approach is applicable under the present regulatory or statutory requirements.
* is used to indicate that the planning approach would apply under pending proposals or proposed decisions.
[1] Requirements for one or more utilities.
[2] States noted in this row have processes underway which may result in adoption of one or multiple planning approaches listed in this table.

Source: LBNL, State Engagement in Electric Distribution System Planning (2017)

MORNING BREAK
9:50 – 10 AM

Five Year Distribution Planning Stakeholder Meeting

Michigan Public Service Commission

Lake Superior Hearing Room

June 27, 2019

MPSC
Michigan Public Service Commission

TOPIC 1:
Load and DER Forecasting

Five Year Distribution Planning Stakeholder Meeting

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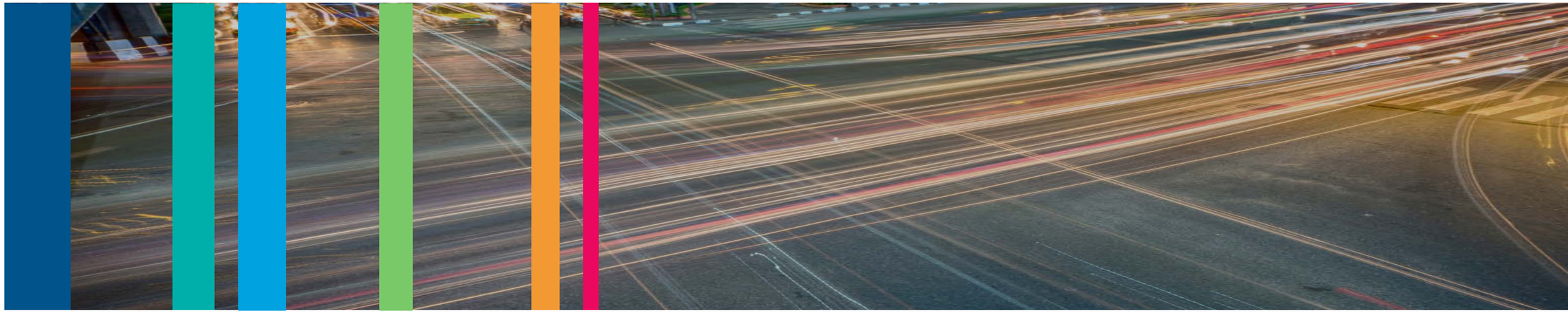


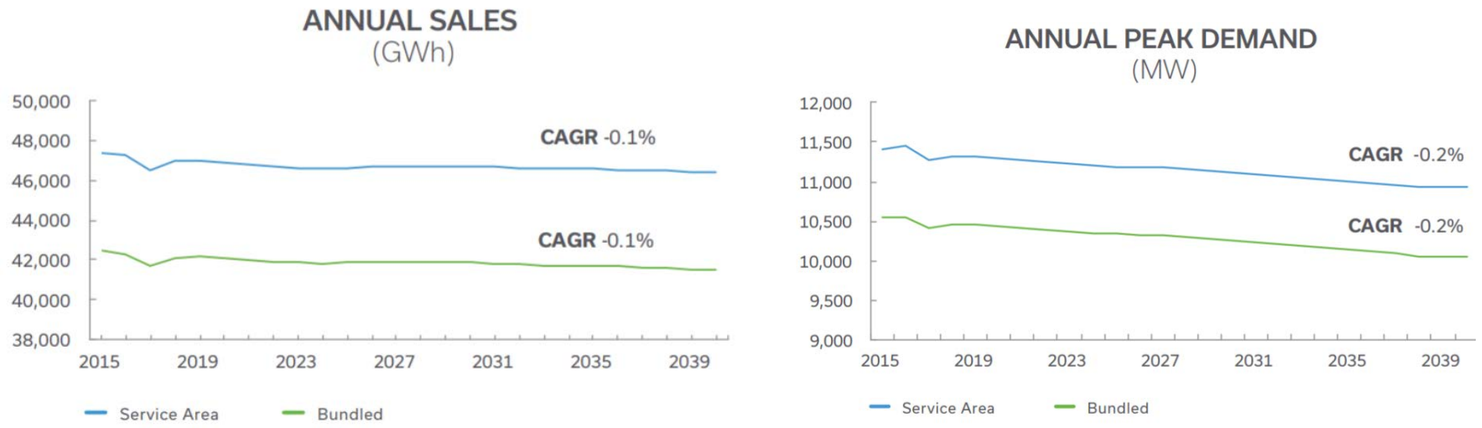
LOAD AND DER FORECASTING

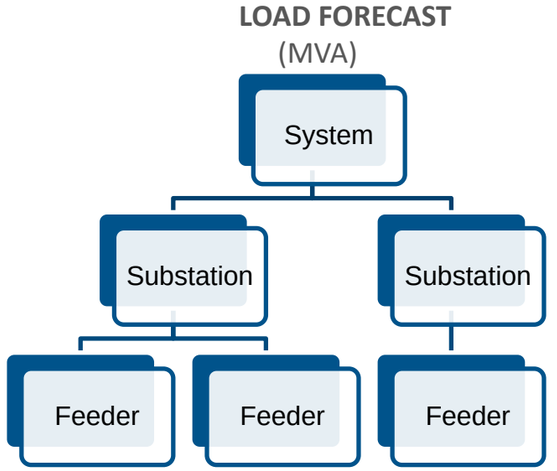
Lansing, MI
June 27, 2019

What is Load Forecasting?

Load forecasting is a projection of the actual amount of power that customers are expected to be using in a future period.

- It is one of several key forecasts continuously tracked by utilities





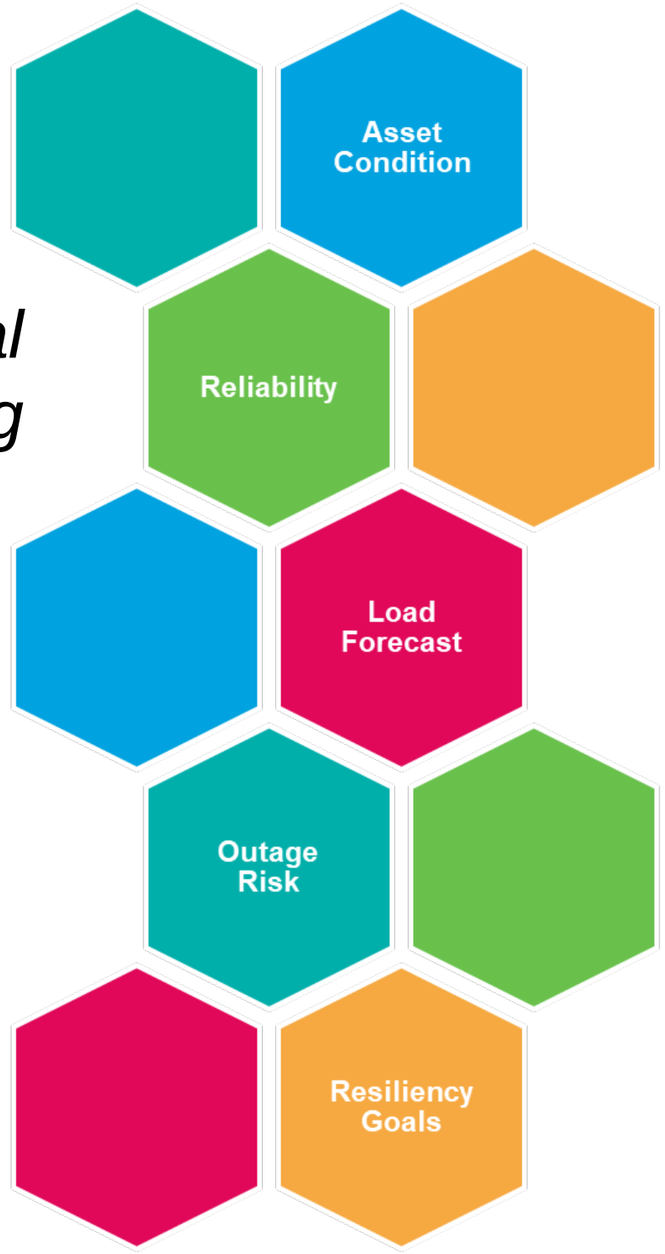
Source for “Annual Sales” and “Annual Peal Demand” Charts: DTE Electric Company 2017 Integrated Resource Plan

- Maintained at multiple levels: System; Substation; Feeder
- Deeply detailed as load varies across location and time
- Allows utilities to ensure that equipment ratings and distribution system planning criteria are maintained

Significance of Load Forecasting

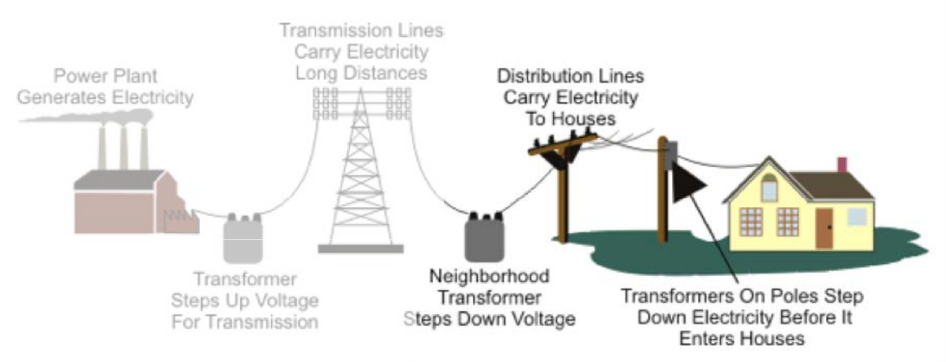
Load Forecasting is a foundational component of the distribution planning process.

- Utility distribution planning imperatives typically include providing capacity safely, reliably, and at reasonable cost
- Load forecasts are key to meeting these imperatives
- They also support utility investment decisions



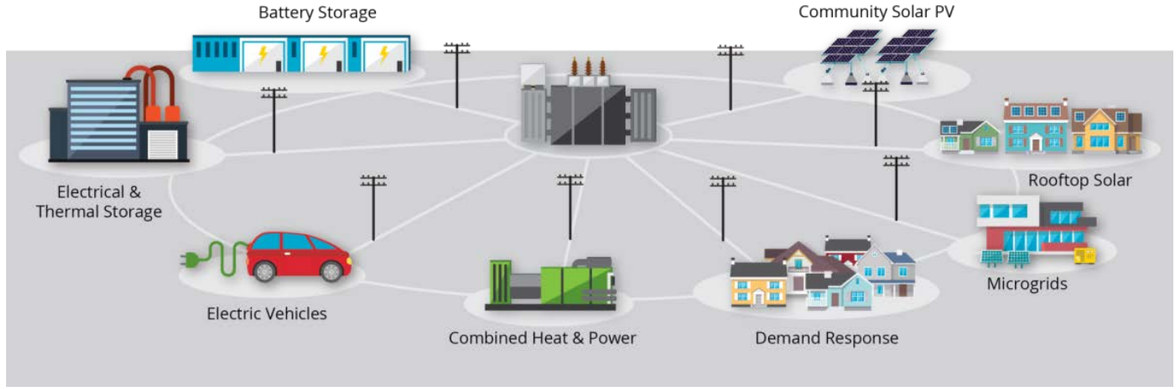
Evolution of Forecasting

Today: Load Forecasting



- Ensure customer growth is accounted for
- Capacity and reliability planning is for peak loading conditions

Emerging: Load and DER Forecasting



- Integrate the presence and availability of Distributed Energy Resources (DER) into forecasts and planning processes
- Capacity and reliability planning extends beyond peak load periods

What are DER?

Resources located at the electric distribution system, either behind the customer meter or in front of the meter

- Energy Efficiency
- Demand Response
- Solar PV
- Energy Storage
- CHP / Cogen
- Electric Vehicles
- Wind
- Microgrid
- Biogas
- Biomass
- Fuel Cells
- Geothermal

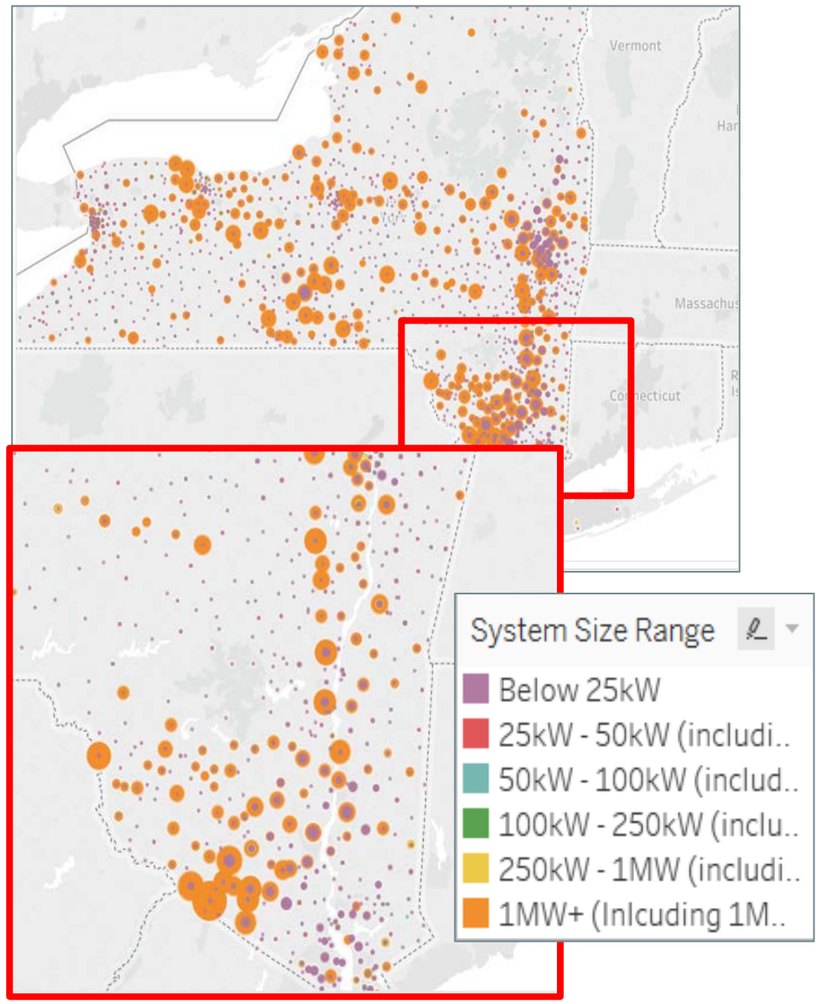
What is DER Forecasting?

DER Forecasting is an emerging area concerned with understanding the geospatial and temporal qualities of future DER.

- How much DER is being adopted?
- Which customers are adopting?
- Where are these resources?
- What is the effect on the system?

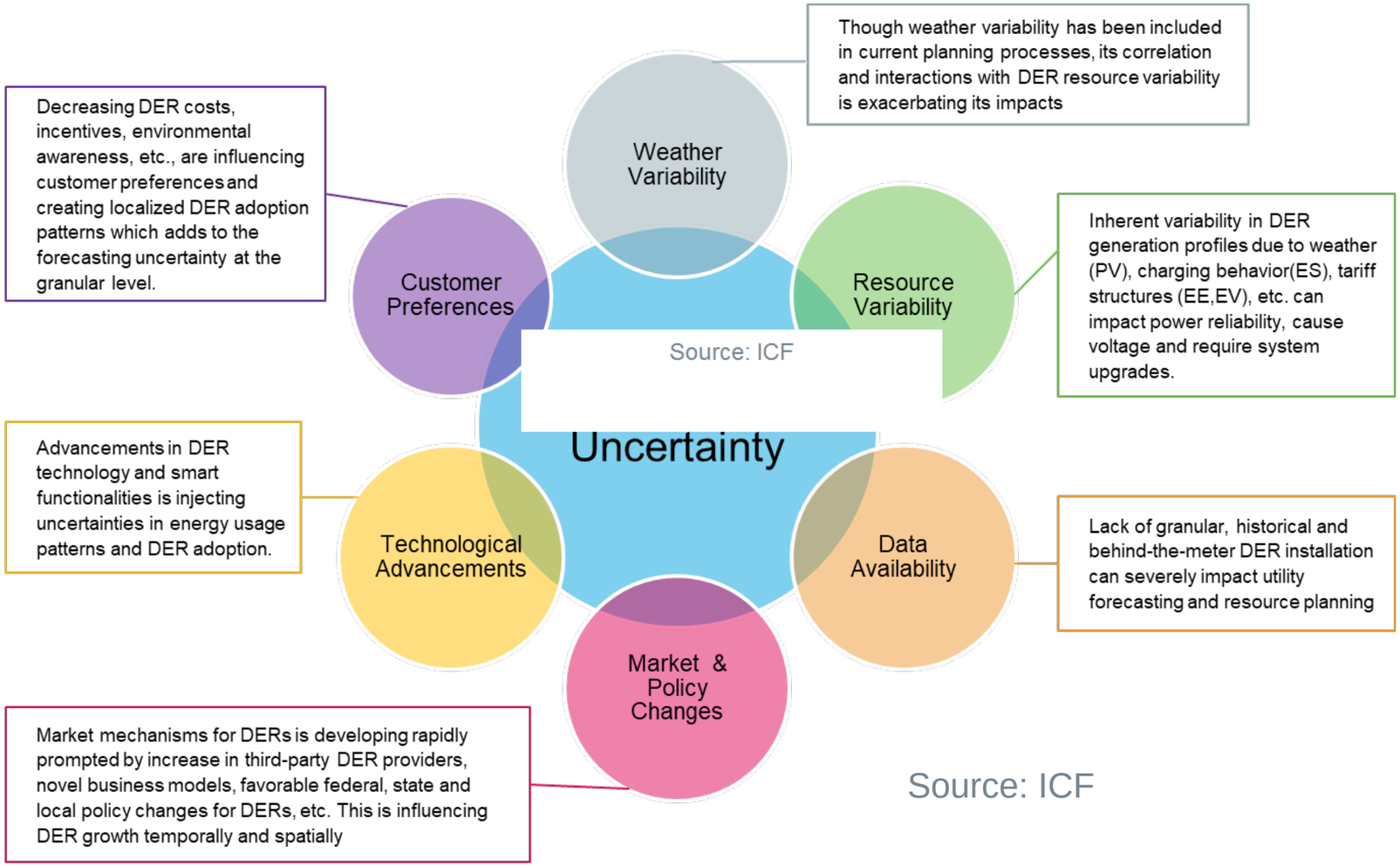
There is significant uncertainty around these questions, given the nascency of DER deployment.

Because DER is expected to continue to grow, the industry is working toward tackling challenges in this domain.



