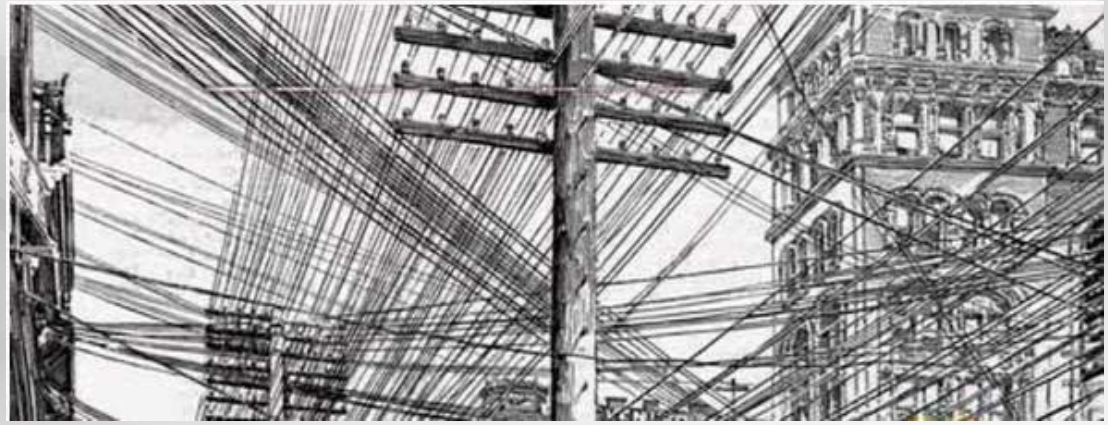

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Distribution System Planning – State Examples by Topic

ALAN COOKE AND JULIET HOMER – Pacific Northwest National Laboratory
LISA SCHWARTZ – Lawrence Berkeley National Laboratory

Acknowledgements

- U.S. Department of Energy
  - Solar Energy Technologies Office
  - Office of Electricity Delivery and Energy Reliability
  - Grid Modernization Lab Consortium (GMLC)
- Oregon Public Utility Commission
- National Renewable Energy Laboratory
- Foundational Report for this work from GMLC work:
  - State Engagements In Distribution System Planning – PNNL-27066. Dec 2017. Prepared by PNNL, LBNL, and NREL.

- Link to report that this webinar is based on:
  - https://epe.pnnl.gov/pdfs/DSP_State_Examples-PNNL-27366.pdf

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Part 1- Distribution System Planning – State Examples by Topic

ALAN COOKE

Pacific Northwest National Laboratory

Webinar – May 14, 2018

Presentation of Planning Approaches, Topics I'll Cover

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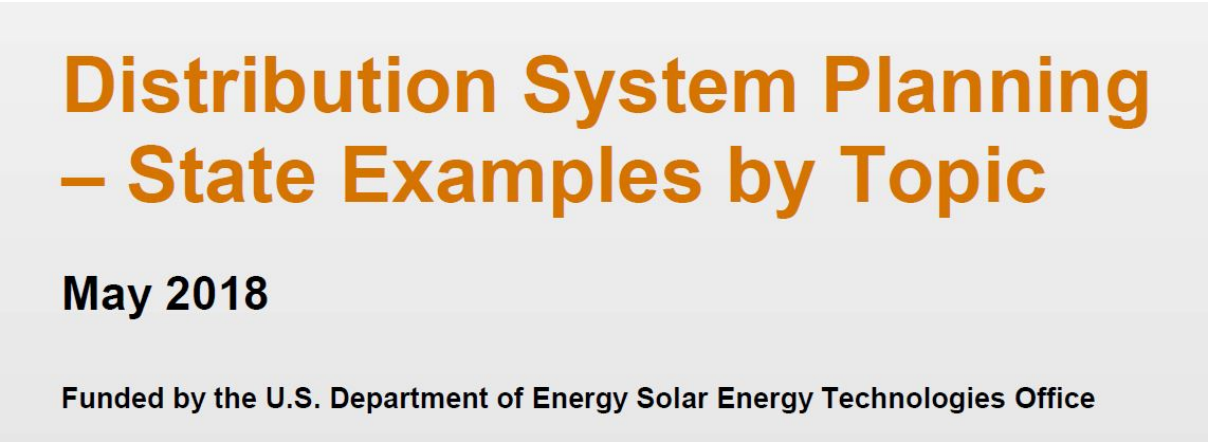
- My job today is to introduce our report, then to dive into some specific planning approaches. I will talk about:
  - distribution planning approaches
  - vision statements, goals and objectives
  - distribution planning and grid modernization material



Context Matters

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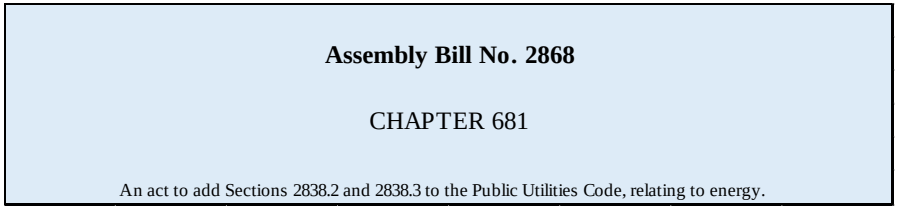
- States work within different contexts, including:
  - statutory requirements
  - regulatory requirements
  - differences among utilities
- The review includes a wide range of contexts and approaches, such as planning in response to:
  - aggressive statutory requirements for renewables, and high existing penetrations of renewables
  - statutory and regulatory requirements for storm hardening
  - statutes instituting distribution investment rate riders
  - other statutory or regulatory initiatives



Assembly Bill No. 2868

CHAPTER 681

An act to add Sections 2838.2 and 2838.3 to the Public Utilities Code, relating to energy.

