REGULATORY TOOLS & PROCESSES FOR DISTRIBUTION PLANNING e Lab

A POTENTIAL eLAB INITIATIVE

RMI. Creating a clean, prosperous, and secure energy future.TM





eLab Regulatory Tools: scope, context, and overview

- Identified increasing need to provide clearer insights to regulators, utilities, customers, and developers about the system-level technical and economic effects of increasing adoption of distributed energy resources (DER)
 - How will DER (lead currently by PV) help or hinder distribution system operations?
 - Where are the best areas for deployment?
 - How will the new resources affect the operations of the rest of the system?
 - What are the long-term effects on planned investments?
 - What is the effect on retail rates?
 - What's the economic impact on customers?
- Objectives:
 - 1. Characterize best practices for the creation & review of distribution resource plans (DRPs), including analysis tools and linkages between model silos
 - 2. Identify relevant stakeholder concerns, and availability of software and data used to model and address them
 - 3. Identify a process framework for regulators, utilities, and third parties to ensure least-cost outcomes that meet policy goals

Reviewing activities in leading states at the "distribution edge" shows common themes

Hawaii

- Focus on alleviating issues with existing, high PV penetration
- Emphasis on incorporating advanced capabilities of DERs

California

Focus on lowering interconnection costs by finding optimal locations

New York

- Focus on **defining markets** for DER development and services
- Acknowledge interaction with NYISO and bulk power interplay

Common themes –

- New rules for distribution planning are rooted in **public policy goals**
 - e.g. DER adoption levels
- Emphasis on safety and reliability of system and possible DER value
- Key goal is lower net costs for ratepayers through adoption of cost-effective technologies
 - e.g. Defer traditional capital projects via DER adoption
- Acknowledged need for regulatory processes that will enable reasonable oversight (retroactive evaluation) and proactive planning and policy development (forward looking)

Hypothesis: Current processes and tools will not adequately meet emerging needs

Current process (e.g. California)

- Utilities submit rate cases detailing planned distribution network expenditures in various FERC budget categories
 - Variety of modeling tools are used in simulating system behavior and upgrade needs
- Regulatory staff & interveners review planned investments
 - Availability of input data and modeling tools for review is inconsistent
- Based on evaluation & comments, regulators must approve and/or modify requested budgets

Emerging needs

- Distribution system planning will be more closely linked to policy goals (e.g. DER adoption levels)
- Advanced capabilities of DERs (e.g. inverters, storage) will need to be modeled to understand ops and value implications for system
- Regulators and stakeholders will need increased capability to vet plans
 - Access to appropriate models and necessary data
 - Standardized process, questions for evaluation
- May require new breed of integrated models and process to evaluate plans in a consistent framework

A variety of existing tools can be used to answer different questions within the DRP process

Model type	Examples	Key outputs	Outstanding questions for DERs
Capacity expansion	Strategist	Bulk power capacity	Options for DERs to reduce bulk capacity needs?
Production cost	Plexos	Generator costs & transmission use	Interaction of aggregated DERs with bulk power commitment & dispatch?
Transmission planning	GE Positive Sequence Loadflow	Steady-state power flows & dynamic results	Impact of aggregated DERs on transmission-level power flows and contingency response?
ISO-level market management		Pricing and contingency metrics	Interaction of DERs with real-time markets and dispatch logic?
Distribution planning	SynerGEE; CYME	Power flow and equipment use	Impact of DERs on equipment use, safety, and dynamic conditions?
DER operations	BlueFin	DER schedules, customer metrics	Interaction of DER fleets with network & grid equipment?