Source: ICF

DER Forecasting Challenges

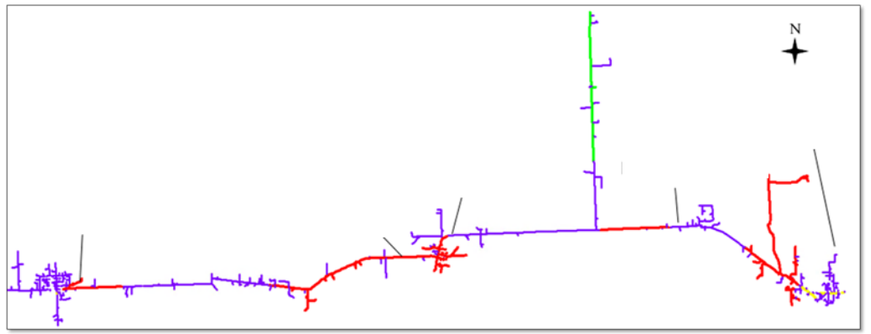


Source: ICF

Evolving Area #1 – Improving Temporal and Spatial Granularity of Load Forecasts

Some utilities are pursuing investments in distribution planning to yield such items as:

- Higher quality circuit information
- Improved load allocations through integration of AMI data with planning software
- Inclusion of DG and Energy Storage devices in circuit power flow models
- Seasonal load and resource profiles by distribution feeder
- Bottom-up compilation of distribution feeder-level forecasts inclusive of DER and EVs (gross and net load)



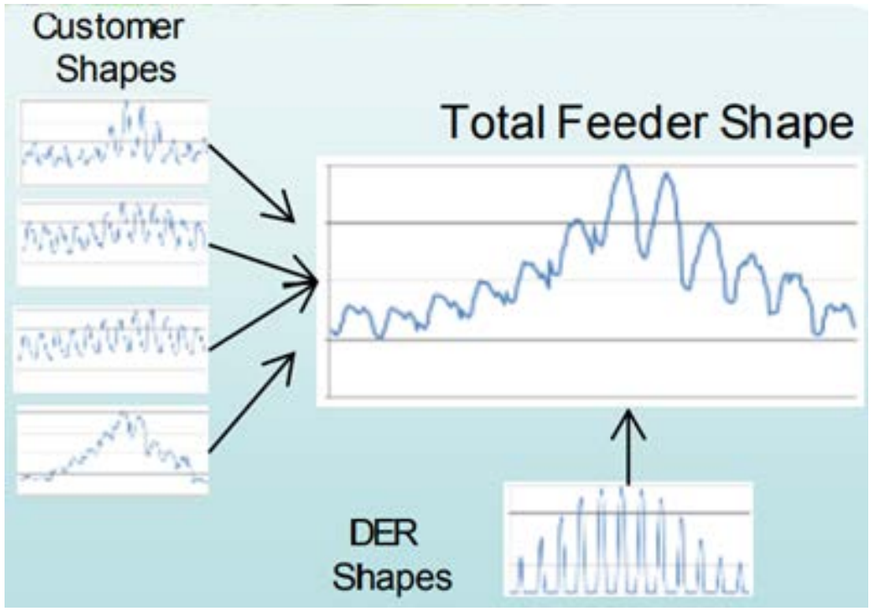


Image source: DER Growth Scenarios and Distribution Load Forecasting Working Group Discussion, May. 3th, "Distributed Generation ". http://drpwg.org/wp-content/uploads/2017/04/GSWG_Distributed_Generation-FINAL.pdf

Evolving Area # 2 – Scenario Analysis and Probabilistic Forecasts

- Scenario Analysis – developing multiple possible scenarios to allow for forecasts to capture a full range of possible outcomes
- Probabilistic forecasts – incorporates the probability distribution of multiple inputs to produce a distribution of possible circuit loads that reflect possible outcomes in probability-weighted framework

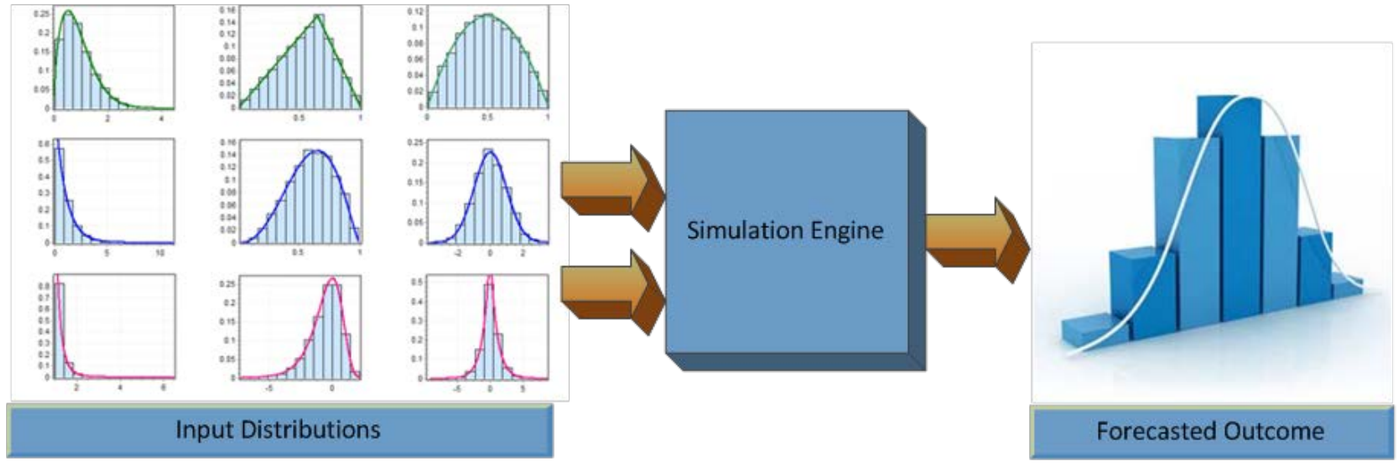


Image source: DER Growth Scenarios and Distribution Load Forecasting Working Group Discussion, May. 3th, "Distributed Generation ". http://drpwg.org/wp-content/uploads/2017/04/GSWG_Distributed_Generation-FINAL.pdf

Conclusions

- Utilities are engaged in a continuous process of load forecasting and its refinement, which forms the foundation for distribution planning.
- These forecasting processes have supported the operation of a distribution system that has supplied needed capacity, reliably, safely, and affordably.
- Utility system level forecasting tied to peak hour demand has a long history with significant experience.
- Circuit level forecasting is undergoing change subject to DER presence. Utilities are seeking to evolve forecasting processes in a prudent manner
- Options exist for refining forecasting processes, however, the introduction of these must be balanced against the effort involved and customer value.
- Potential future increases in energy storage devices and/or electric vehicles will continue to require refinements to the utility forecasting process.
- Probabilistic methods and scenario assumptions are beginning to be used to bound the short- and long-term impacts of forecast variability.

TOPIC 2:
Hosting Capacity

Five Year Distribution Planning Stakeholder Meeting

Michigan Public Service Commission

Lake Superior Hearing Room

June 27, 2019

MPSC

Michigan Public Service Commission

Hosting Capacity

Methods, Applications, Opportunities and Challenges

Jeff Smith
Manager, Distribution Operations and Planning
jsmith@epri.com

MPSC Distribution Planning Stakeholder Meeting

6/27/2019 – Lansing, MI

Outline

- Overview – what is Hosting Capacity?
- Methods
  - Approach evolution
  - Comparisons
- Data and Modeling Requirements
  - State of the industry
  - Implementation Challenges
- Applications

What is Hosting Capacity and Why is it So Important?

- Definition:
  - Hosting Capacity is the amount of DER that can be accommodated without adversely impacting power quality or reliability under current configurations and without requiring infrastructure upgrades.
- Hosting Capacity is
  - Location dependent
  - Feeder-specific
  - Time-varying
- Hosting capacity considers
  - Voltage violations
  - Thermal overloads
  - Protection mis-operation
  - Safety/reliability/power quality
- Hosting capacity evaluations require distribution system modeling

Hosting Capacity Illustration

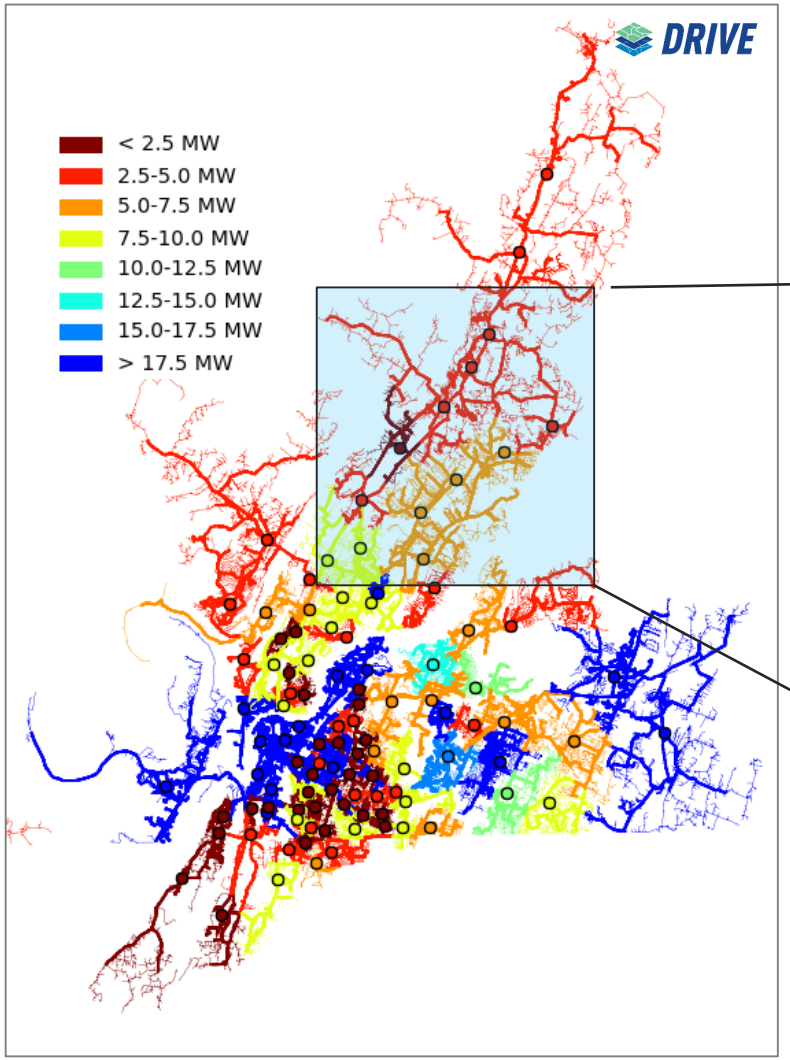
Substation Marker

*Hosting Capacity

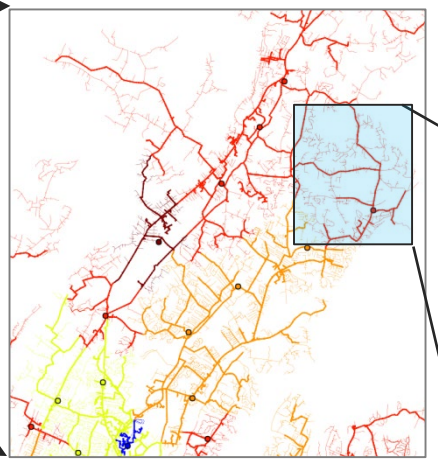
lower

higher

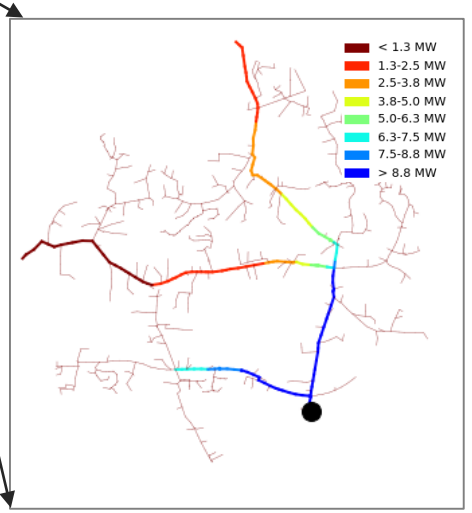
System Hosting Capacity
(~ 300 distribution feeders)



Substation-level Hosting Capacity

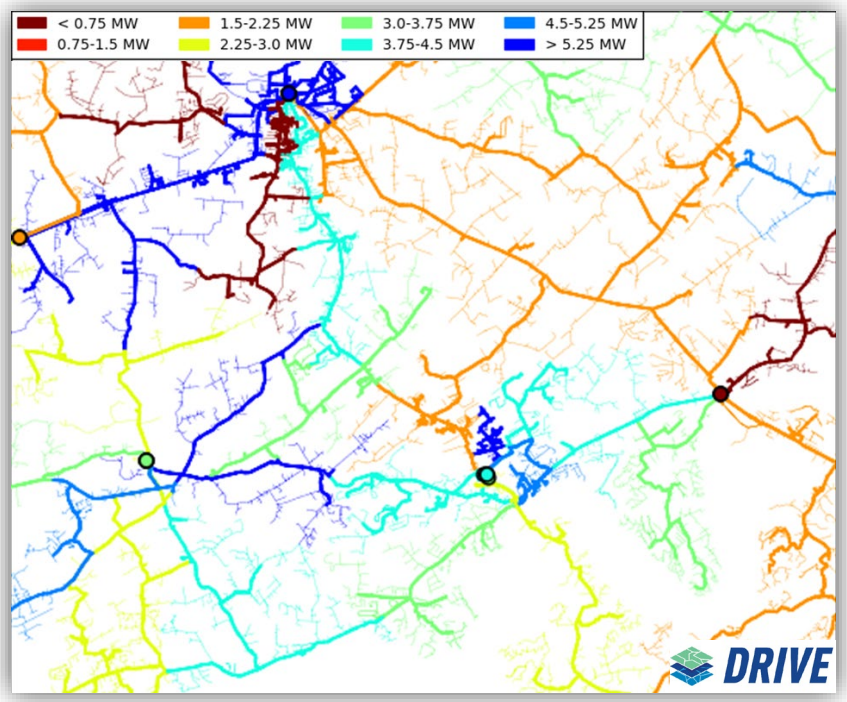


Feeder-level Hosting Capacity



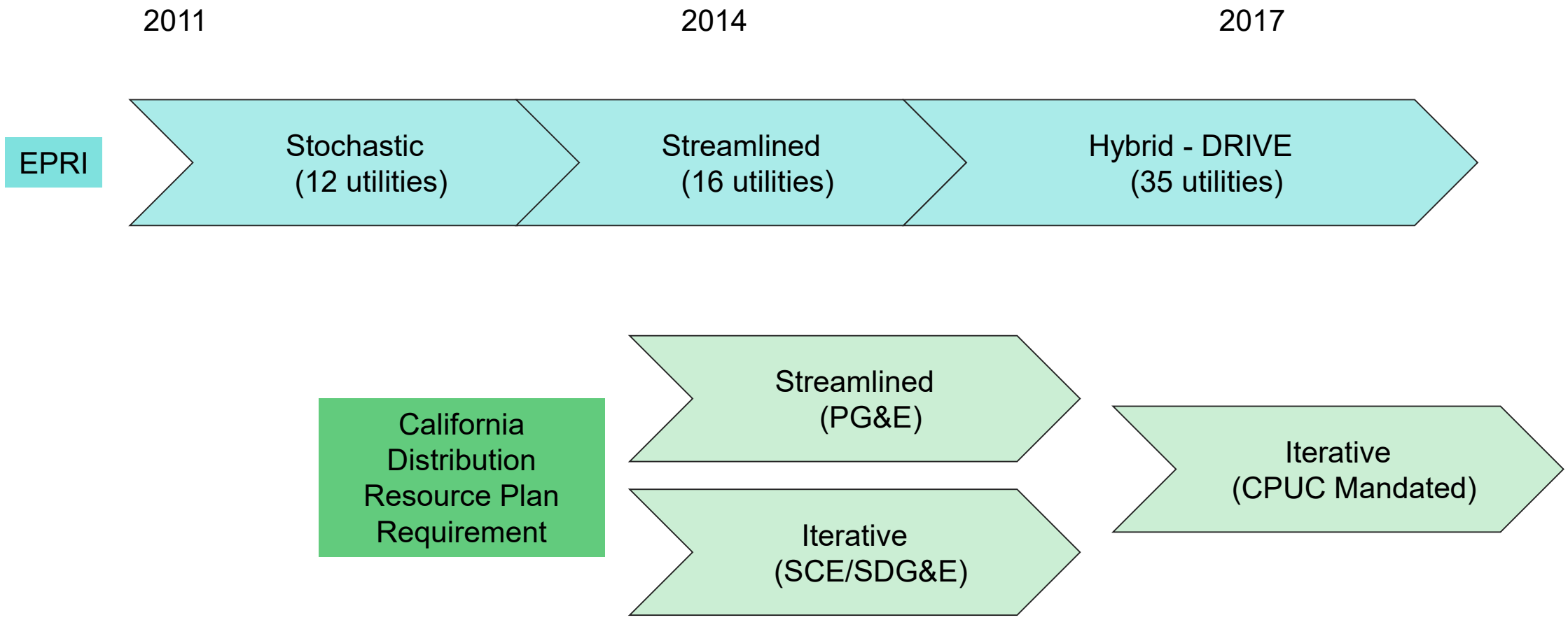
Hosting Capacity Methods

Method Considerations



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

Background on Hosting Capacity Methods and Evolution



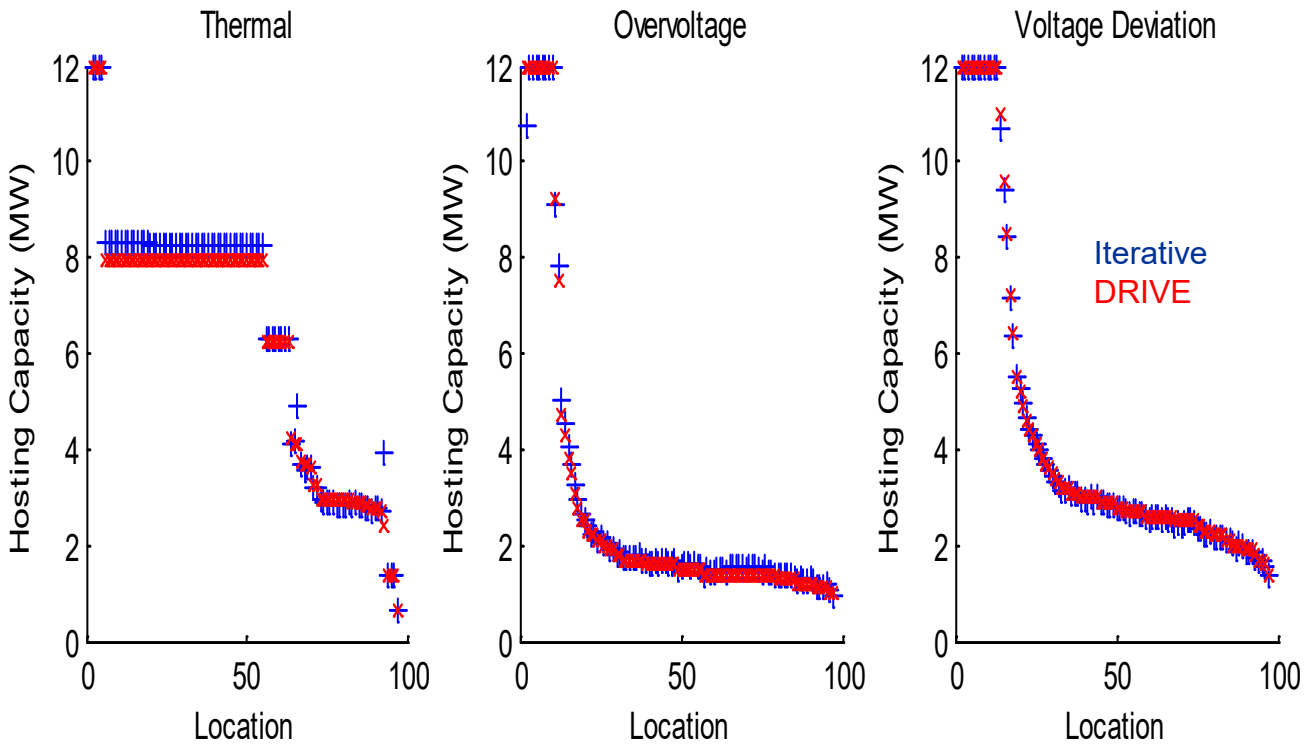
Hosting Capacity methods have and will continue to evolve

Hosting Capacity Methods

Method	Approach	Advantages/Disadvantages	Recommended Use Case
Stochastic	Power flow for all cases	well understood technique, computationally intensive	+DER planning
Iterative (ICA)	Power flow for all cases	well understood technique, computationally intensive	+Inform screening +Inform developers
Streamlined (ICA)	Power flow + calculations	computationally efficient, not fully developed	+Inform screening +Inform developers
Hybrid (DRIVE)	Power flow + calculations	computationally efficient, not well understood method	+DER planning +Inform screening +Inform developers

Different methods have different ramifications on computation time, data required, and application

Comparison of Methods

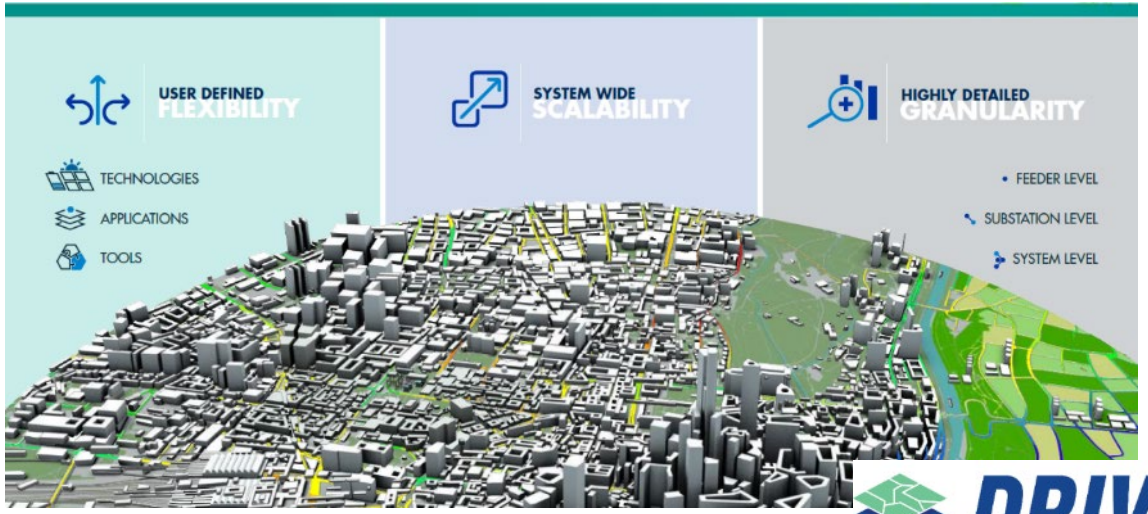


SDG&E "Iterative" and DRIVE show similar results across multiple feeders

Different methods can produce similar results

Next Steps in Hosting Capacity Methods

- Continue to utilize all methods, encourages innovation
- Enhanced methods need to address new challenges (DER Value assessments, mitigation solutions, automation, etc)
- Perform ongoing validation to better understand each approach



DRIVE User Group is an example of these efforts:

- Evolving hosting capacity methods and applications through broad industry engagement
- Over 35 utilities joined to date (US, Europe, Asia, Africa)