State Activities by Planning Approach

- The Grid Modernization Laboratory Consortium 2017 report was foundational, reviewing planning approaches on a state-by-state basis[1]
- The May 2018 report is organized by planning approach, using information from 2017 updated with new developments since fall 2017
- Both reports cover 15 states plus the District of Columbia
- Table 1 in the report provides a roadmap, listing the planning approaches we summarize and the states reported within the report

GRID MODERNIZATION LABORATORY CONSORTIUM
U.S. Department of Energy

[1] Grid Modernization Laboratory Consortium. 2017b. *State Engagement in Electric Distribution System Planning*. PNNL-27066. Prepared by PNNL, LBNL, and NREL for the US Department of Energy.

The Roadmap – Table 1

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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.

From Cooke, et. al., *Distribution System Planning – State Examples by Topic, PNNL and LBNL, May, 2018.*

Vision Statements, Goals and Objectives

- Recognizing the importance of having a vision statement or goals and objectives, we discuss a sample of such statements.

Vision Statements, Goals and Objectives, continued

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- Minnesota's Commission guided their process by asking 3 questions:[1]
  - "Are we planning for and investing in the distribution system that we will need in the future?"
  - "Are the planning processes aligned to ensure future reliability, efficient use of resources, maximize customer benefits, and successful implementation of public policy?"
  - "What Commission actions would support improved alignment of planning for and investment in the distribution system?"
- Maryland's Commission initiated a grid modernization process "… to ensure that electric distribution systems in Maryland are customer-centered, affordable, reliable and environmentally sustainable." [1]
- Minnesota and Maryland captured themes common to many states – customers, reliability, affordability, efficiency, and implementing policies

[1] For citations, see page 4.1 of Cooke, et. al., *Distribution System Planning – State Examples by Topic, PNNL and LBNL, May, 2018.*

Distribution Planning – Leading Edge Considerations

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- Distribution planning has historically been performed, with pieces such as capital improvement plans appearing in general rate cases
- Several states have recently required utilities to submit distribution plans to the Commission to facilitate several objectives
  - Michigan's Commission desired a greater understanding of the capital expenditures utilities submitted as part of general rate cases
  - Maryland's Commission desired a greater understanding of the methodologies used by jurisdictional utilities to justify their investment plans
  - California's Commission required distribution planning to support state greenhouse gas goals, to modernize the system to support 2-way power flows, to enable customer choice and to animate opportunities for distributed energy resources
- Overall, many states included in our report desire moving in a direction of greater visibility into the planning process and increased opportunity for stakeholder involvement

Grid Modernization Planning

- Table 1 shows 5 states with grid modernization planning requirements either in response to legislation or regulations, for 1 or more utilities
- Hawaii – the Hawaii Commission provided guidance to the state's utilities to develop a grid modernization strategy, with areas of interest being:
  - Current status of electric grid infrastructure pertaining to grid modernization
  - Grid architecture and interoperability
  - Grid-facing technologies
  - Customer-facing technologies
  - Pace of grid modernization implementation
  - Costs and benefits of grid modernization
  - Flexibility and resilience
  - Health, cybersecurity, data access, and privacy

Grid Modernization Planning, continued

- To complete the story of Hawaii
  - Hawaiian Electric Companies (HECO) filed grid modernization plans in 2017
  - In 2018 HECO proposed a new planning process to integrate customer, distribution, transmission and bulk power resource levels of the system
- Several states have processes underway that have not yet resulted in GMP requirements. Thus, there is likely more to come.

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Questions?

Distribution System Planning – State Examples by Topic

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ALAN COOKE, PNNL – alan.cooke@pnnl.gov
JULIET HOMER, PNNL – juliet.homer@pnnl.gov
LISA SCHWARTZ, LBNL – lcschwartz@lbl.gov

Distribution System Planning Part 2:

- Hosting capacity analysis
- Non-wires alternatives
- Voluntary planning and surcharges

Lisa Schwartz, Electricity Markets and Policy Group

May 14, 2018

Hosting Capacity Analysis - 1

- Amount of DERs that can be interconnected without adversely impacting power quality or reliability under existing control and protection systems and without infrastructure upgrades
- Some states require regulated utilities to do it
  - CA, HI, MN, NY
- Some utilities do it on their own motion
  - e.g., Pepco
- Power system criteria
  - Thermal
  - Power quality/voltage
  - Protection
  - Reliability/safety