Tool usefulness for regulators and stakeholders depends on level of detail and the goals of the analysis

• Direct regulator or stakeholder modeling will likely be limited to addressing higher-level questions; involvement in detailed modeling would likely involve utility collaboration

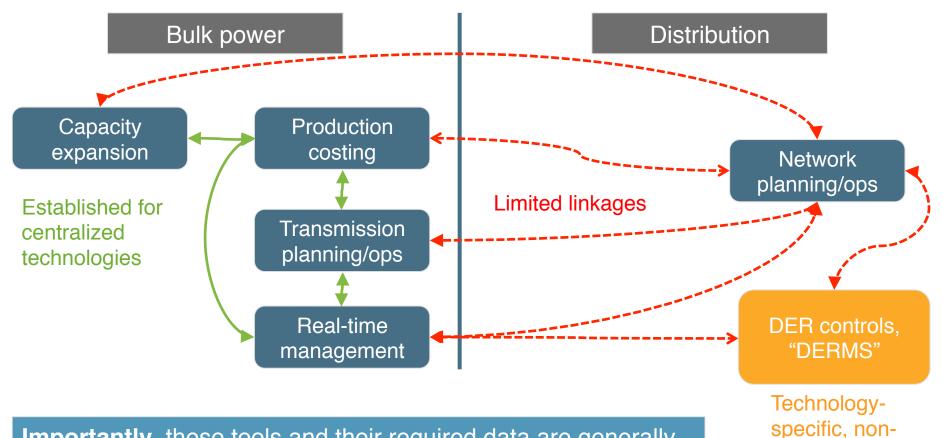
		Analys			
Analytical question	Powerflow analysis	Agg. DER ops	Bulk PCM/ CEM	Financial modeling	Regulator/stakeholder involvement
What distribution investments are necessary to achieve DER goals?	5	1			Methodology oversight
What value do advanced DER capabilities provide?	5	5		1	Methodology oversight
What bulk power assets can be deferred by DER?		1	\checkmark	1	Direct use
What are customer impacts?		<i>√</i>	5	✓	Direct use
Etc.					

Gaps between operational and planning models need to be bridged to correctly model DERs

Outputs of network planning / operations models		Relevant model linkages			
		DERs in distribution system			Bulk power
		Customer	Aggregator	DSO	
0 years	Investment plan to meet load growth, maintain reliability	Customer technology	Planning- related impacts of DER fleet operation	Inter- connection plan; impact on electrical network	Offsetting resource adequacy requirements, transmission planning
Months- years	Specific, rate case-related investments	uptake			Impact on ISO reliability assessment; capacity market auctions
ay head	Load management;	Short-term device use forecasts	Optimized	Network stability; equipment operations	Interaction with ISO
Real time	equipment operations	Real-time data linkages	DER fleet schedule		energy, A/S markets

Gaps between bulk power and distribution system analysis limit accurate assessment of DER value

Utility planning processes tend to be split between transmission- and distribution- level analysis. Integrated DRP modeling requires an explicit link between these silos.



Importantly, these tools and their required data are generally only available to the utility, not regulatory staff and third parties

standardized

New tools and an improved DRP process framework could help address the identified gaps

Potential modeling tool solutions

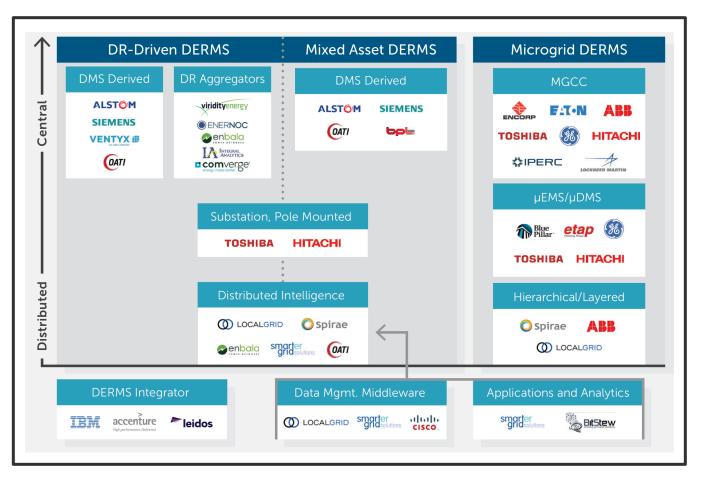
- A new breed of software models is emerging that focus on distributionlevel analysis of DERs for operational and planning purposes
- Many of these tools also link DERs to transmission-level analysis, in both the long-term and short-term timeframes
- Several gaps remain in determining the usefulness of these tools within the overall DRP process

Regulatory process solutions

- A DRP process driven by clear policy goals and with attentive, analytical stakeholder review could aid in optimal utility distribution investment
- New or improved analytical tools can be used by both utility planners and stakeholders to find least-cost outcomes that meet policy needs
- The specifics of the process (e.g. data access, model use) need to be addressed

Modeling tools: "DERMS" solutions

DER Management Systems (DERMS) make up a rapidly-growing category of tools for monitoring and managing distribution systems and connected DERs.