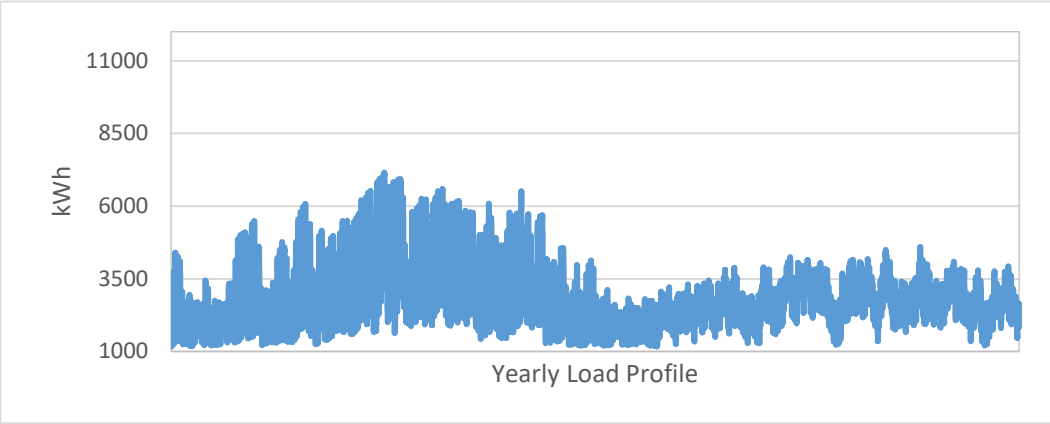
DRIVE

Hosting Capacity Data Requirements

System Data Requirements for Hosting Capacity

Measurement Data

- SCADA information on each feeder to better inform modeling requirements
- Assists in identifying non-traditional planning periods (e.g., daytime minimum load)



GIS Mapping of Distribution Infrastructure

- What assets are located where
- Ratings/capabilities
- Existing DER

EPRI Experience

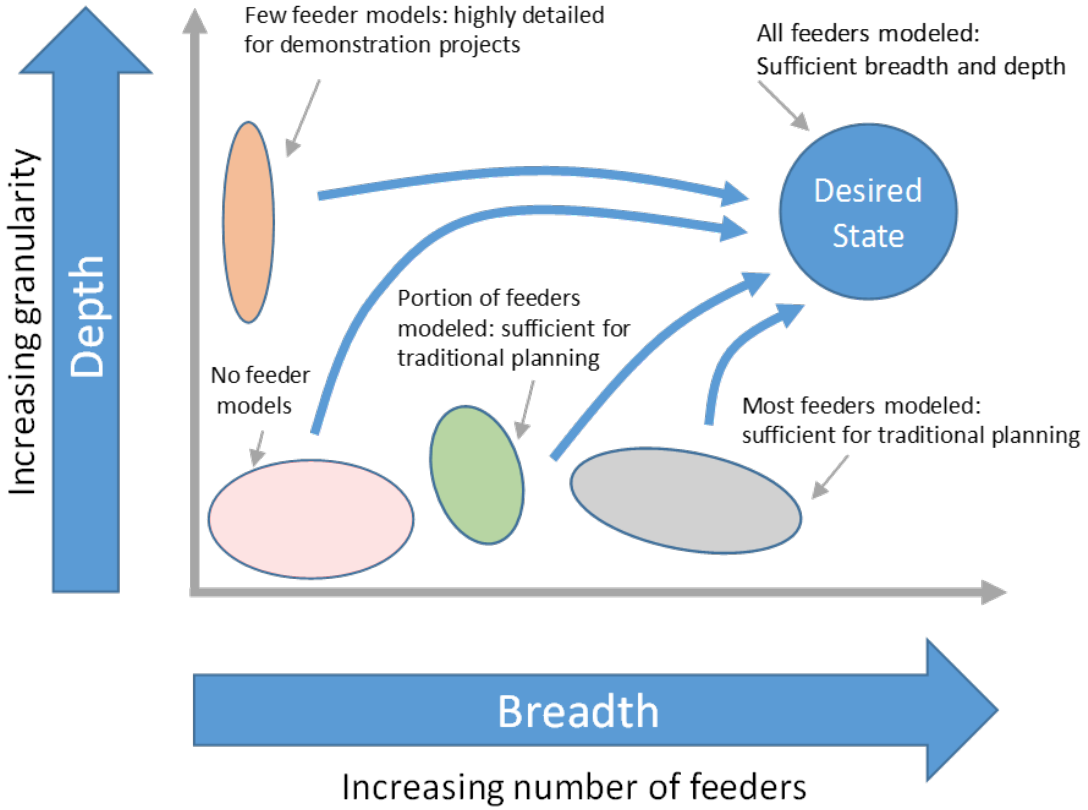
Distribution utilities typically have sufficient GIS representation. However, utilities may not have 100% SCADA coverage.

Modeling Requirements for Hosting Capacity

- Individual feeder analysis
  - Medium-voltage assets modeled
  - Peak-load models represented (current capability for most utilities)
  - Off-peak models of distribution system (not historically needed)
  - Interconnected DER
- System-wide analysis
  - Models of all individual feeders

EPRI Experience

Significant variations across the industry regarding availability of distribution models



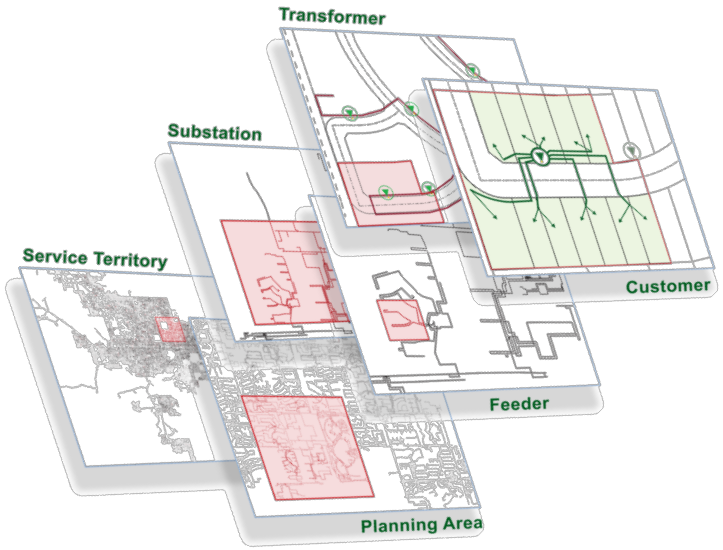
Distribution Modeling Guidelines- Executive Summary: Recommendations for System and Asset Modeling for Distributed Energy Resource Assessments, EPRI, Palo Alto, CA: 2015. 3002008894.

Challenge: Distribution System is Immense" in Scale

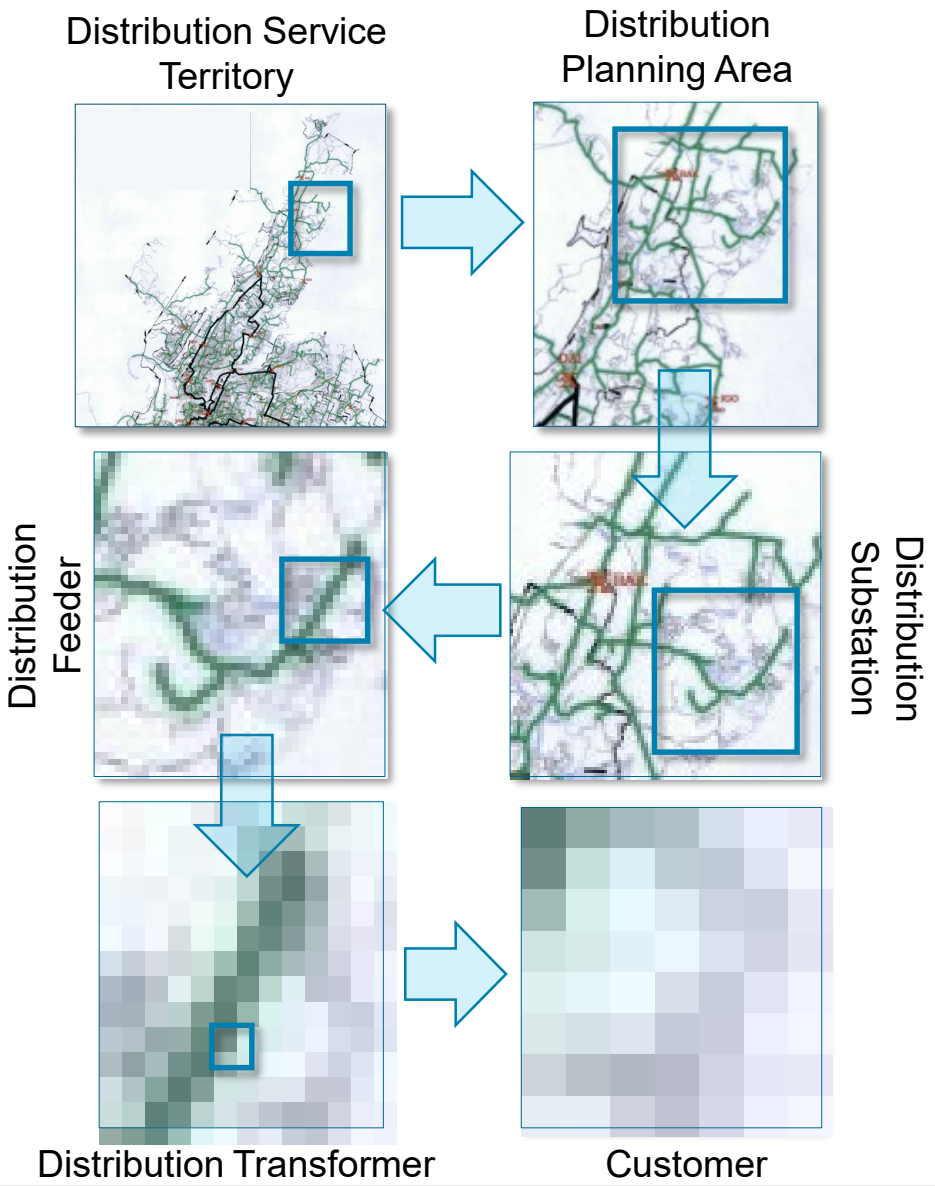
Breadth

- Models of entire distribution area may not be available - some are developed on as-need basis
- Traditional planning techniques have been successful w/o models
- System-wide distribution models are difficult to develop and maintain

Typical Distribution Utility	Count
Service Territory	1
Planning Area	1's - 10's
Substations	10's - 100's
Feeders	100's -1000's
Transformers	1000s - 1,000,000's
Customers	100,000's - 1,000,000's



Challenge – Grid-Edge Modeling and Measurements



Depth

- "Edge" of grid is less known
- Models may not be available
- Metering/sensing data may not be available as well

Additional Consideration: Connected DER and Queue

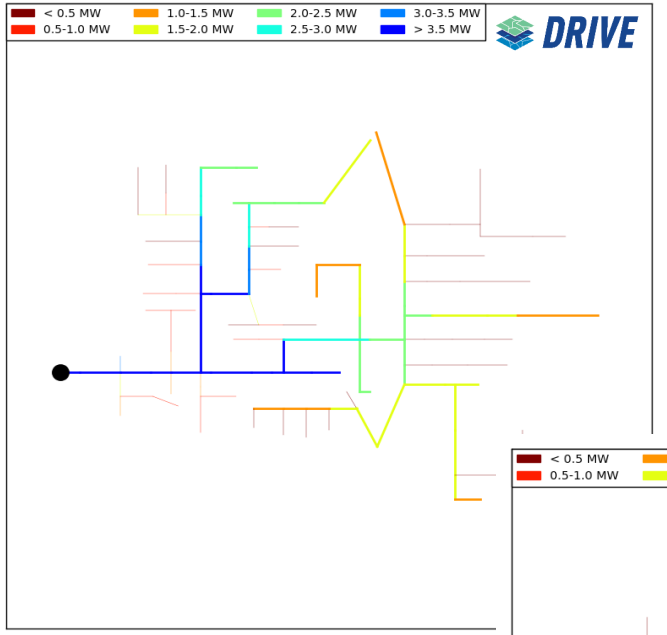
Issue

- Hosting capacity should consider
  - Connected DER (existing)
  - Approved DER (in interconnection queue - this can be very difficult to manage)

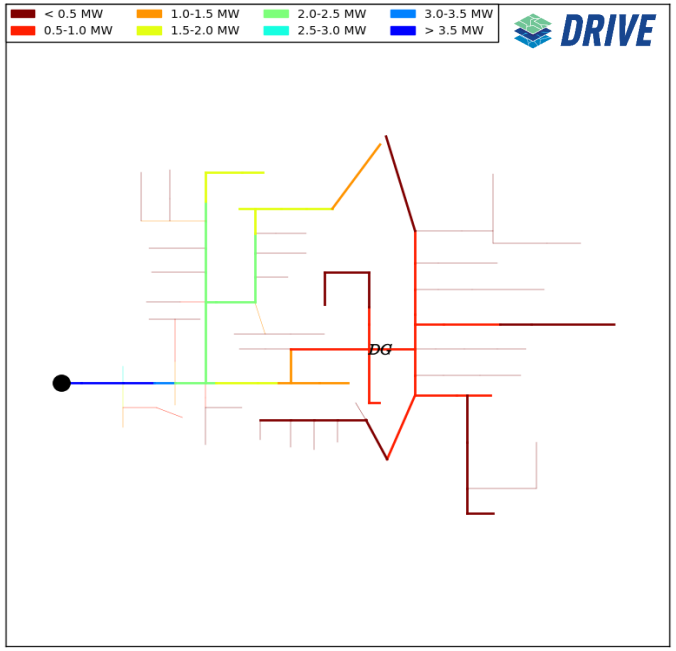
Solution

- Mapping of existing and newly approved DER into planning models - requires new processes to be in place.
- Distribution models updated on regular basis (refresh cycle determined based upon need)

Without Connected DER



With Connected DER



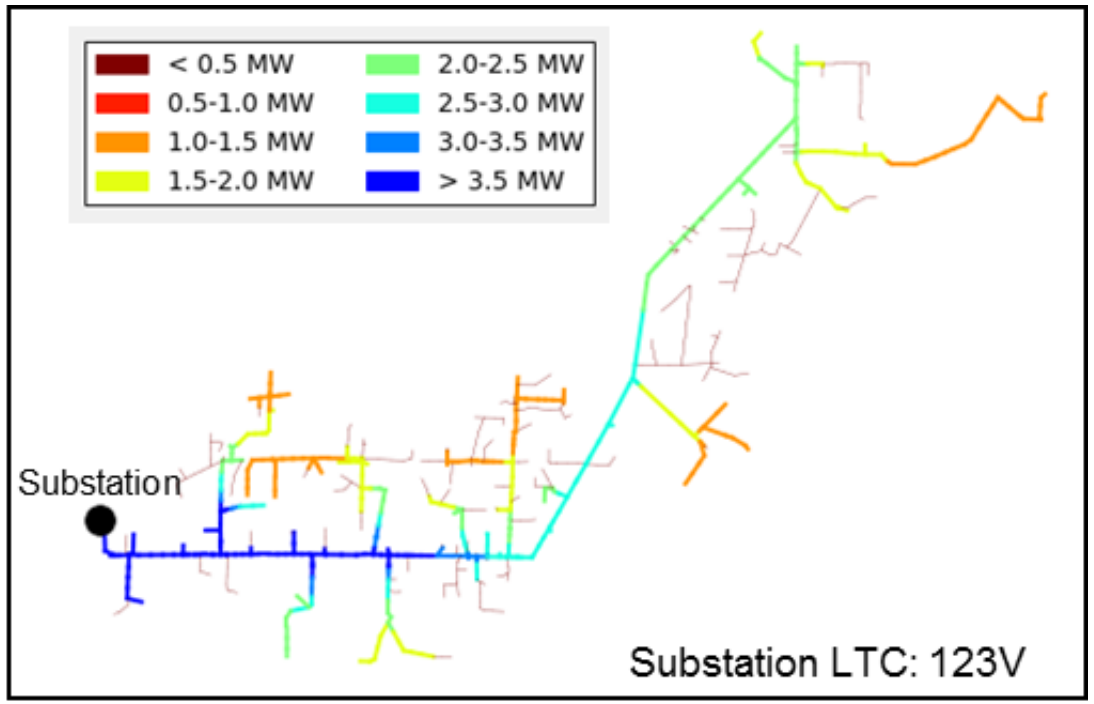
Additional Consideration: Hosting Capacity Impact Factors

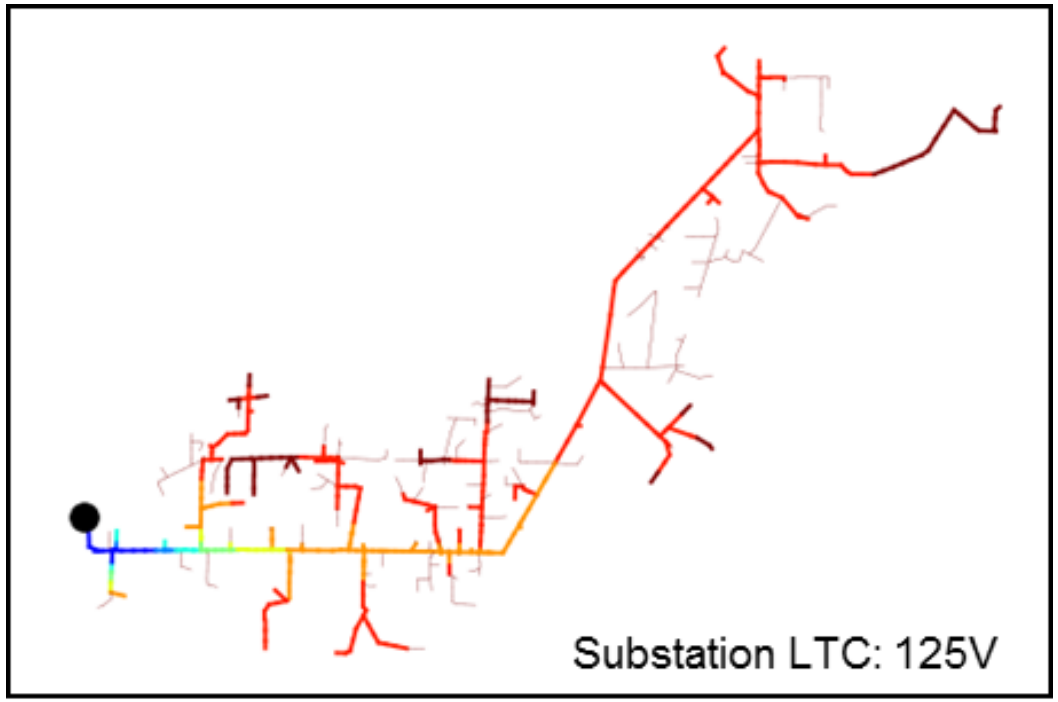
- Various factors impact hosting capacity
  - Some more important than others
  - Modeling all impact factors extremely difficult
- Modeling accuracy - Inaccurate/outdated data
  - Planning models not reflecting design and/or "as operated" conditions
  - Future (queued) DER and load uncertainty
  - All models are an approximation

Minor variations in input assumptions and impact factors have greater impact on results than one method vs another

Impact		Hosting Capacity Impact Factor
High	DER	Location
High		Type/Technology/Portfolio
High		Smart Inverter
High		Communication and Control
High		Aggregation
Medium		Efficiency
Medium		Single-Phase
Low		Vendor
Low		Plant layout
Medium		local weather patterns (renewables)
Medium		Panel orientation (PV)
High	Distribution	Voltage control scheme
High		Configuration/reconfiguration
High		Load level and allocation
High		Phasing information (load/laterals)
Medium		Protection system design
Medium		Granularity of MV models (# of nodes)
High		Grounding practices
High	Misc	Time
Medium		Modeling of service transformers
Medium		Modeling of services/secondaries
Low		Planning software platform
Medium		Transmission constraints
Medium		Transmission grid configuration/dispatch

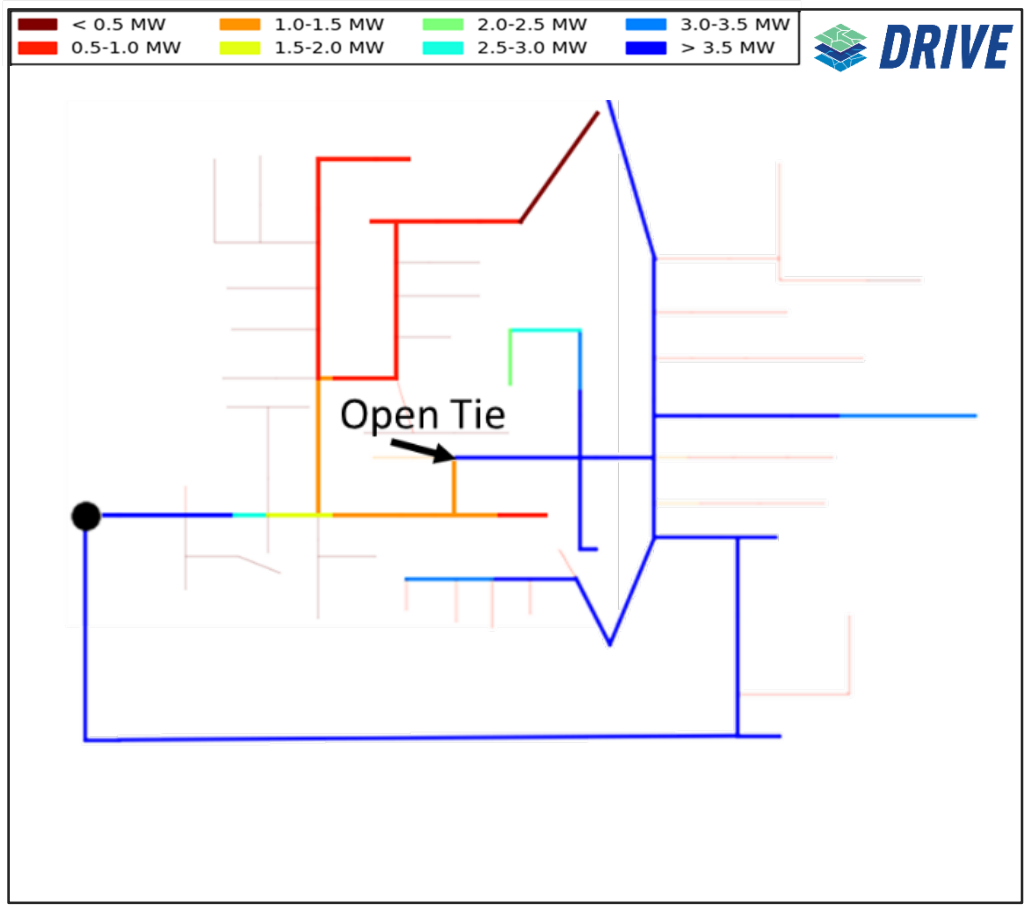
Example: Impact of Voltage Regulation on HC