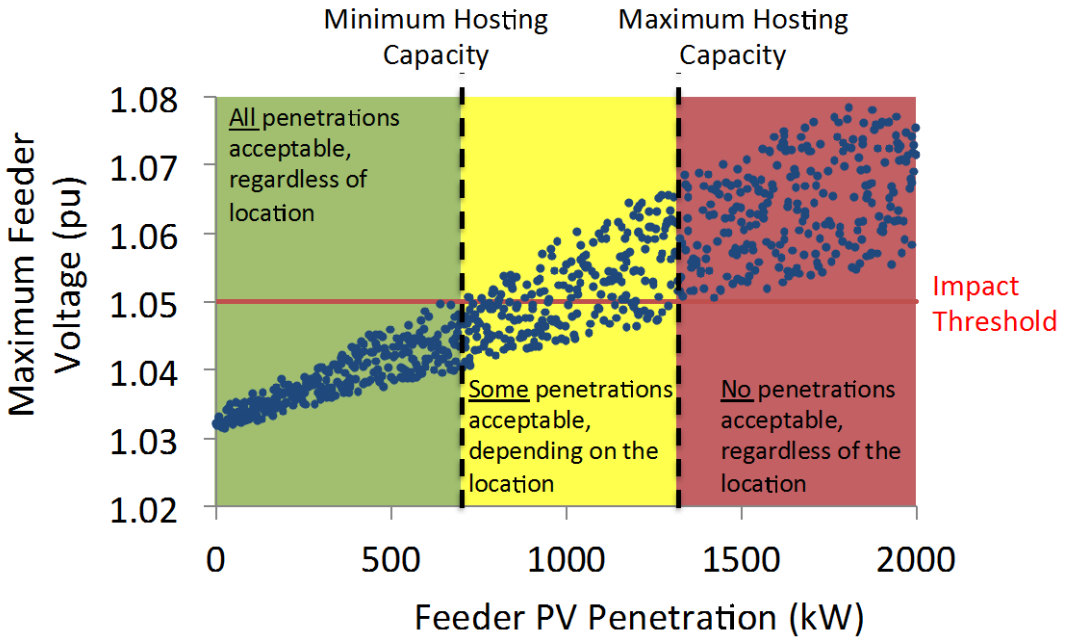


Figure adapted by Berkeley Lab from EPRI (2015), *Distribution Feeder Hosting Capacity: What Matters When Planning for DER?*

Hosting Capacity Analysis - 2

Methodologies

Detailed Analysis	**Iterative** power flow simulations conducted at each node until violations occur — e.g., SCE, SDG&E, PG&E and Pepco. **Stochastic** analysis (piloted by EPRI) uses many simulations (such as different sizes in different locations) to give uncertainty range.
Streamlined	Simplified algorithms for each power system limitation to estimate when violations occur — e.g., PG&E and SCE initially used this method. Xcel and NY utilities use EPRI's DRIVE tool, a combination of streamlined and stochastic.
Shorthand Equations	Very simple calculation method, developed by EPRI/NREL

Source: Slobodan Matic, GE Consulting

Hosting Capacity Analysis - 3

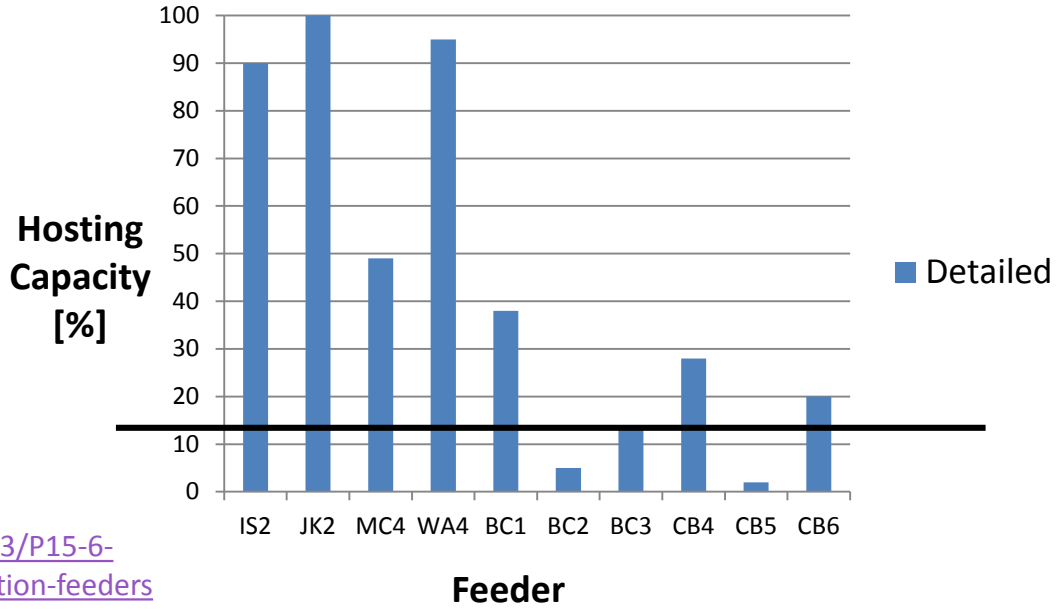
Three use cases

Use Case	Objective	Capability
Development Guide	Support market-driven DER deployment	Identify areas with potentially lower interconnection costs
Interconnection Technical Screens	Improve the interconnection screening process	Augment or replace rules of thumb; determine need for detailed study
Distribution Planning Tool	Enable greater DER integration	Identify potential future constraints and proactive upgrades