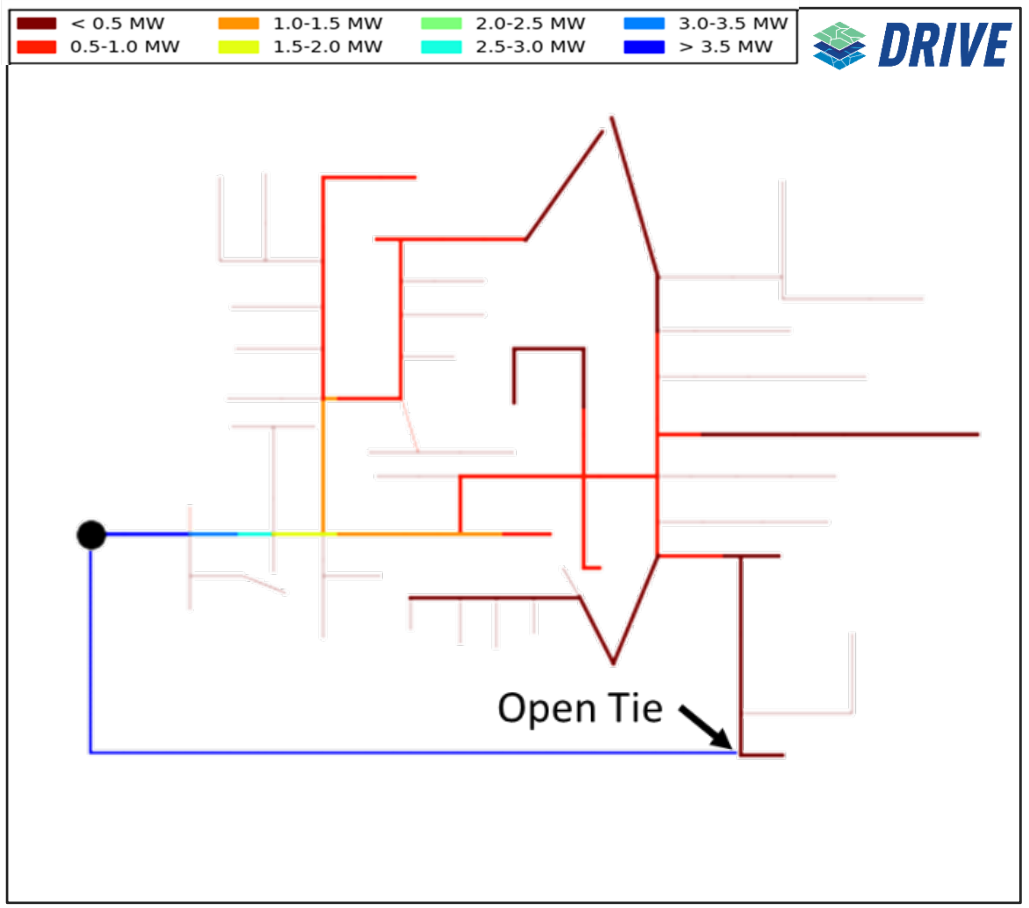


Example: Impact of Feeder Reconfiguration on HC

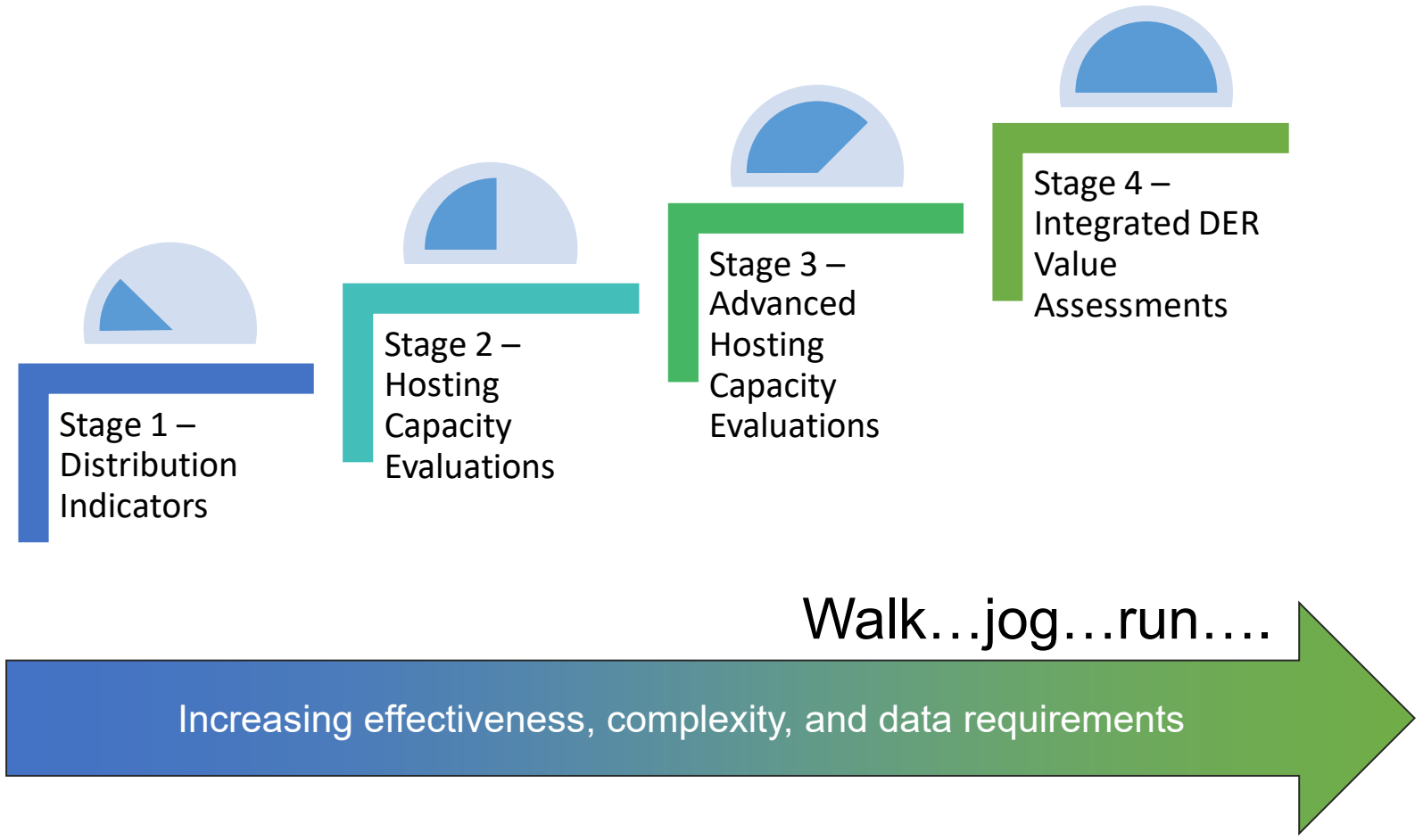
Normal Configuration



Alternative Configuration



Example Implementation Roadmap

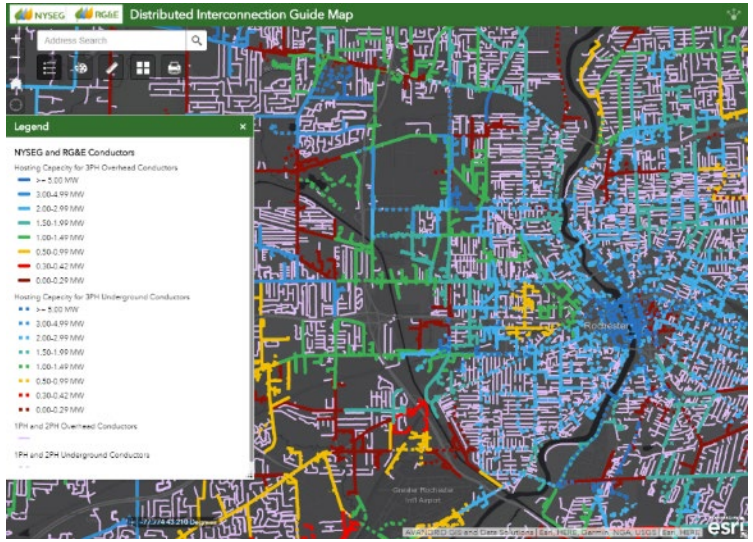


Defining a Roadmap for Successful Implementation of a Hosting Capacity Method for New York State, EPRI, Palo Alto, CA: 2016. 3002008848

Hosting Capacity Applications

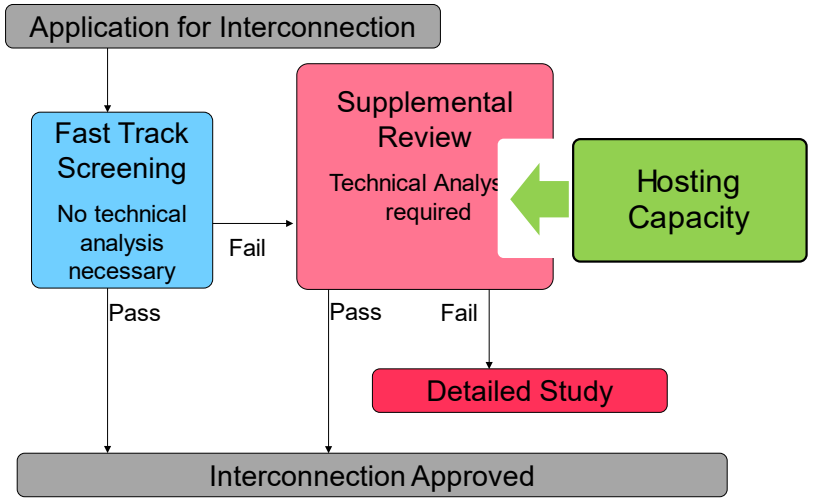
How Utilities Are Applying Hosting Capacity

Informing Developers

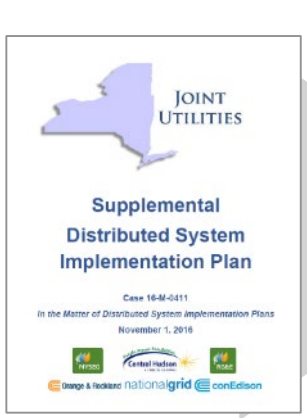


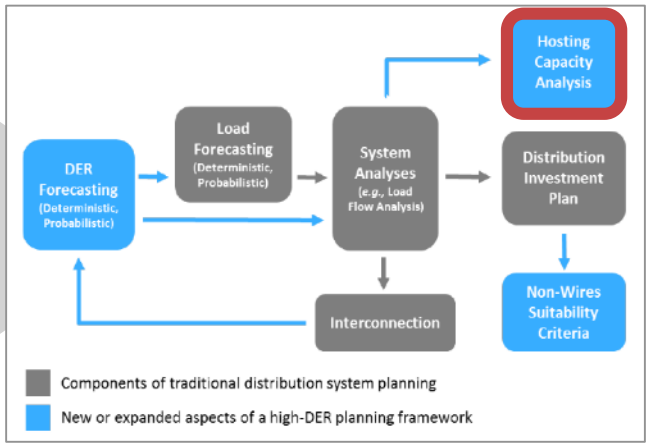
NYSEG/RG&E, [NY Utility Maps]

Assisting Screening



Enabling DER Planning

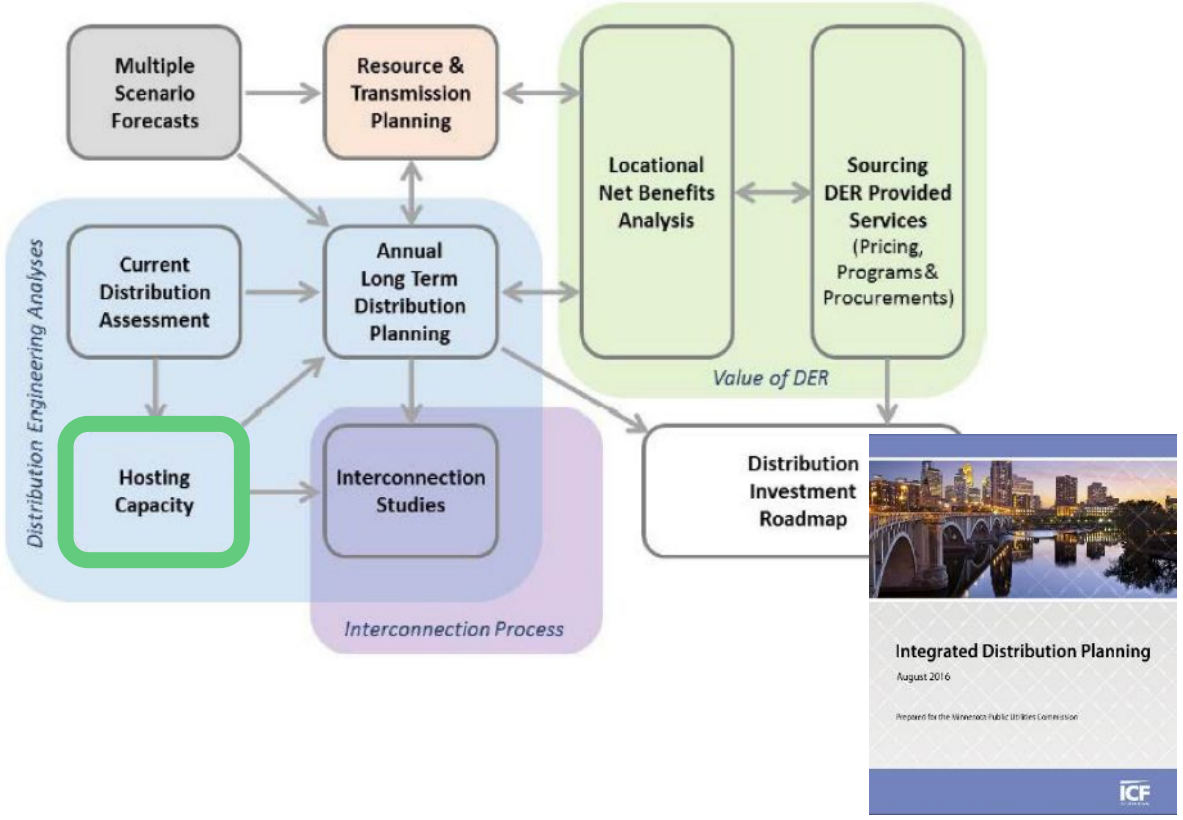




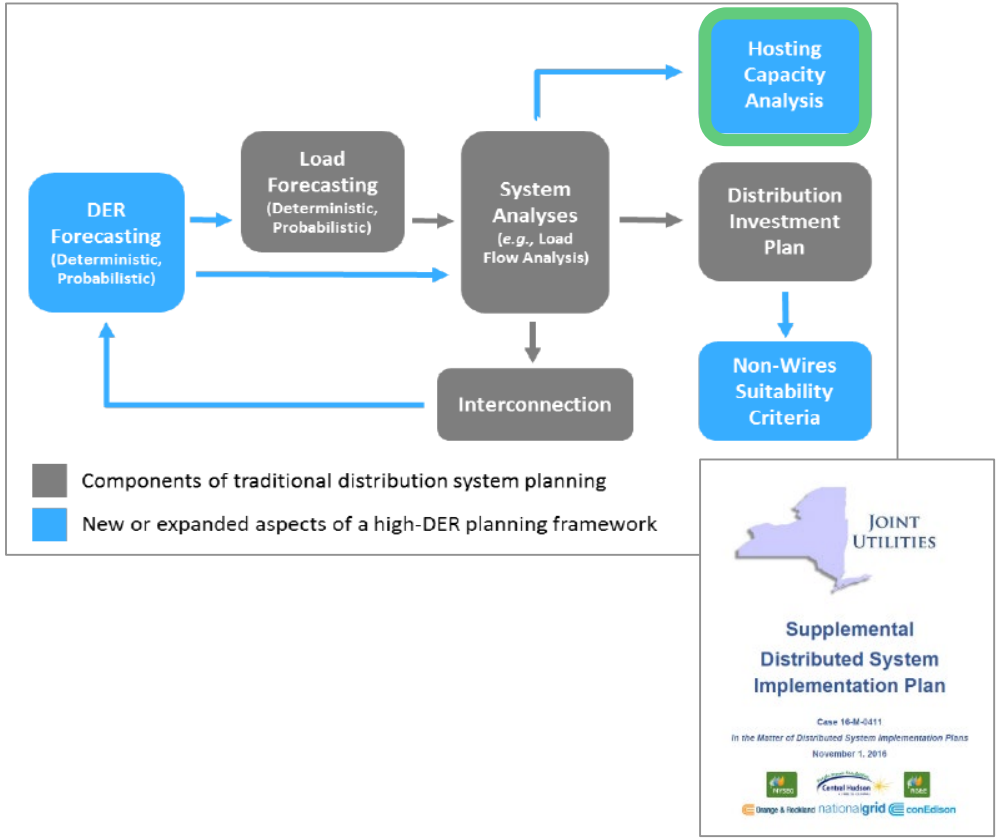
Enabling DER Planning

Key Considerations: Scalability of method, scenarios

MN Integrated Planning

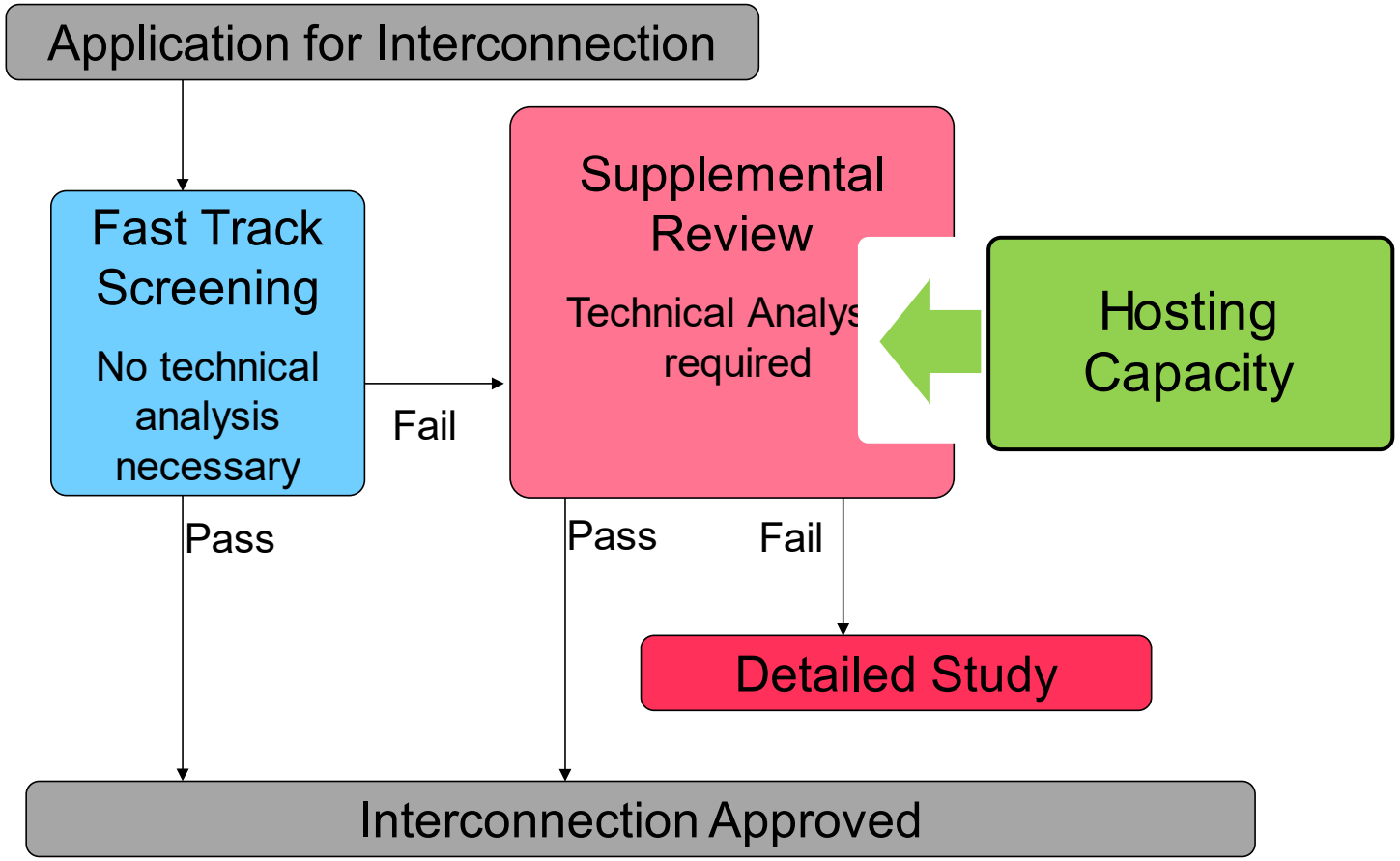


NY REV DSIP



Assisting in Screening

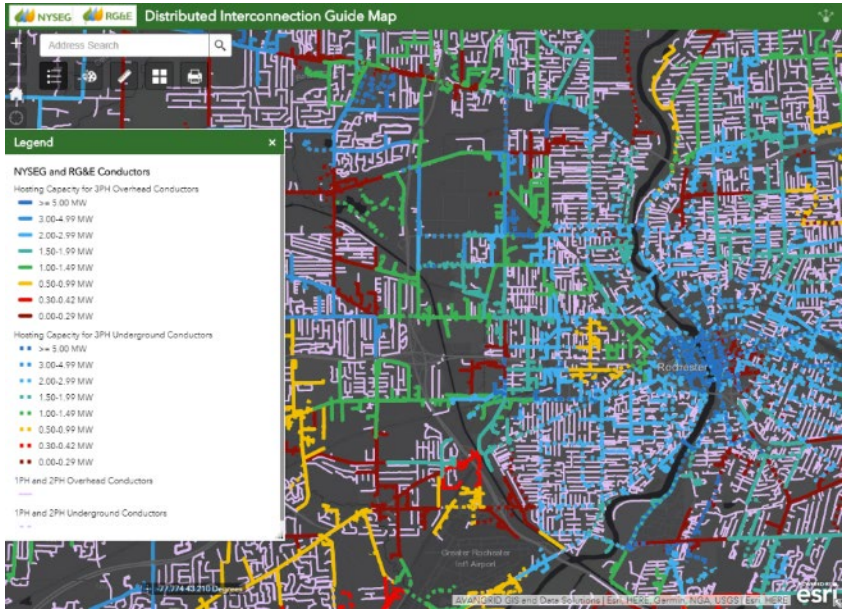
Key Considerations: Accuracy, impact factors, need for engineering judgement



Informing Developers

Key Considerations: Granularity, frequency of updates, existing DER

[Xcel Energy Hosting Maps]



NYSEG/RG&E

[View all NY Utility Maps]

Additional study is needed to evaluate developer usage of HC maps for siting DER

Summary

- Hosting capacity is a complex analysis that requires planners to analyze their distribution systems in a new manner
- HC methods are available but will evolve
  - Although matured through the years, methods are still relatively new and will continue to evolve
  - Different methods can produce similar results, however data and computational requirements vary
  - Methods are available in most planning tools
- HC applications are broad
  - Enabling planning for DER
  - Informing developers
  - Assisting with interconnection screening
- HC poses challenges
  - May require additional measurement data on each feeder
  - System-wide electrical models may not be readily available (if not, this could be time intensive to develop)
  - New processes are needed for model upkeep
- HC provides opportunities
  - Assisting planners dealing with future DER scenarios - knowing HC is critical for planners dealing with a “DER future”
  - HC can assist engineers with time-intensive interconnection screening
  - Assisting DER developers in siting DER…?