Adapted from ICF International, forthcoming report for U.S. DOE

Example: Interconnection screening

"15% rule" allows aggregate DER penetration below 15% of feeder peak load



Graph: DSTAR, http://www.dstar.org/research/project/103/P15-6-impact-and-practical-limits-of-pv-penetration-on-distribution-feeders

Hosting Capacity Analysis - 4

- Example: Minnesota
  - State law requires Xcel Energy to conduct a distribution study to identify interconnection points for small-scale distributed generation (DG) and system upgrades to support DG development
  - No formal Commission action is required
  - Xcel filed 1st hosting capacity analysis on 12/1/16 (Docket 15-962)
    - Staff issued briefing papers and parties commented
    - Commission decision required hosting capacity analyses Nov. 1 each year and provided guidance for 2017 analysis:
      - Reliable estimates and maps of available hosting capacity at feeder level
      - Details to inform distribution planning and upgrades for efficient DG integration
      - Detailed information on data, modeling assumptions and methodologies
  - Xcel Energy filed 2nd analysis on 11/1/17 (Docket 17-777)
  - PUC staff filed briefing papers and proposed distribution planning requirements for all regulated utilities at 4/19/18 public meeting (Docket 15-556) — includes hosting capacity analysis

Non-Wires Alternatives – 1★

- Investments in energy efficiency, demand response, distributed generation and storage that provide specific services at specific locations in order to defer, mitigate or eliminate the need for traditional distribution infrastructure investments — for example:
  - New York - Utilities jointly provided suitability criteria for NWAs and described how criteria will be applied to projects in their capital plans

Project Type Suitability	Project types include Load Relief and Reliability*. Other categories currently have minimal suitability and will be reviewed as suitability changes due to State policy or technological changes.	
Timeline Suitability	**Large Project**	36 to 60 months
	Small Project	18 to 24 months
Cost Suitability	**Large Project**	≥ $1M
	Small Project	≥ $300k

*Reliability projects entail projects for remote single source regions or customer-requested enhanced reliability projects. Source: Central Hudson NWA Opportunity

★Natalie Mims Frick contributed research for these NWA slides.

Non-Wires Alternatives – 2

- The NY Joint Utilities' supplemental filing describes how utilities use their procurement processes to award contracts for NWAs. Information on the Joint Utilities NWA process is here and on the REV Connect website.

Utility	Project Name	Project Type	Project Size	Project status and procurement and development timeline
Central Hudson	Philips Road/ Substation	Load relief	Large (5 MW)	RFP issued: 11/2014 Timeline: 42 mo.
Central Hudson	Coldenham/ Distribution Feeder Upgrade	Load relief	Small (1 MW)	RFP issued: 3/2017 Timeline: 34 mos.
NYSEG	Java 2nd Transformer and 12 kV Conversion	Load relief and reliability	Not provided	RFP issued: 2016 Timeline: 3/2019
Con Ed	West 42nd St Load Transfer	Load relief	42 MW	RFP issued: 12/2017 Timeline: 12 MW needed by May 2021

Non-Wires Alternatives – 3

- **CA** PUC staff proposed a Distribution Investment Deferral Framework (DIDF) on 6/30/17
  - Part of a rulemaking to establish policies, procedures and rules to guide IOUs in developing Distribution Resource Plan Proposals

- CPUC order 2/15/18
  - "The central objective of the DIDF is to identify and capture opportunities for DERs to cost-effectively defer or avoid traditional IOU investments that are planned to mitigate forecasted deficiencies of the distribution system."
  - IOUs file annually detailed Grid Needs Assessment and Distribution Deferral Opportunity Report. General rate case applications must match these filings.
  - Distribution Planning Advisory Group – Stakeholder feedback on reports
  - Annually by Dec. 1, each IOU recommends distribution deferral projects for solicitations via the Competitive Solicitation Framework Request for Offers.

Non-Wires Alternatives – 4

- **RI**
  - PUC created Least Cost Procurement Standards in July 2017 (Docket 4684) with guidelines for incorporating NWAs into utility System Reliability Procurement (SRP) plans. NWA implementation costs, as well as other types of expenditures, are recovered in SRP.
  - In August 2017, National Grid filed its Efficiency and System Reliability Procurement Plan. The SRP plan highlighted the use of NWAs for:
    - Highly utilized distribution systems
    - Areas where construction is physically constrained
    - Areas where the utility anticipates demand growth
  - Investigation Into the Changing Electric Distribution System (Docket No 4600) produced a Guidance Document in October 2017 on how the PUC will consider distribution system investments in National Grid regulatory proceedings.
  - Power Sector Transformation Initiative Phase I report, November 2017

Voluntary Planning and Surcharges

- Legislation in some states encourages utilities to accelerate investments in grid modernization or replacement of aging facilities to improve safety, resilience and reliability — for example:
  - **IL** - Energy Infrastructure Modernization Act allows utilities to file investment plans for distribution upgrades (e.g., smart meters, grid hardening)
    - Utilities file annual Grid Modernization Action Plans with formula rates for approval by Commerce Commission (e.g., ICC order on Ameren plan)
  - **IN** - Transmission, Distribution, and Storage System Improvement Charge to encourage T&D investments for safety, reliability, modernization
    - 7-year plans, for approval by Indiana Utility Regulatory Commission
    - For capital projects (*not* for vegetation management)
    - Charge limited to 80% of "approved capital expenditures and TDSIC costs"; remaining 20% addressed in general rate case
  - **MD** – BGE and Pepco used surcharge riders to recover costs for accelerated distribution system upgrades designed to increase grid resilience in response to weather events that caused widespread outages.
  - **PA** – Utilities can propose a Distribution System Improvement Charge to recover reasonable and prudent costs to repair, improve or replace certain eligible distribution property by filing Long Term Infrastructure Improvement Plans (e.g., see FirstEnergy LTIIP)

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Part 3- Distribution System Planning – State Examples by Topic

JULIET HOMER, P.E., PMP

Pacific Northwest National Laboratory

Webinar – May 14, 2018

U.S. DEPARTMENT OF ENERGY

Topics I'll cover

- Locational value
- Standardization of methodologies
- Reporting on poor performing circuits
- Aligning processes

Locational Value

- Q: What's the value of rooftop solar?
- A: It depends
- Value is context dependent
- Solar could be valuable in one location and expensive in another
- California and New York are actively engaged in looking at this
- California
  - In Distribution Resource Plans, CA utilities required to define criteria for then identifying specific locational values for DERs.
- New York's Value of DER (VDER) proceeding– provides a framework for valuing and developing compensation methodologies for DERs.
  - Value Stack tariff is a compensation method that takes into account previously unquantified values, including locational and environmental benefits.

California Locational Value

- Locational Net Benefits Analysis (LNBA) working group established
- Commission directed utilities to use a consistent two part methodology:
  - System-level avoided costs - estimates system-level avoided costs for a given DER solution calculated through E3's DER Avoided Cost Calculator

    +
  - Project deferral benefits - calculates value of deferring specific capital project

    =

  Total Achievable Avoided Cost for a given DER solution at a specific location
- Demonstration projects underway to test tools for locational net benefits analysis
- Completion of final LNBA models expected in mid-2018

CA LNBA Use Cases

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- Two LNBA use cases agreed to by working group and approved:
  1. Public Tool and Heat Map to enable customers and developers to identify optimal locations for installing DERs
  2. Using LNBA for prioritizing candidate distribution deferral opportunities for the Distribution Investment Deferral Framework

  Plus a third:

  3. LNBA to serve a cost-effectiveness use and update the DER Avoided Cost tool
- Refinement recommended by the Commission in June 2017, included:
  - Methods for valuing location-specific grid services provided by smart inverters
  - Methods for evaluating the effect on avoided cost of DER working in concert within the same substation footprint
  - Improved heat map and spreadsheet tool
  - Increasing granularity in avoided-cost values
  - New subgroup to develop methodologies for nonzero location-specific transmission costs (with CAISO)

New York Locational Value

- New York Value of DER proceeding (VDER) - provide incentives reflecting the locational value of DER
- In short term, intended to replace net metering for community solar PV (up to 5 MW) - will eventually be applied to all DERs across the grid
- Approach: Identifying, quantifying, and compensating for:
  - Demand Reduction Value (DRV) - Applies to all projects in a utility's territory and is based on the utility's average cost of service.
    - Utilities fix the DRV for three years from time of interconnection and update it every three years
  - Locational System Relief Value (LSRV) - Specific to projects that, based on location and characteristics, contribute to meeting a particular utility need and provide a specific, higher value to the distribution system.
    - LSRV is recalculated as needed but at least every 3 years and fixed for 10 years
- Utilities were required to include in implementation proposals for the identification of, compensation for, and MW caps for LSRV zones.

New York Locational Value, cont.

- Utilities determined threshold criteria for determining LSRV zones, and identified initial areas on its system meeting these criteria
  - Example 1: Con Edison threshold – LSRV areas are those where projected energy use in 2021 reaches or exceeds:
    - 98% of current capability in sub-transmission lines or area stations or
    - 90% of the current capability in distribution network areas.
    - Applying criteria -**19%** of Con Edison service territory qualify as LSRV zones
  - Example 2: National Grid threshold - scaled loads on all distribution substations to 2020 and then screened against planning ratings to identify potential loadings above those ratings.
    - Applying criteria - **16%** of National Grid substations were identified as LSRV areas
- Marginal cost of service (MCOS) studies are the basis for LSRV and DRV compensation calculations
- Goals of VDER phase 2 include improve MCOS studies and LSRV methodology and standardize them to the extent possible
  - However, “symmetry across all utilities in all aspects of the distribution planning methods is not realistic or necessarily desirable.”