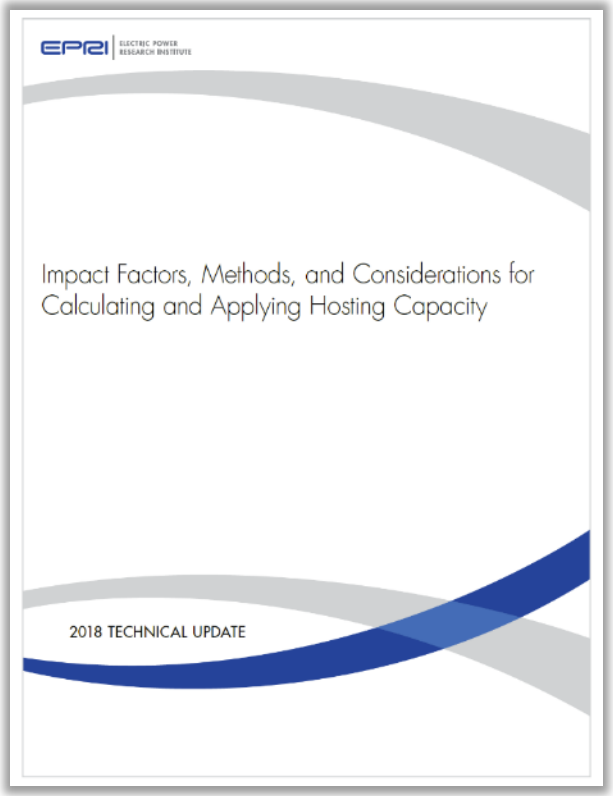
Resources

Detailed Hosting Capacity Method

- Impact of High-Penetration PV on Distribution System Performance: Example Cases and Analysis Approach. EPRI, Palo Alto, CA: 2011. 1021982
- Analysis of High-Penetration Solar PV Impacts for Distribution Planning: Stochastic and Time-Series Methods for Determining Feeder Hosting Capacity. EPRI, Palo Alto, CA: 2012. 1026640
- Rylander, M., Smith, J., “Comprehensive Approach for Determining Distribution Network Hosting Capacity for Solar PV”, 2nd International Workshop on Integration of Solar Power Into Power Systems, Lisbon, Portugal, Nov 2012.
- Rylander, M., Smith, J., "Stochastic Approach for Distribution Planning with DER", 2012 CIGRE Grid of the Future Symposium, Kansas City, MO, 2012
- Rylander, M., Smith, J., "Comprehensive Approach for Determining Distribution Network Hosting Capacity for Solar PV", 2nd International Workshop on Integration of Solar Power Into Distribution Systems, 12-13 November, 2012
- Distributed PV Feeder Analysis: Preliminary Findings from Hosting Capacity Analysis of 18 Distribution Feeders. EPRI, Palo Alto, CA: 2013. 3002001245.
- Alternatives to the 15% Rule: Modeling and Hosting Capacity Analysis of 16 Feeders. EPRI, Palo Alto, CA: 2015. 3002005812.

Hybrid Hosting Capacity Method

- **Impact Factors, Methods, and Considerations for Calculating and Applying Hosting Capacity. EPRI, Palo Alto, CA: 2018. 3002011009.**
- EPIC 1 – Project 4 Demonstration of Grid Support Functions of DER: Demonstration and Comparison of the “EPRI Distribution Resource Integration and Value Estimation Hosting Capacity” and “SDG&E Iterative Integration Capacity Analysis” Tools, Mar. 2018. https://www.sdge.com/sites/default/files/EPIC-1 Project 4_Module 3_Final Report.pdf
- Integration of Hosting Capacity Analysis into Distribution Planning Tools. EPRI, Palo Alto, CA: 2016. 3002005793
- Defining a Roadmap for Successful Implementation of a Hosting Capacity Method for New York State, EPRI, Palo Alto, CA: 2016. 3002008848
- A New Method for Characterizing Distribution System Hosting Capacity for Distributed Energy Resources: A Streamlined Approach for Solar PV. EPRI, Palo Alto, CA: 2014. 3002003278.
- Rylander, M., Smith, J., Sunderman, W., “Streamlined Method For Determining Distribution System Hosting Capacity”, 23rd International Conference on Electricity Distribution, CIRED, Lyon, France, 2015
- Rylander, M., Smith, J., Sunderman, W., “Streamlined Method For Determining Distribution System Hosting Capacity”, Rural Electric Power Conference, Asheville, NC, 2015 (accepted for IAS Transactions)
- Distribution Feeder Hosting Capacity: What Matters When Planning for DER?. EPRI, Palo Alto, CA: 2015. 3002004777
- Smith, J., Rylander, M., Rogers, L., Dugan, R., “It’s All in the Plans: Maximizing the Benefits and Minimizing the Impacts of DERs in an Integrated Grid”, Power and Energy Magazine, March/April 2015.



News Articles

- Why are the newest distribution system buzzwords 'hosting capacity analysis'? - Utility Dive
- Exploring the Untamed Frontier of Hosting Capacity on the Grid Edge - Greentech Media Squared
- How Much DER Fits? Utilities Developing a Hosting Capacity Analysis Tool for DER - T&D world

LUNCH BREAK: 11:30 AM – 1:00 PM

- Some food/restaurant suggestions
  - American
    - Buffalo Wild Wings
    - Chick-fil-A
    - Culver's
    - Frank's Press Box
    - Houlihan's
    - Jersey Mike's Subs
    - The Rusty Mug
  - Asian
    - Panda Express
    - Little Panda Chinese Restaurant
    - Sushi Moto
    - Ukai Hibatchi Grill & Sushi
  - Italian
    - Carrabba's Italian Grill
    - Cottage Inn Pizza
  - Mexican
    - Cancun Mexican Grill
    - Chipotle
    - El Burrito Mexicano
  - Mediterranean
    - Zaytoon Mediterranean
    - ChouPli Wood-Fired Kabob
  - Other
    - Horrocks (soup, salad, & pizza bar)

TOPIC 3:
Non-Wires Alternatives

Five Year Distribution Planning Stakeholder Meeting

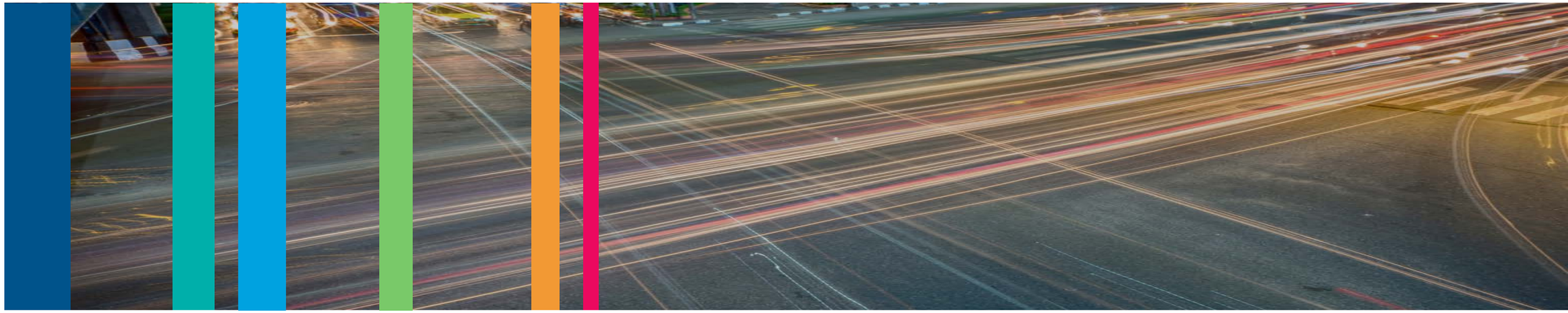
Michigan Public Service Commission

Lake Superior Hearing Room

June 27, 2019

MPSC

Michigan Public Service Commission



Non-Wires Alternatives

Lansing, MI
June 27, 2019

Agenda

This presentation seeks to answer:

- What is an NWA?
- Where are project occurring ?
- Why is this important?

Overview

What is a Non-Wires Alternative (NWA)?

NWA: a portfolio of distributed energy resources (DER) such as energy efficiency (EE), demand response (DR), solar PV, battery energy storage (BES), combined heat and power (CHP) etc. that can be used to help provide grid needs.

NWA Drivers

Regulatory Policy

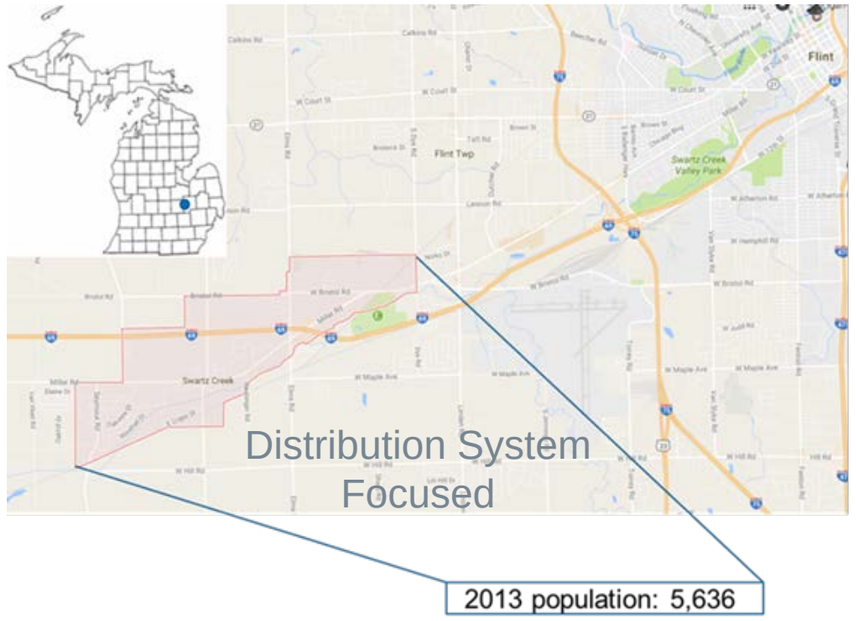
Environmental Goals

R&D / Innovation

Cost Reduction

Example NWA: Town of Swartz Creek, Michigan

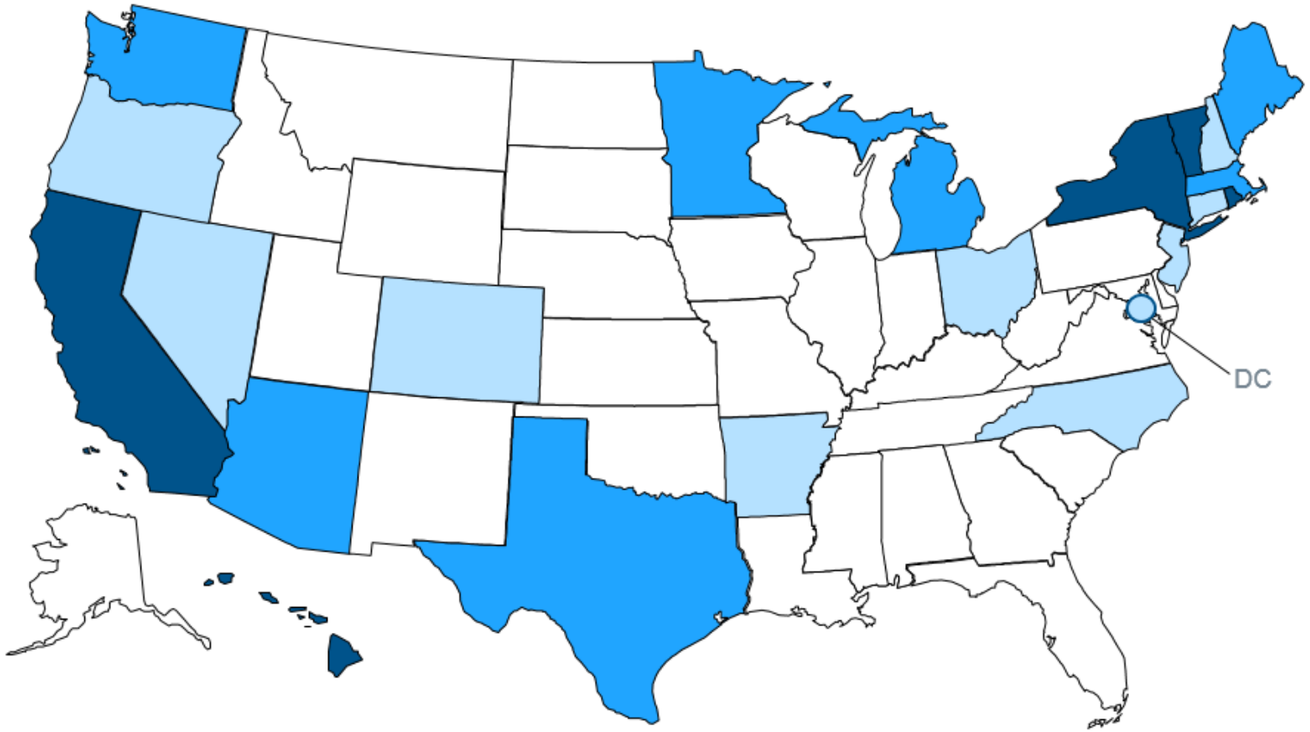
Source: Consumers Energy, Mark Luoma, Peak Load Management Association 36th Conference, 2017



NON-WIRES ALTERNATIVES TODAY

- Still in pilot phase
- Momentum is building
- Growing numbers of utilities are working on NWA projects
- Propelled by regulatory mandates, internal utility decisions, and public/stakeholder input
- Integrated Distribution Planning learnings are being generated

Non-Wires Activities



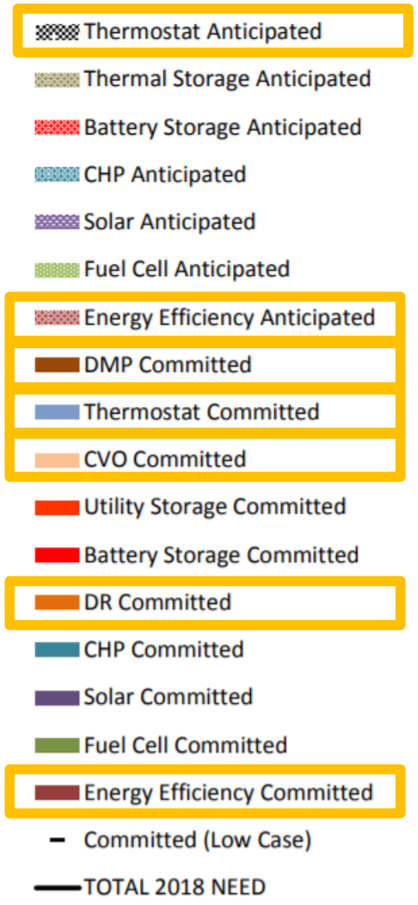
Source: ICF

Example: Con Edison Brooklyn Queens Demand Management Program

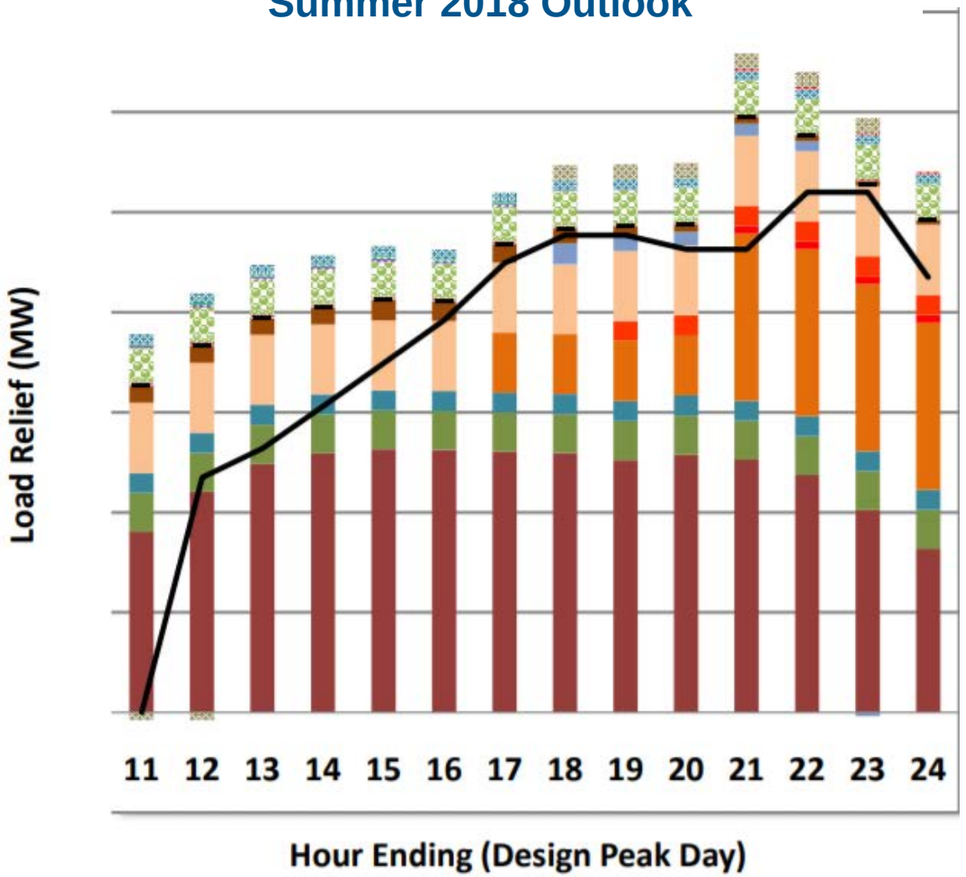
Goal: $1.2 B Substation Deferral with DER portfolio

	2016	2017	2018	Total
Customer Side Solutions	9 MW	23 MW	9 MW	41 MW
Utility Side Solutions	3 MW	8 MW	-	11 MW
Total	**12 MW**	**31 MW**	**9 MW**	**52 MW**

An outlier in terms of its size, BQDM played an important role in NY REV and in propelling forward the NWA concept.