Standardization of Methods - Examples

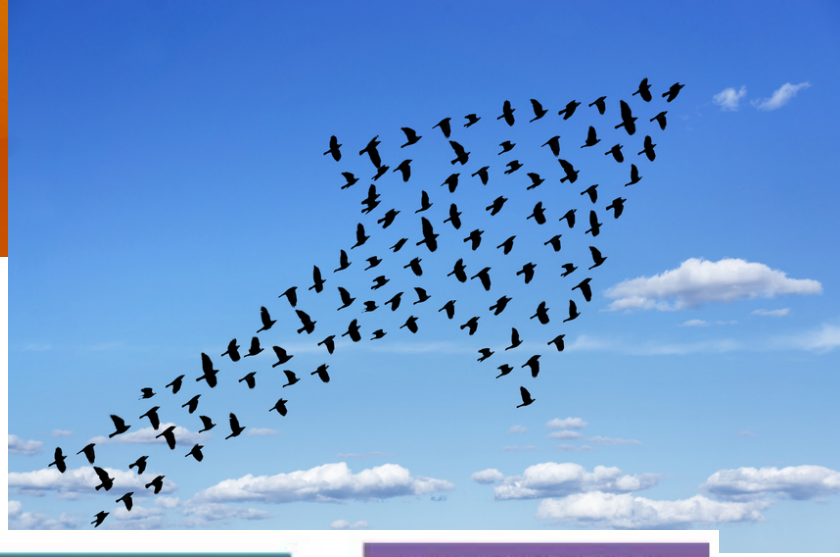
- New York
  - MCOS and LSRV methodology (future)
  - Distributed System Implementation Plans (DSIPs)
    - Step 1: Utilities individually filed Initial DSIPs
      - Identify immediate changes that can be made to support state energy goals,
      - Provide info on current five-year capital investment plans
    - Step 2: Utilities jointly filed Supplemental DSIPs
      - Addressing tools, processes and protocols that can be jointly developed or under shared standards
    - Benefit-Cost Analysis

- California
  - Workshop process has been used to develop standard tools and methodologies related to:
    - hosting capacity analysis
    - locational benefits analysis
    - DER growth scenarios
    - load forecasts