Con Edison BQDM DER Portfolio Summer 2018 Outlook



Source: Con Edison, Brooklyn-Queens Demand Management , Targeted Demand Management (April, 2017)

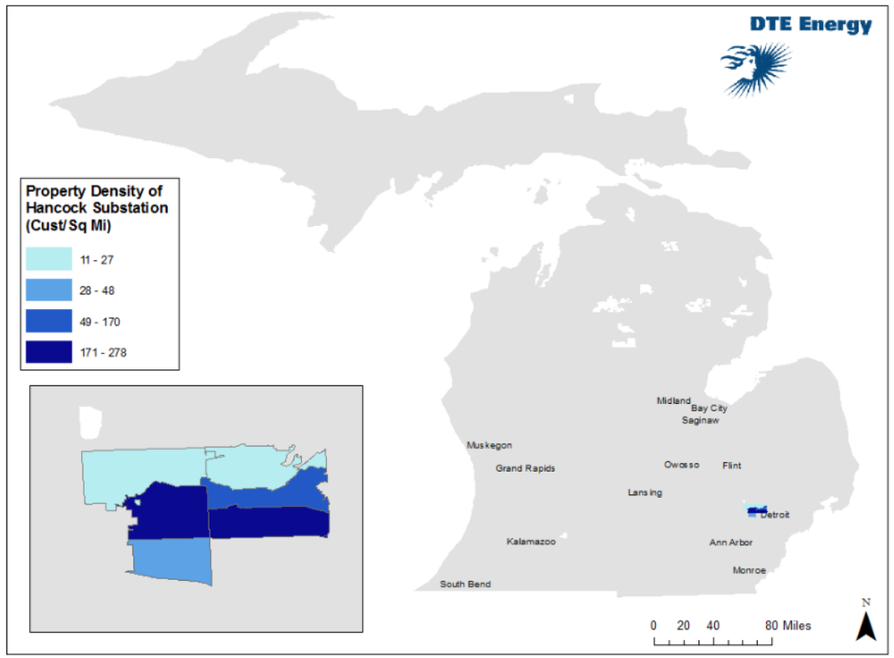
Other Examples

Arizona Public Service	• Punkin Center • Thermal constraint on distribution feeder
Bonneville Power Administration	• South of Allston • Transmission constraint
San Diego Gas & Electric	• Borrego Springs Microgrid • Reliability issue related to sub-transmission line
Central Hudson Gas & Electric	• Peak Perks Demand Management Program • Distribution Constraint

Projects have varied depending on the specific need.

Michigan Examples

Example NWA: Commerce Township, Michigan

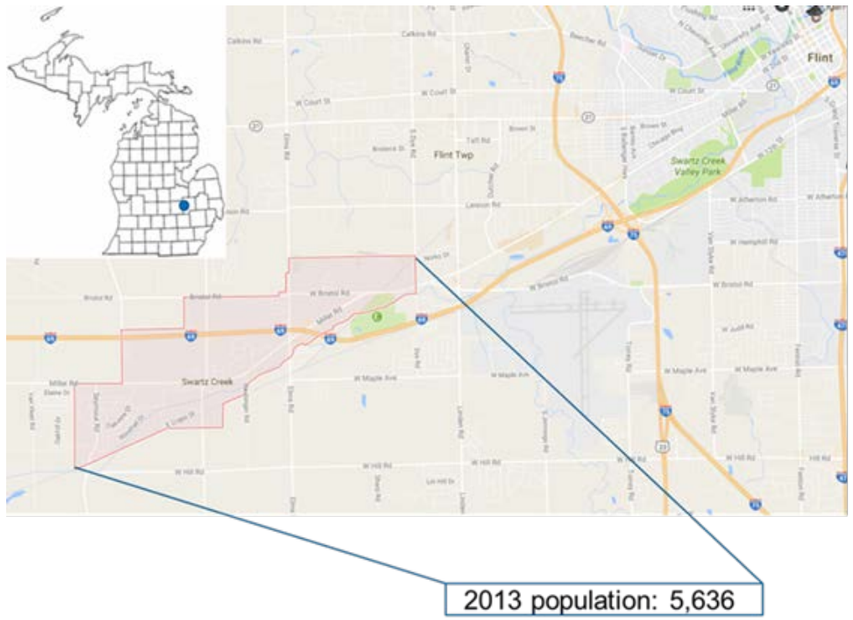


Customer Premises

- 1,161 Commercial
- 7,589 Residential

Source: DTE Energy, Non-Wires Alternatives 2018 Working Group Meeting, 07/2018, Lansing, MI

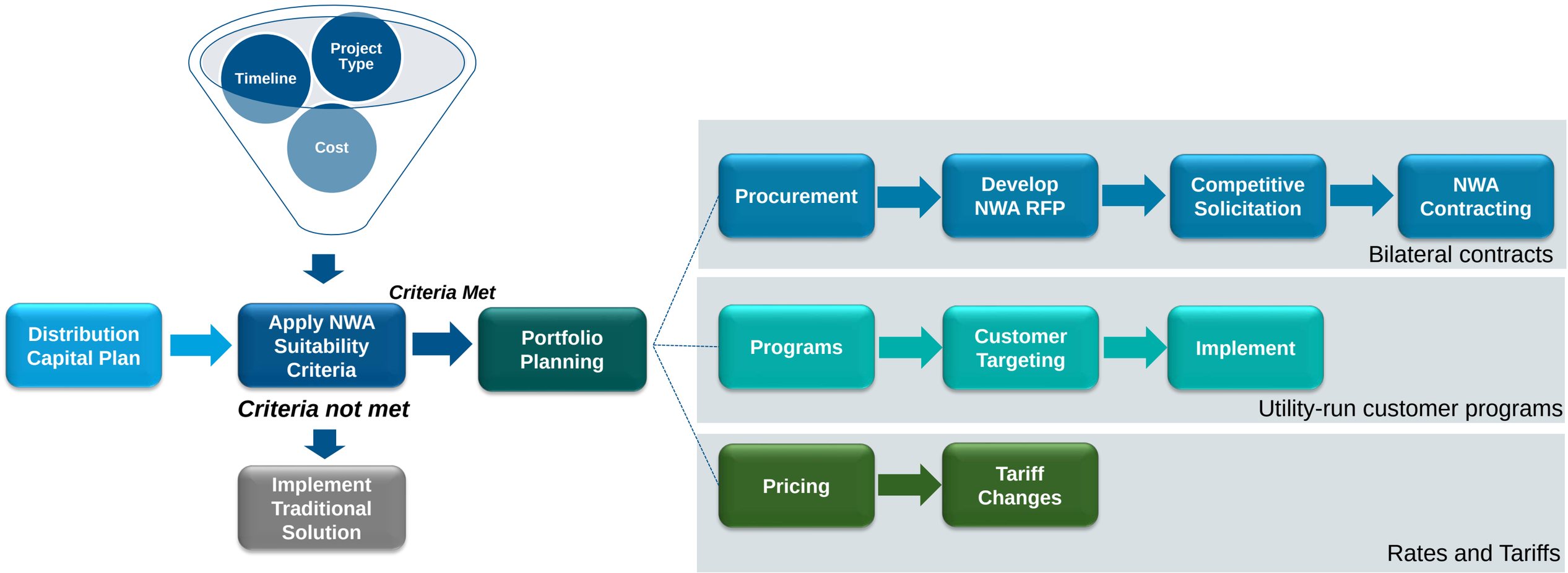
Example NWA: Town of Swartz Creek, Michigan



Source: Consumers Energy, Mark Luoma, Peak Load Management Association 36th Conference, 2017

NWA Framework

Prototypical NWA Framework



Source: ICF

Programs

Case study spotlight:

NWA Case Studies	Using EE	Using DR	Using Storage	Average Size Load Reduction
10	4	7	5	1-85 MW

DSM is proving to be a foundational component of NWA.

Procurement

Case study spotlight: REV CONNECT

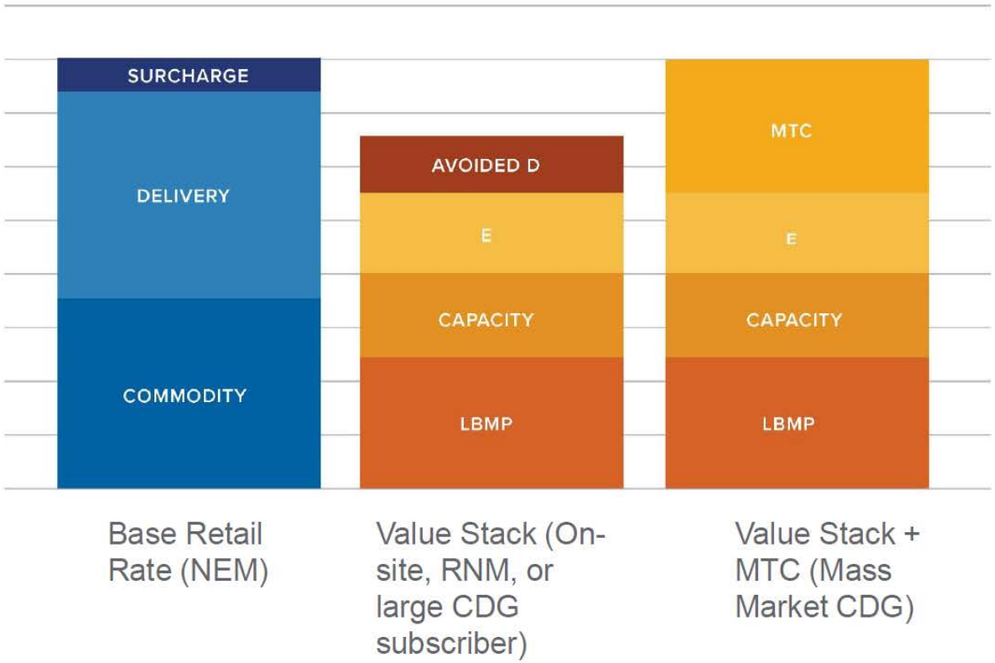
NWA Opportunities Listed	Listed and Successful	No Resolution Listed	Average Size Load Reduction
47	6	39	5-10 MW

Many jurisdictions are pursuing opportunities for procuring DER within NWA. However, these need ample lead time, lots of work in the contracting process.

Source: Data is from REV Connect website. https://nyrevconnect.com

Pricing

Value of DER (New York)



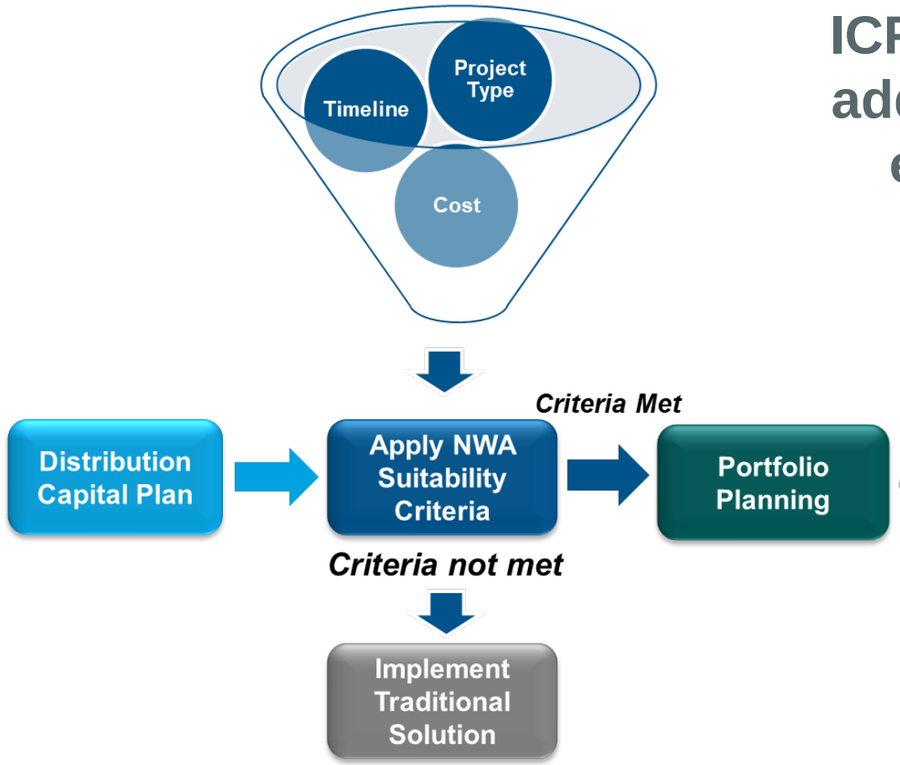
- Avoided D – avoided demand
- E – environmental benefit
- Capacity – ICAP
- LBMP – energy commodity
- MTC – market transition credit for CDG

Source: NYSERDA, *Summary of Updated Value Stack Order*, 04/25/2019

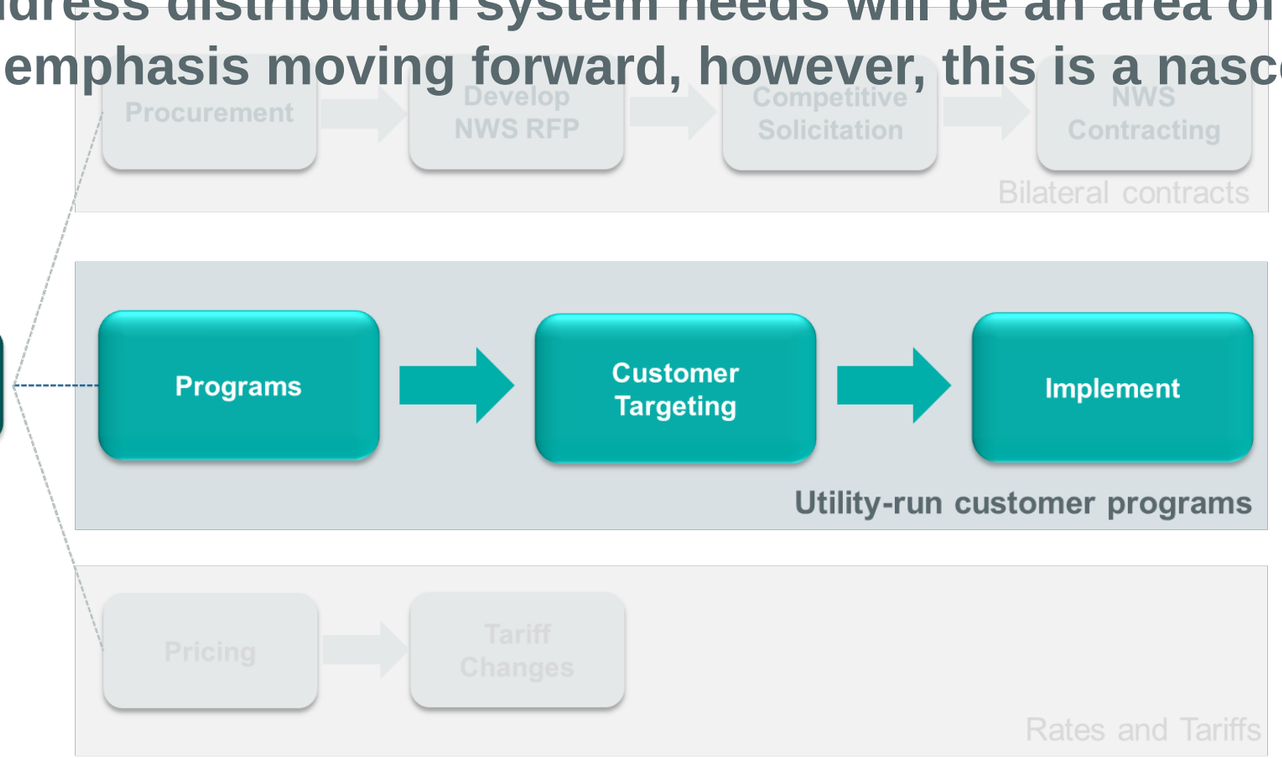
Work is underway to use design tariffs for NWA. Challenges include capturing geospatial and temporal values and setting compensation levels sufficiently to mitigate grid investment.

Applying Utility Programs to NWA

Shifting Emphasis in NWA



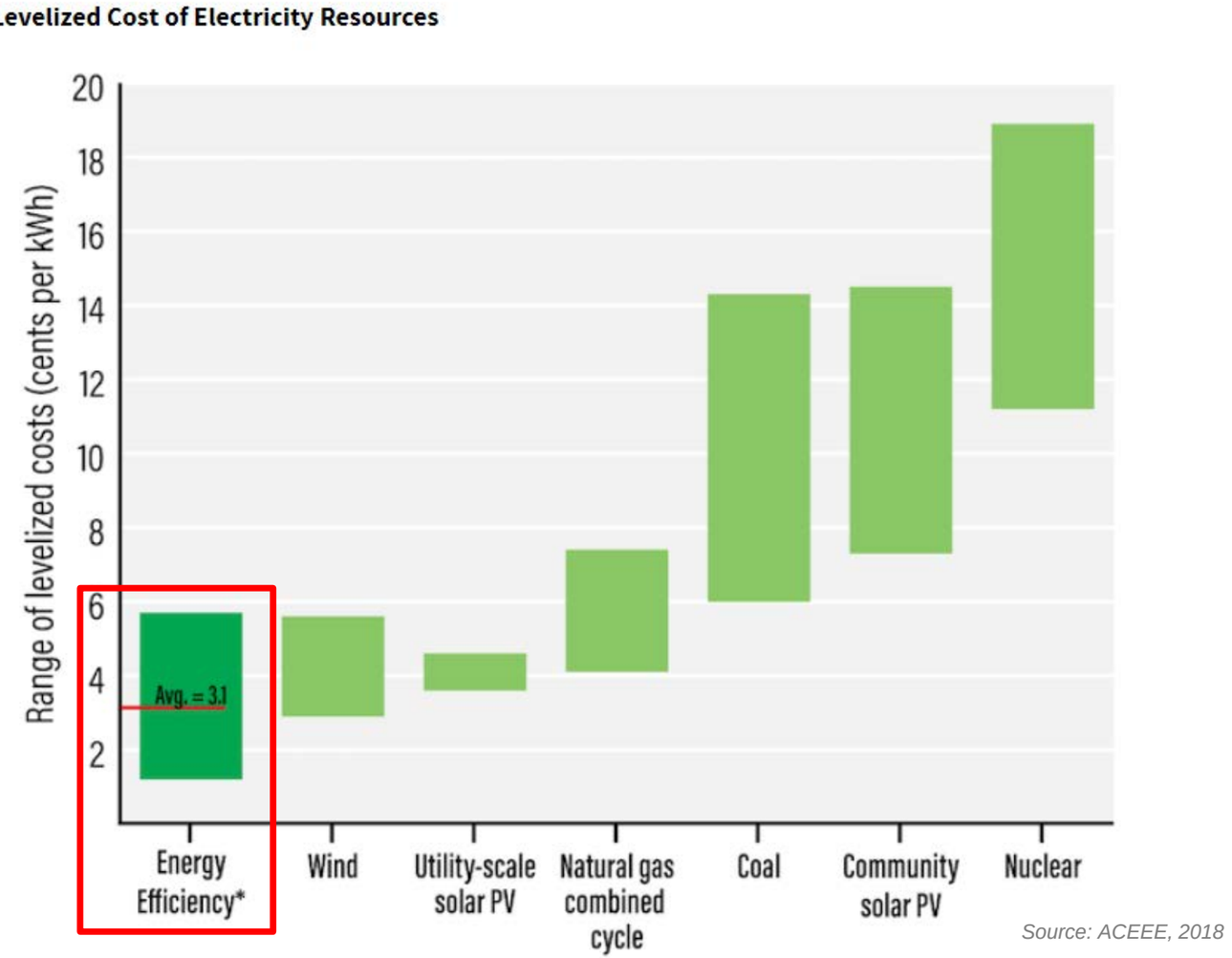
ICF expects that finding ways to direct utility DSM programs to address distribution system needs will be an area of increased emphasis moving forward, however, this is a nascent area



Source: ICF

Energy Waste Reduction: Low Cost Resource (Energy)

- EWR continues to be a low cost energy (kWh) resource on a levelized cost basis
- Increasingly – there is recognition that EWR provides benefits on a locational and temporal basis
- Understanding how EWR contributes to load reduction is a challenge



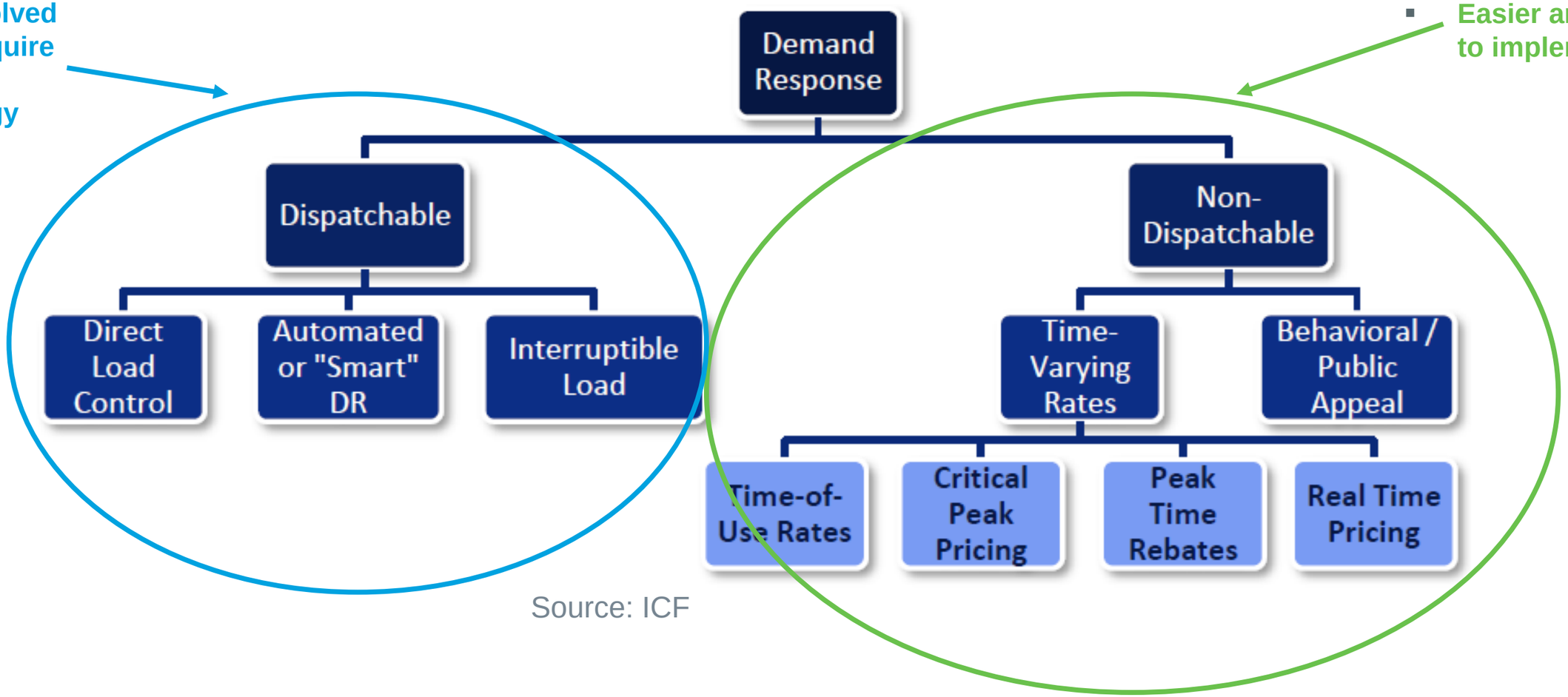
Source: ACEEE, 2018

*Notes: Energy efficiency program portfolio data from Molina and Relf 2018. Represents costs to utilities or program administrators only, including shareholder performance incentives if applicable. All other data from Lazard 2018 Unsubsidized Levelized Cost of Energy Comparison.

Demand Response: Has Potential for Local Needs

- More predictable, more certain load reduction
- More involved setup, require enabling technology

- Less reliable, more uncertainty around load reductions
- Easier and faster to implement

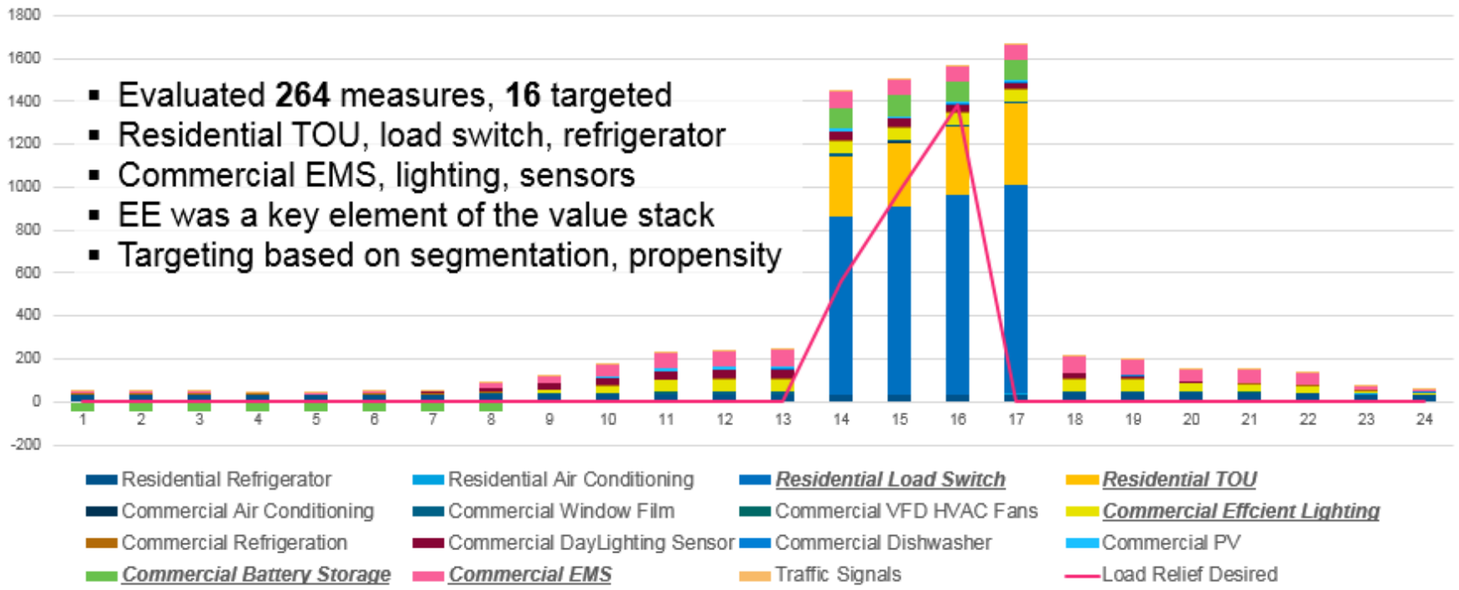


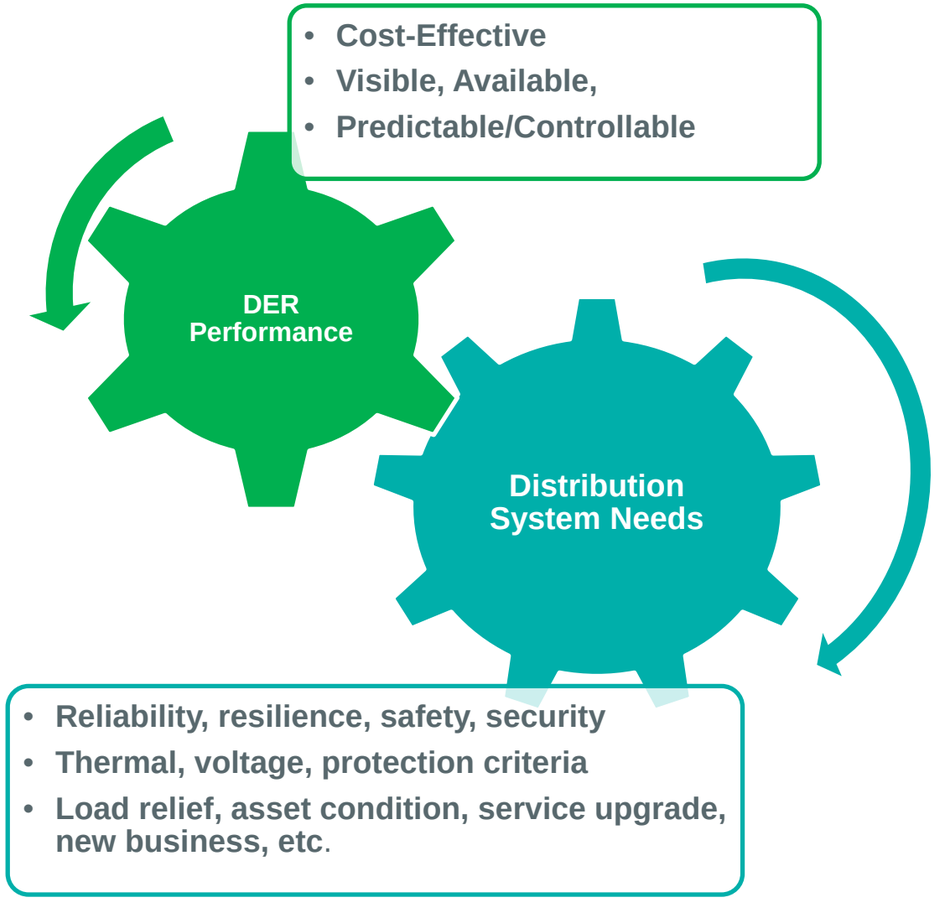
Source: ICF

Connecting Distribution Planning and Program Analysis

- Customer programs have potentially to be geographically targeted
- Potential to be flexible, manageable, fast
- There is an increased emphasis of enhancing analytics within utility planning organizations to be able assess these solutions in a comprehensive way, along with other DER

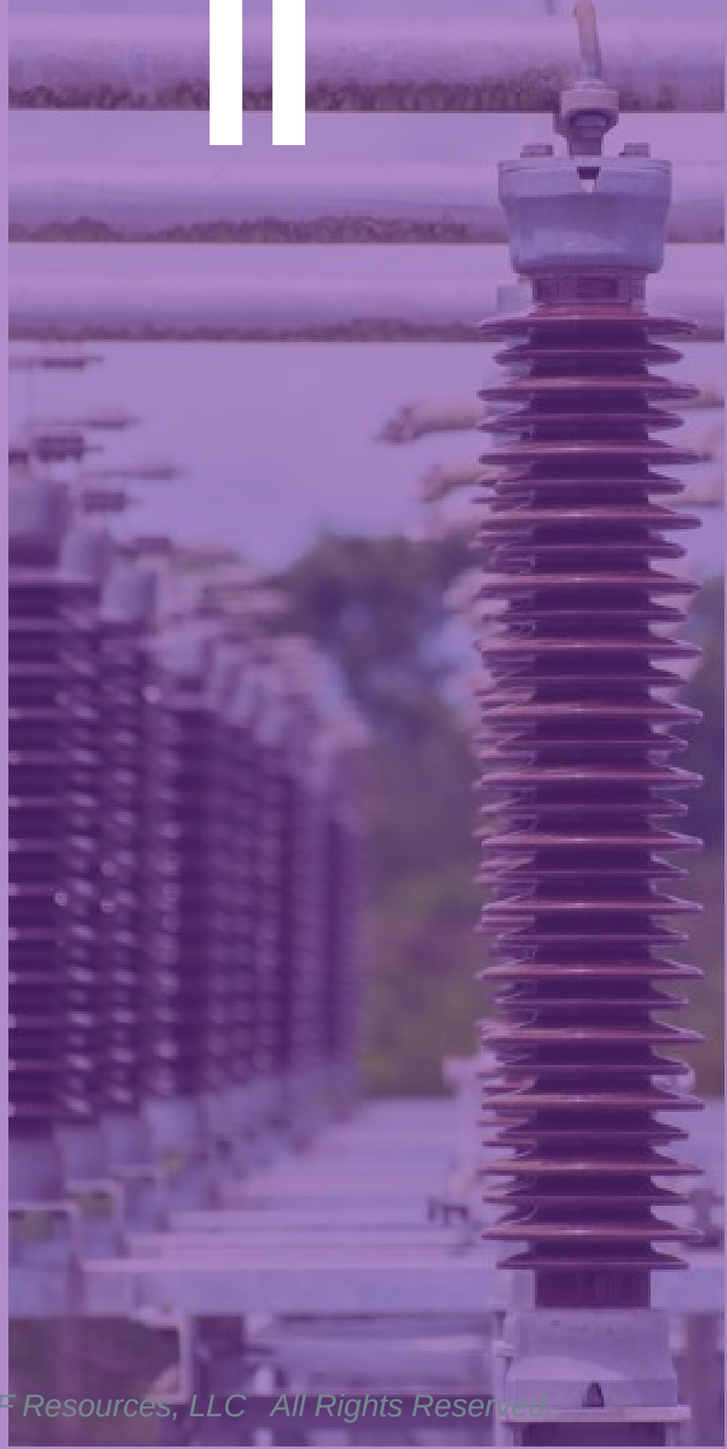
Schwartz Creek: DER Demand Reduction





Connecting Planning Criteria to DER Performance

The Role of Pilots and Analytics



Conclusions

Conclusions

- Non-wires-alternatives can encompass a broad array of potential DER solutions.
- The concept is gaining momentum and many jurisdictions are proceeding with pilots and implementation.
- Michigan is too!
- NWAs remain predominantly a strategy for managing capacity, and the number of such projects available depends in large part on capacity needs that exist within the planning horizon.
- There is an increased emphasis of enhancing analytics within utility planning organizations to be able assess DER and traditional solutions in a comprehensive way.
- ICF expects that finding ways to direct utility DSM programs to address distribution system needs will be an area of increased emphasis moving forward, however, this is a nascent area.
- Pilots remain important to gathering empirical learnings.

Non-Wires Alternatives

Advancing Distribution Planning Methods and Tools to Consider NWA

Jeff Smith
Manager, Distribution Operations and Planning
jsmith@epri.com

MPSC Distribution Planning Stakeholder Meeting

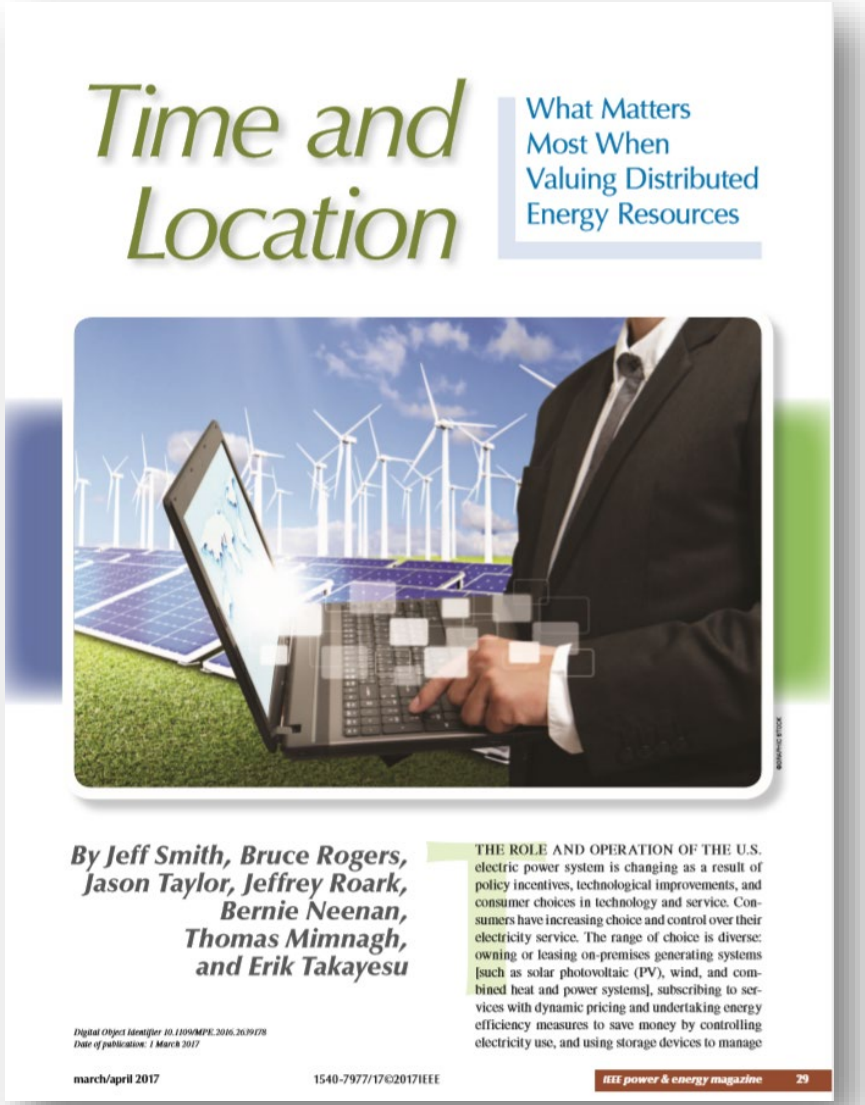
6/27/2019 – Lansing, MI

Planning for DER: It's Not Just About Hosting Capacity

- Time and location matter
  - What does that mean exactly?
- Affective integration requires new processes, tools, and data
  - Analytical tool capabilities: not just peak planning
  - Additional data: additional data enabling "edge of grid" visibility (SCADA, AMI, etc.)

OpenDSS: EPRI's open-source tool developed specifically to enable smart grid analysis such as time and locational value assessments of DER

www.epri.com/opendss


Time and Location

What Matters Most When Valuing Distributed Energy Resources

By Jeff Smith, Bruce Rogers, Jason Taylor, Jeffrey Roark, Bernie Neenan, Thomas Mimnagh, and Erik Takayesu

THE ROLE AND OPERATION OF THE U.S. electric power system is changing as a result of policy incentives, technological improvements, and consumer choices in technology and service. Consumers have increasing choice and control over their electricity service. The range of choice is diverse: owning or leasing on-premises generating systems [such as solar photovoltaic (PV), wind, and combined heat and power systems], subscribing to services with dynamic pricing and undertaking energy efficiency measures to save money by controlling electricity use, and using storage devices to manage

Digital Object Identifier 10.1109/MPE.2016.2639178
Date of publication: 1 March 2017

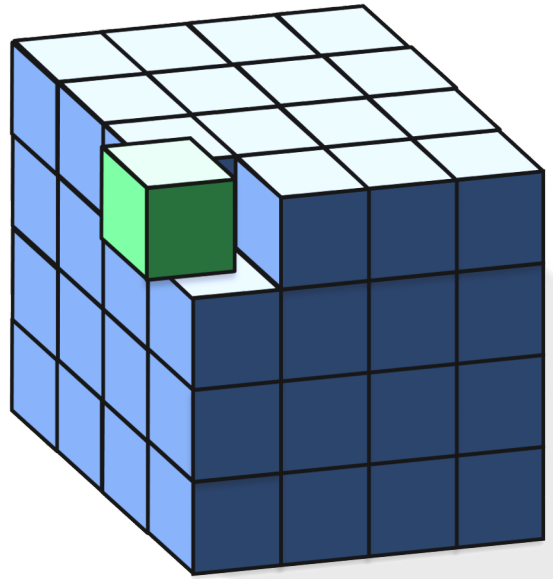
march/april 2017 1540-7977/17©2017IEEE IEEE power & energy magazine 29

Link to Article

Link to Full Report

Today's Tools Only Answer a Piece of the Puzzle

- Singular focus on system peak
- Static representation of system conditions
- Manual feeder by feeder analysis for full system
- Manual time intensive alternatives assessments
- Emerging technologies and resources not adequately modeled
- Cannot identify time and locational values
- Limited support for coordination with transmission planning/IRP



New processes, methods, and tools are needed

EPRI Advanced Distribution Planning Platform Overview

Prototype Under Development

Planning Inputs

- Load and DER growth
- Load profiles
- Analysis timeframe
- System configuration
- Operating criteria & objectives
- **Long-term horizon**
- **Alternative scenarios**
- **Sensitivity studies**

System Assessment

- Does grid meet projected load and DER growth
- Does grid maintain safety and reliability
- **DER locational value**
- **Hosting capacity**

Alternative Identification

- Type, location, size, and timing of projected need
- Identify conventional solutions
- **Identify non-wires solutions**

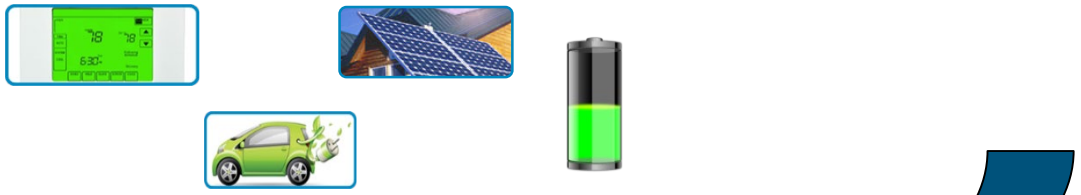
Alternative Evaluation

- Evaluate technical performance and estimate costs
- Determine preferred alternative
- **New planning objectives**

Alternative Selection

- Implement projects

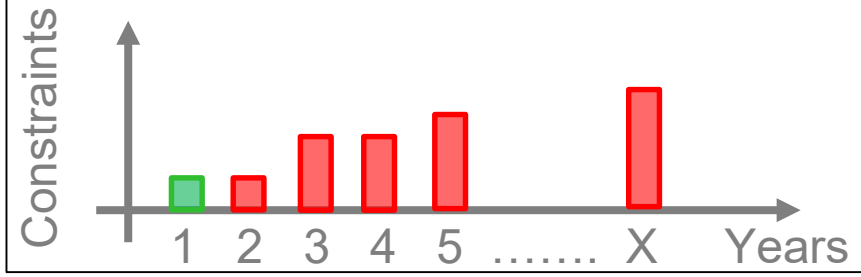
Resource & Bulk System Planning



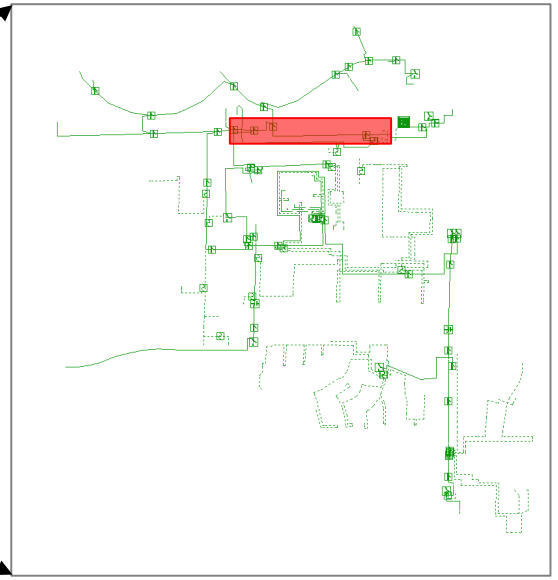
Automated Multi-year optimization

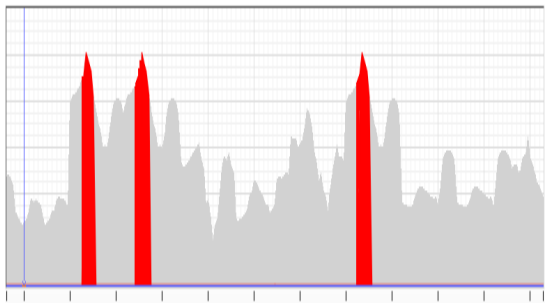
Example Use Case – System and Alternative Analysis

1 System-wide, multi-year constraint screening



2 Constraint severity analysis





3 Wires/non-wires alternative analysis

Traditional Alternatives

- Reconfiguration
- Reconductoring
- Transformer upgrades
- Voltage regulation

&

Non-wires Alternatives

- DER placement / dispatch
- Storage, solar, CHP, etc.
- Demand response
- Load dispatch
- Customer incentives

Project Objective

Develop, test, and demonstrate new methods and tools to automate planning assessments and support holistic decision making

Advanced Planning Project - Overview

Approach

- Work with industry-leading planners to develop a comprehensive and efficient process that captures the growing demands of distribution planning
- Leverage advanced capabilities present in OpenDSS and DRIVE to develop an initial prototype tool
- Test and validate new methods using real-world systems and use cases
- Work with industry to transfer new methods to existing planning tools

Value

- Comprehensive planning method that meets the near and long-term needs of distribution planning
- Flexible and scalable planning method that can integrate into existing planning tools
- Proven, validated, and transparent method and tool for industry benchmarking

Utilities Participating in Advanced Planning Project

Ameren
FORTIS ALBERTA
People. Power. Possibilities. Central Hudson A FORTIS COMPANY
LG&E KU PPL companies
Consumers Energy Count on Us®
Portland General Electric
DUKE ENERGY®
TVA
Exelon
Southern Company
FirstEnergy
SRP®

Answering Planning Challenges

How do I…..