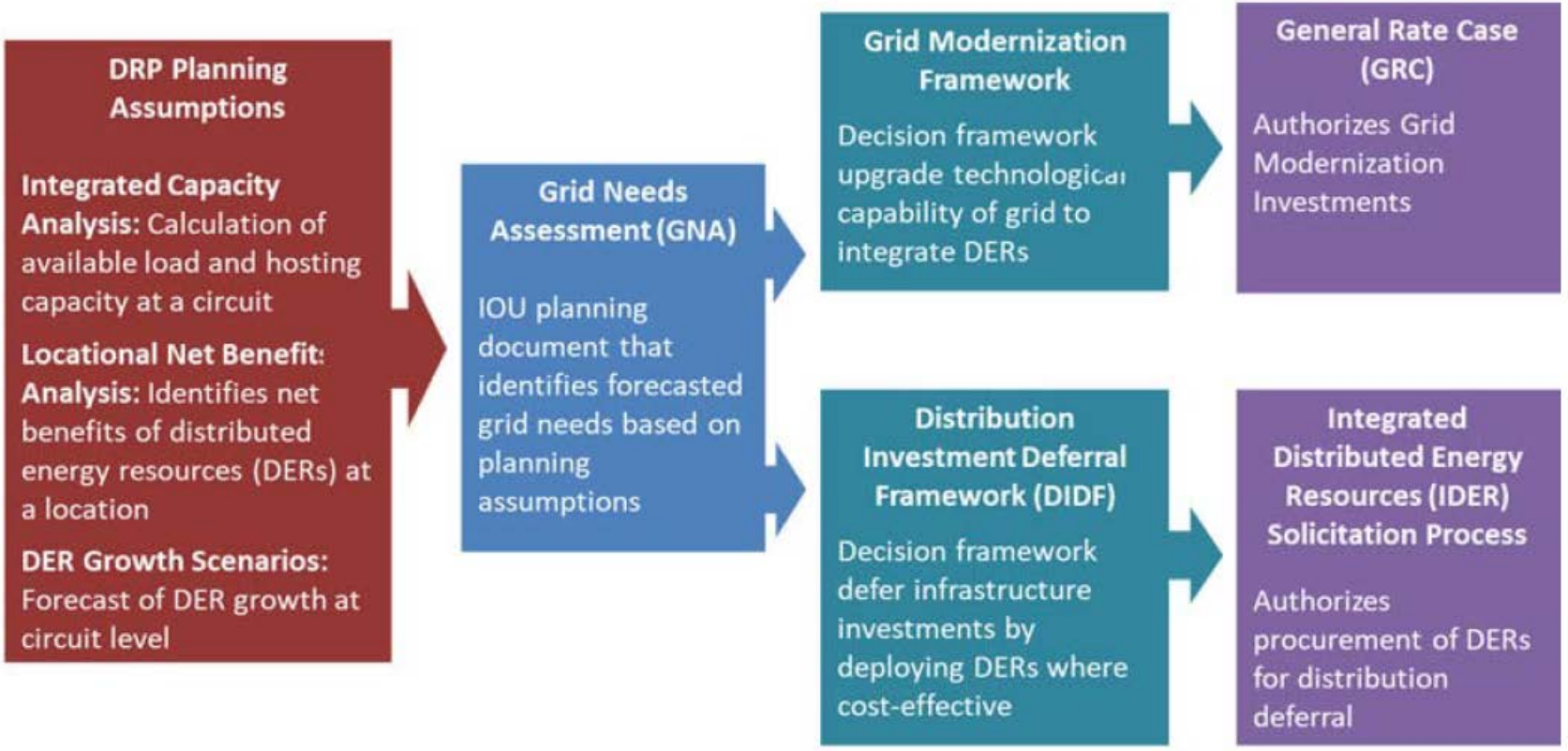
Reporting on Poor Performing Circuits

- Florida, Illinois, Ohio, Pennsylvania, and Rhode Island require utilities to report on the worst-performing feeders
- Illinois requires annual reporting with:
  - reliability performance,
  - 3-year plan for future investments
  - Identify future potential reliability challenges
- Ohio requires yearly reports on distribution systems including reporting on worst-performing circuits
- Pennsylvania utilities must report quarterly on worst-performing circuits and propose investments

Aligning processes



- CA, HI, MN, RI and WA are making strides in aligning planning processes
- CA's Distribution Resource Planning process links multiple activities



Source: *Workshop on Integrated Distributed Energy Resources. Energy Division Presentation.* July 10, 2017. http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442455025