- Efficiently conduct system-wide studies?
- Optimize my investment decisions?
- Apply load and DER profiles across daily – annual time frames?
- Determine the real value of DER to the grid and maximize its value by sizing and locating where it is needed?
- Represent and analyze operational reconfiguration?
- Consider the affect of electrification?
- Integrate / coordinate with transmission planning/IRP?

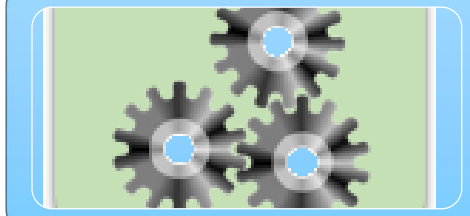
Key R&D Tasks

Develop

- Work with industry to identify gaps, new objective functions, data needs
- Develop a flexible and comprehensive planning process

Apply

- Apply new planning framework for specific utility-driven use cases
- Test, refine, and validate new planning solution



Implement

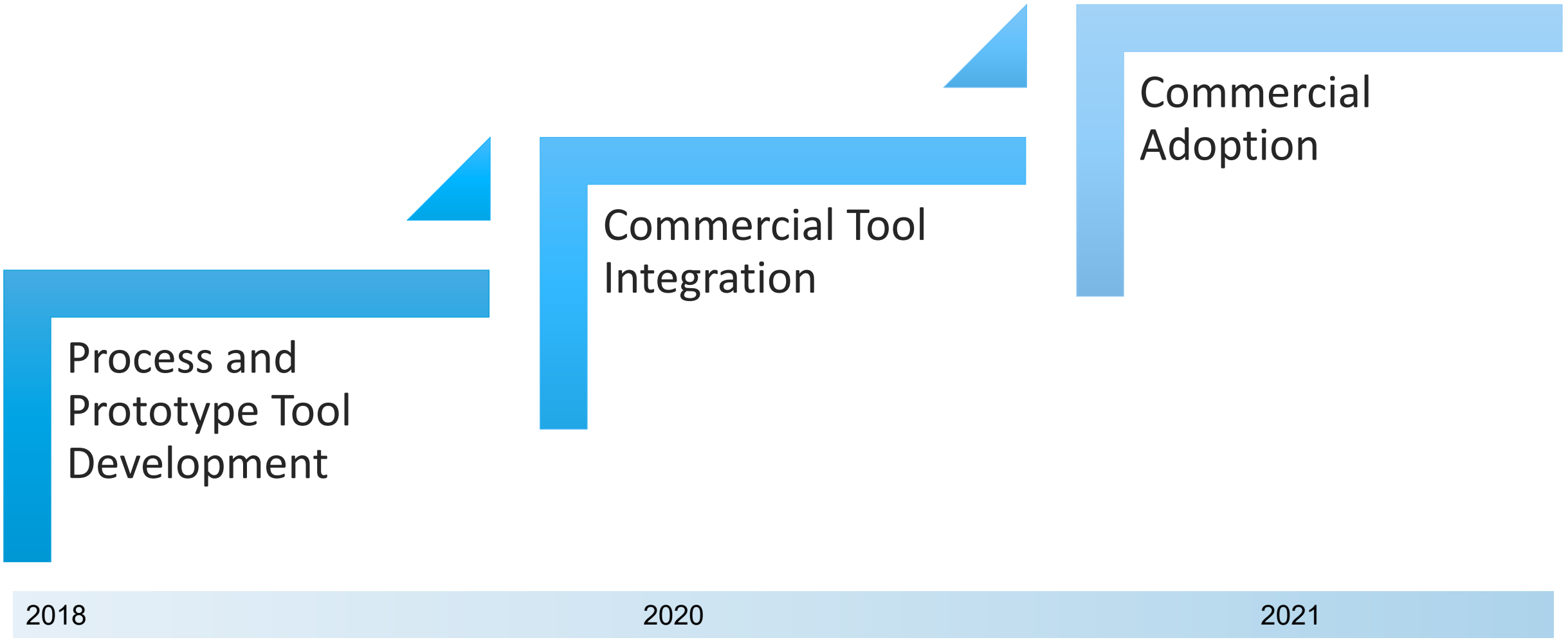
- Implement in a prototype planning platform
- Leverage advanced distribution planning analytics available in OpenDSS and DRIVE™

Share

- Document/share vision and lessons learned
- Provide prototype software for application and direction for future development

Prototype to Vendor Implementation

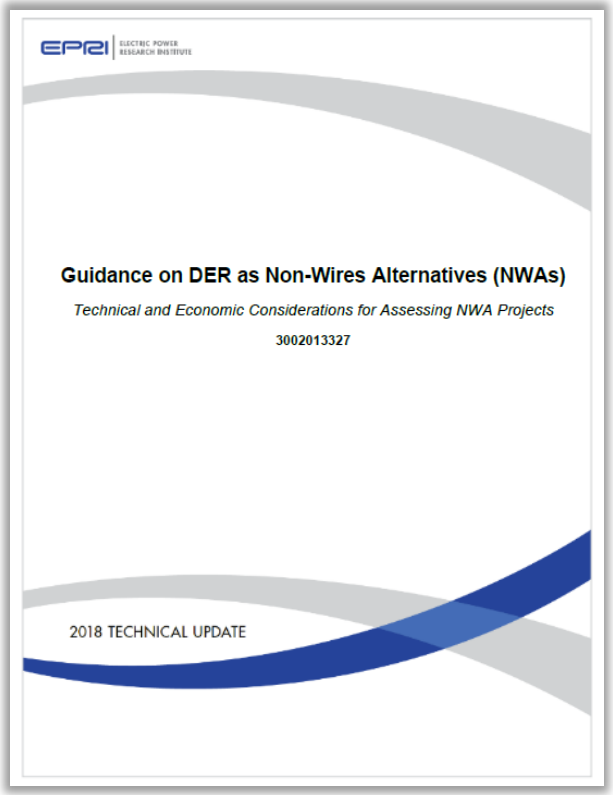
Long-Term Vision



Questions

NWA Resources

- The Evolving Load Profile & Impact on Assets and Reliability. EPRI, Palo Alto, CA: 2014. 3002003229
- Time and Locational Value of DER: Methods and Applications. EPRI, Palo Alto, CA: 2016. 3002008410
- Incorporating DER into Distribution Planning. EPRI, Palo Alto, CA: 2017. 3002010997
- Distribution Planning Guidebook for the Modern Grid. EPRI, Palo Alto, CA: 2018. 3002013384
- Guidance on DER as Non-Wires Alternatives: Technical and Economic Considerations for Assessing NWA Projects. EPRI, Palo Alto, CA: 2018. 3002013327
- Modernizing the Distribution Planning Process: Current Activities and Lessons Learned to Date. EPRI, Palo Alto, CA: 2018. 3002013411
- Future Planning Process and Criteria: Optimizing Investment Decision. EPRI, Palo Alto, CA: 2019. 3002015278
- Alternative Identification and Optimization Methods. EPRI, Palo Alto, CA: 2019. 3002015279
- Value Assessment of DER Planning Alternatives. EPRI, Palo Alto, CA: 2019. 3002015279
- Methods for Quantifying the Time and Locational Value of DER Solutions. EPRI, Palo Alto, CA: 2019. 3002015284
- Non-Wire Solutions (NWS) Provided by Third-Parties: Business Arrangements & Regulatory Challenges. EPRI, Palo Alto, CA: 2019. 3002015767



TOPIC 4:
Cost Benefit Analysis

Five Year Distribution Planning Stakeholder Meeting

Michigan Public Service Commission

Lake Superior Hearing Room

June 27, 2019

MPSC

Michigan Public Service Commission

icf.com

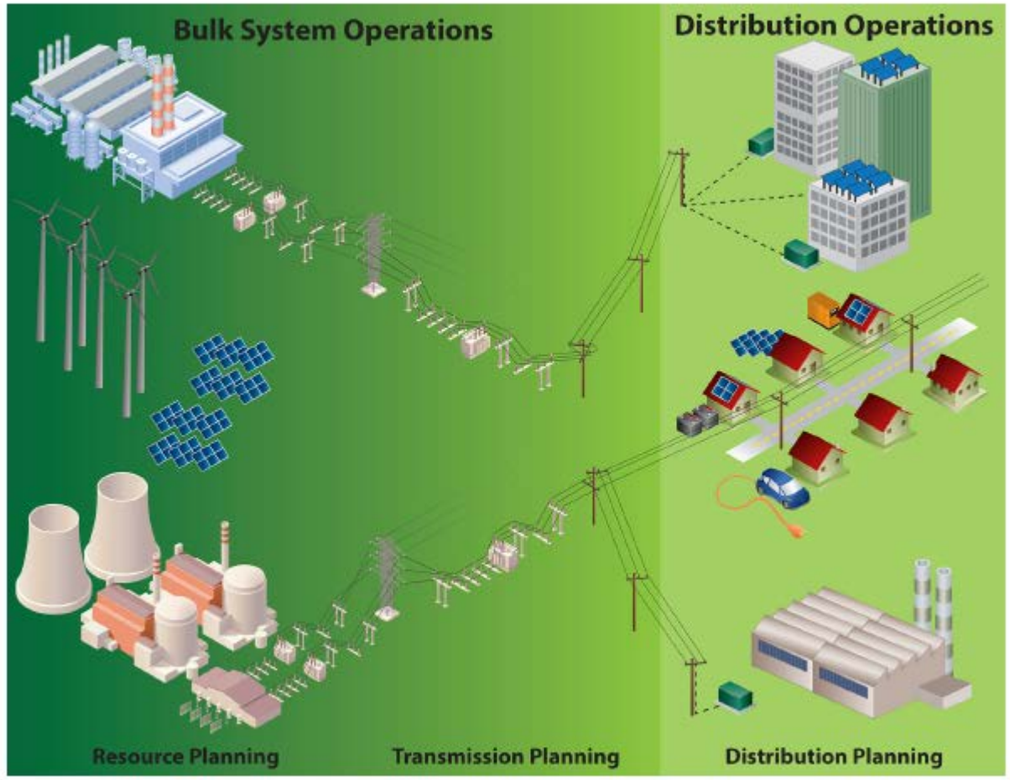
we are ICF

Benefit Cost Analysis

Lansing, MI
June 27, 2019

Utility Investments

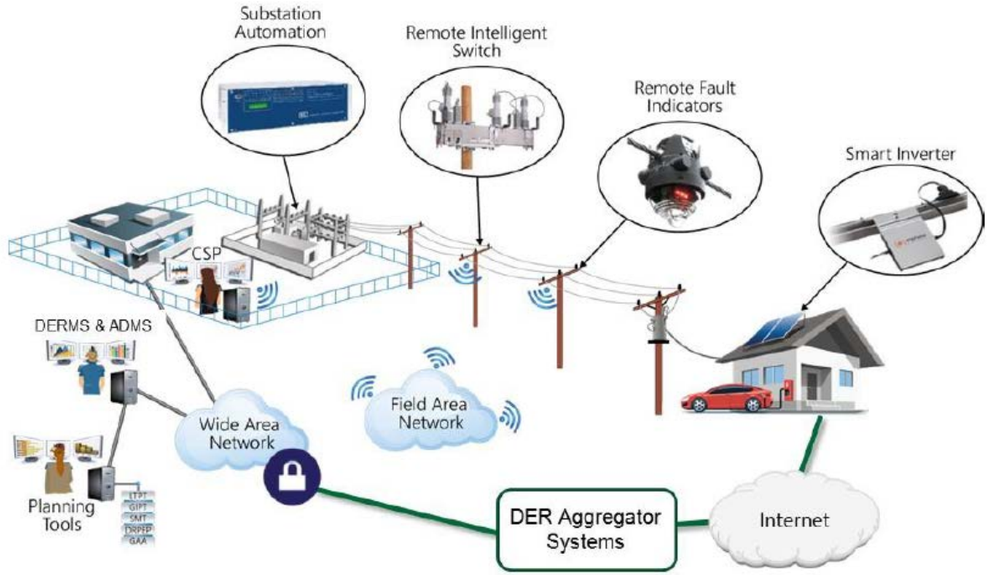
- Utilities already make choices internally on investments and prioritize those investments in terms of customer and corporate risks
- Rate cases are the mechanism to validate the prudency of investment portfolios
- A new set of utility investments have proliferated in the context of grid modernization, in some cases tied to policy objectives



Source: *Integrated Grid: A Benefit-Cost Framework* , EPRI (February, 2015)

Grid Modernization Investments

- The definition of what constitutes a “grid modernization” investment/expenditure can be different in each state
- New frameworks are emerging to evaluate benefits and costs of some grid modernization investments
- Grid modernization investments may serve more than one purpose (i.e. safety & reliability, policy and customer choice)
- The benefit categories and quantification methodologies may vary by framework



Source: U.S. DOE-DSPx Decision Guide, Volume III (June 28, 2017)

Grid Expenditures Methodologies

- The U.S. DOE-DSPx Decision Guide (Volume III) outlines cost-effectiveness methods and their application by category of grid expenditure
- There are three (3) main types of methodologies used to evaluate grid expenditures

Methodology	Grid Expenditure Category
Least-cost, best-fit	• Investments required to meet specifications and standards to maintain safety and reliability
Benefit Cost Analysis	• Investments for energy efficiency or demand side management (DSM) programs, non-wires solutions, and/or DG tariffs • Other expenditures proposed to enable public policy or incremental societal benefits
Opt-in (no regulatory justification)	• Investments deliberately paid by customers to integrate their distributed resource

Cost-Effectiveness Resources

February, 2015
Integrated Grid: A Benefit-Cost Framework (EPRI)

Spring 2017
National standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources (National Efficiency Screening Project)

June 28, 2017
DSPx – Decision Guide. Volume III. (DOE)
Section 3.4 Cost-Effectiveness

May 2018
Review of Recent Cost-Benefit Studies Related to Net Metering and Distributed Solar (ICF for DOE)

February 2019 – Draft for review
Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments (LBNL)

March 7-8 2019
Mid-Atlantic and NARUC-NASEO Task Force on Comprehensive Electricity Planning, Distribution Systems and Planning Training
"Benefit-Cost Analysis for Utility-Facing Grid modernization Investments"

In Progress
DSPx – Guidebook Volume IV. (DOE-OE) - Grid Modernization Investment Economics Chapter

Cost-Effectiveness Tests for Programs or Tariffs

Cost-Effectiveness Test	Focus	Approach
Total Resource Cost (TRC)	Utility + Customers who participate	Costs and benefits of the utility and customers who participate (may include quantifiable non-energy benefits)
Utility/Program Cost Test (UCT/PACT)	Utility	Costs and benefits of the utility that affect revenue requirement (only include environmental costs and benefits paid by the utility)
Participant Cost Test (PCT)	Customers who participate	Cost and benefits of customers who participate
Ratepayer Impact Measure (RIM)	Rate impacts to all customers	Cost and benefits that will affect utility rates (includes lost revenue)
Societal Costs Test (SCT)	Society	Costs and benefits experienced by society (includes non-monetary benefits)
Resource Value Test (RVT)*	Regulator	Costs and benefits of the utility, plus costs and benefits associated with achieving policy goals

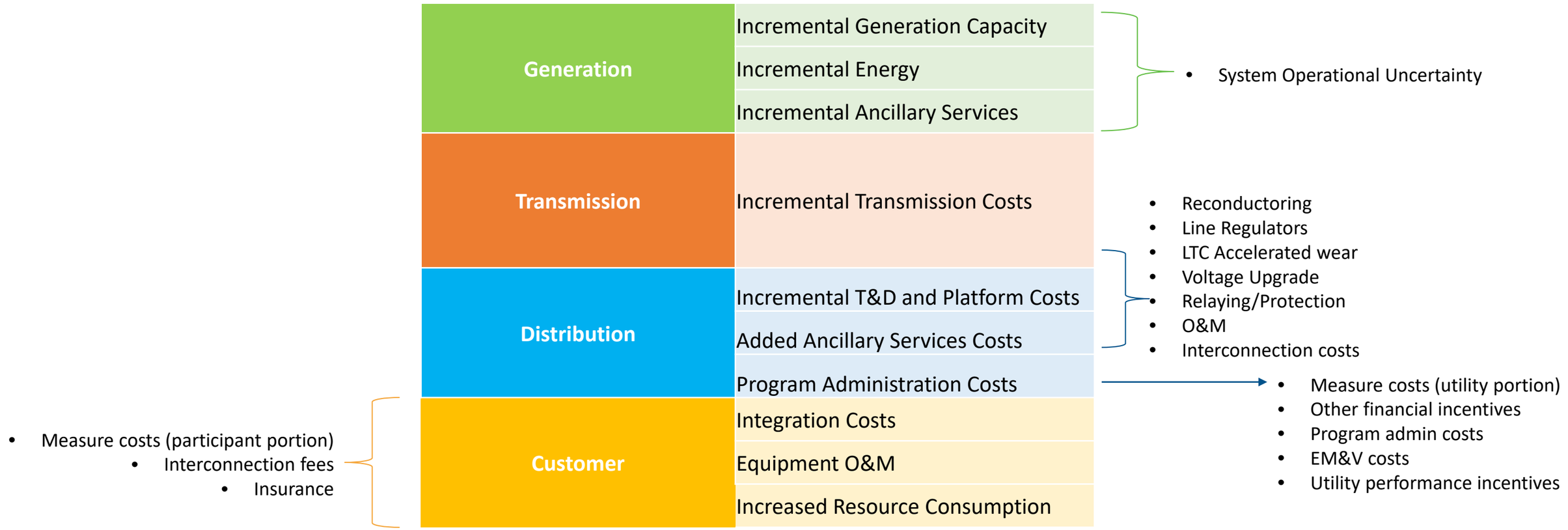
*Emerging cost-effectiveness test for energy efficiency, introduces a "Regulatory test"

Benefit Categories Examples

Generation	Avoided Generation Capacity
	Avoided Energy
	Avoided O&M
	Avoided Environmental Compliance
	Avoided Renewable Compliance
	Avoided Ancillary Services
	Fuel Hedging / Reduced Risk
	Wholesale Market Price Suppression
Transmission	Avoided Transmission Capital Infrastructure or Charges
	Avoided Transmission O&M or Charges
	Avoided Transmission Losses
Distribution	Avoided Distribution Capital Infrastructure or Charges
	Avoided Distribution O&M
	Avoided Distribution Voltage/Power Quality Costs
	Avoided Outages Costs
	Avoided Restoration Costs
	Reduced Revenue Cycle Service Costs / Reduced Staging Costs

Societal	Avoided GHG Cost (Social Cost of Carbon)
	Avoided Criteria Pollutants
	Avoided Water Impacts
	Avoided Land Impacts
	Avoided Public Safety Costs
	Local jobs and economic development
	Energy Security
Customer	Bill Savings
	Reduced Customer Outage Costs

Cost Categories



Takeaways

- **DER penetration is still low in Michigan**
- **Leading states still continue to evolve their BCA frameworks**
- **Utilities already perform business case analysis on their investments**
- **Resources:**
  - *Integrated Grid: A Benefit-Cost Framework* (EPRI)
  - National standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources (National Efficiency Screening Project)
  - DSPx – Decision Guide. Volume III. (DOE)
  - Review of Recent Cost-Benefit Studies Related to Net Metering and Distributed Solar (ICF for DOE)
  - Mid-Atlantic and NARUC-NASEO Task Force on Comprehensive Electricity Planning, Distribution Systems and Planning Training "Benefit-Cost Analysis for Utility-Facing Grid modernization Investments"

AFTERNOON BREAK
2:45 – 3:00 PM

Five Year Distribution Planning Stakeholder Meeting

Michigan Public Service Commission

Lake Superior Hearing Room

June 27, 2019

MPSC
Michigan Public Service Commission

Holistic Integration & Open Q&A: Reviewing Today's Topics

Five Year Distribution Planning Stakeholder Meeting

Michigan Public Service Commission

Lake Superior Hearing Room

June 27, 2019

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