From Hawaii Integrated Grid Planning – March 2018 Report

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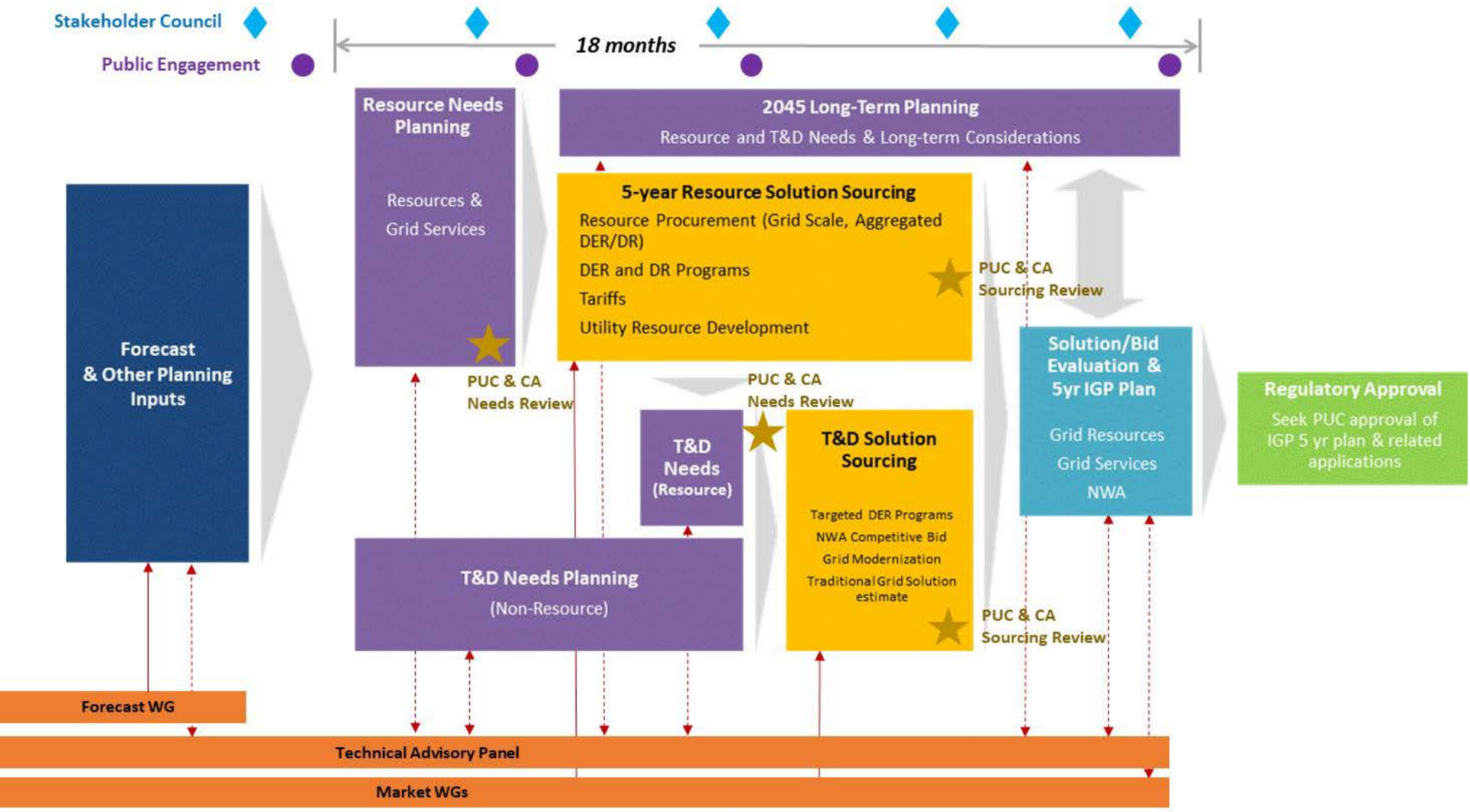
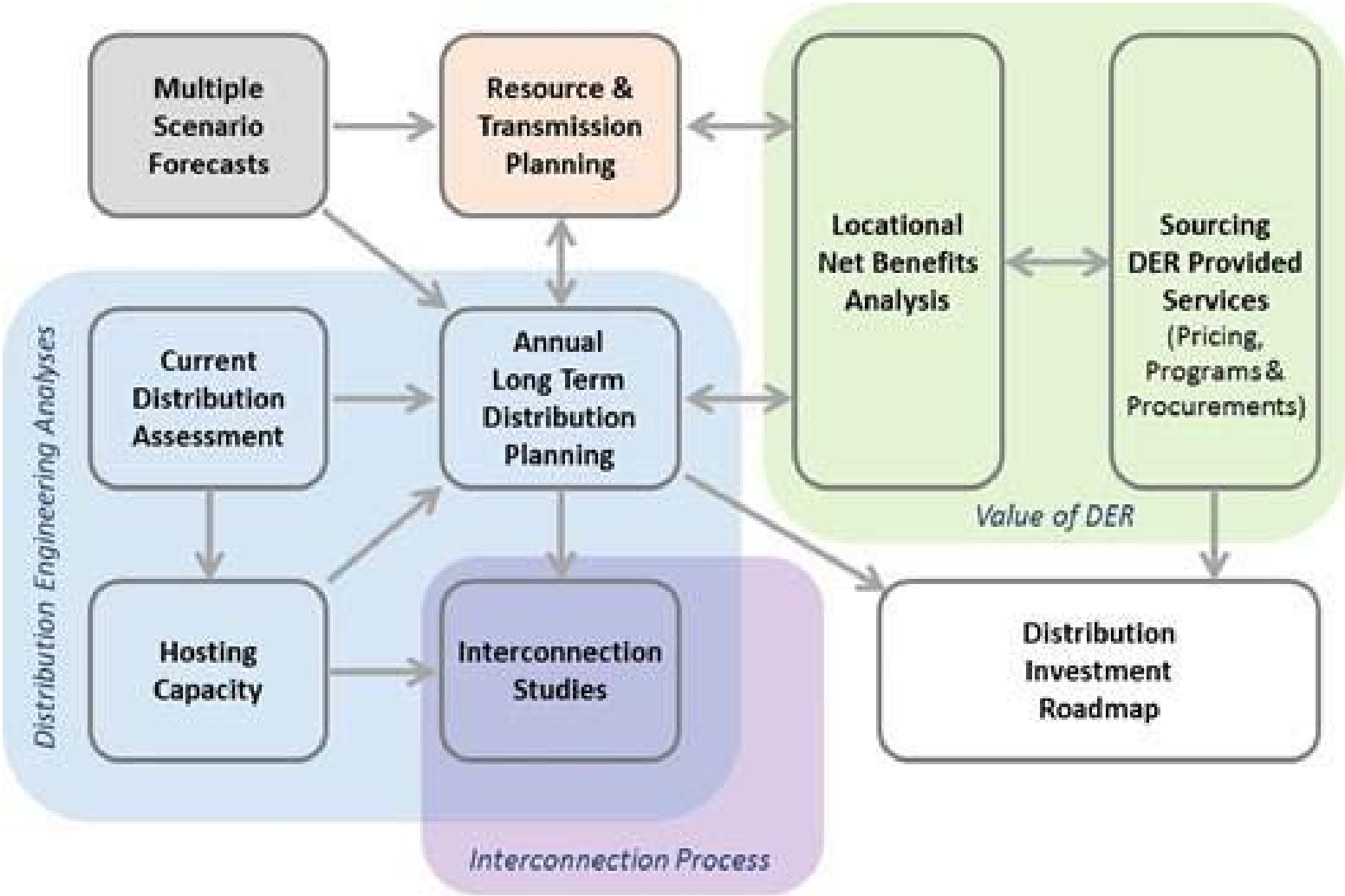


Integrated Distribution System Planning



From ICF International. 2016. *Integrated Distribution Planning*. For the Minnesota Public Utilities Commission. August.

Training for States on Distribution Systems and Planning

- Last year, Berkeley Lab and NARUC convened a public utility commission (PUC) advisory group from diverse states to help identify distribution system planning needs and guide a training program.
- Partnership with PNNL and NREL; sponsored by U.S. DOE
- Three regional trainings to date - *links to agenda and slides*
  - New England states – Sept. 27-29, 2017
  - Midwest states (MISO footprint) – Jan. 16-17, 2018
  - Western states – May 2-3, 2018
- Most recent training for PUCs *and* state energy offices, with participation of National Association of State Energy Officials
- State consumer representatives training with National Association of State Utility Consumer Advocates
  - Webinars begin this month; in-person training at NASUCA meetings
- Possible additional training in FY19
  - Mid-Atlantic and South

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Questions?

Distribution System Planning – State Examples by Topic

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Lawrence Berkeley National Laboratory

ALAN COOKE, PNNL – alan.cooke@pnnl.gov
JULIET HOMER, PNNL – juliet.homer@pnnl.gov
LISA SCHWARTZ, LBNL – lcschwartz@lbl.gov