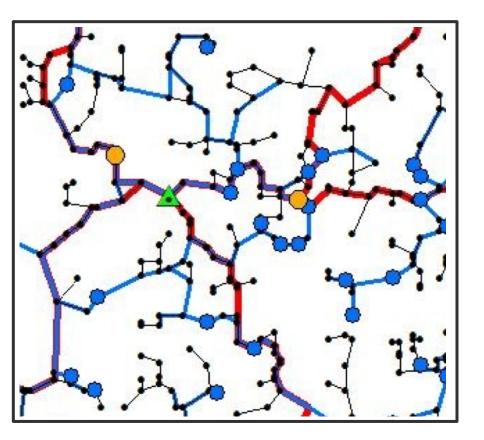


Several issues are important in determine use in creating/evaluating DRPs:

- Level of interface with ISO-level modeling
- Capability of DERMS as a planning tool
- Data requirements & accessibility

Modeling tools: Reference network models

Reference Network Models (RNMs) simulate least-cost expansion of distribution grids under different scenarios. Several studies have explored the potential for regulators to use these tools directly to benchmark utility plans against "efficient" investment.

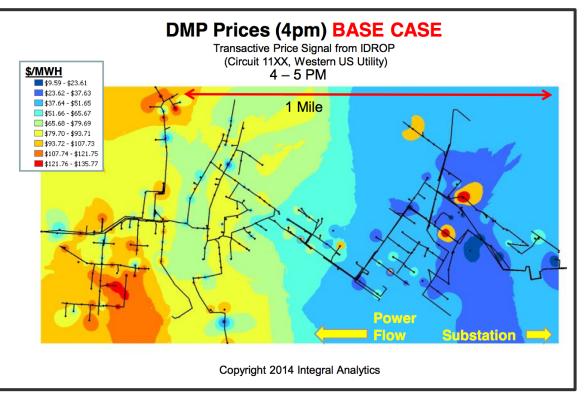


Several issues are important in determining RNMs' applicability to the DRP process:

- Data requirements are very high: loads, PV generation, network topology, etc.
- Unclear availability of RNMs that account for advanced DER capabilities
- Fundamental mismatch between utilityowned models and RNM may limit acceptance within utility

Modeling tools: Distribution marginal cost

Distribution Marginal Cost (DMC) has been proposed by at least one software vendor as a way to prioritize DER investment in optimal locations within the distribution grid. DMC can take into account both long-run and short-run costs to arrive at time- and locationspecific avoided costs for DERs.



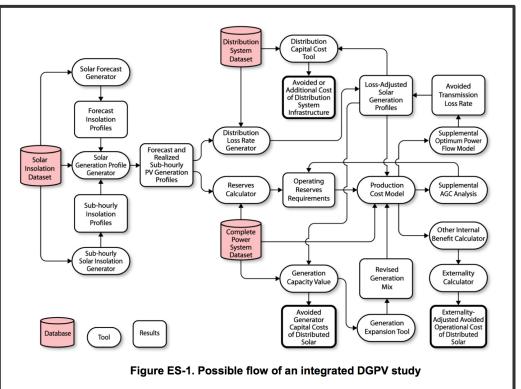
Several issues are important in determining DMC's applicability to the DRP process:

- Data requirements are very high: loads, PV generation, network topology, demographics, etc.
- Non-universal treatment of advanced DER capabilities by DMC models
- Accessibility to regulators and stakeholders may be limited

Modeling tools: NREL full study framework

NREL has laid out possible tools for assessing benefits/costs of distributed PV, and a potential framework for a comprehensive study to evaluate the impacts of PV holistically.

Several tools (e.g. spreadsheet analysis) for individual impact categories already exist and are available to regulators or stakeholders.



The NREL framework's applicability to the DRP process depends on several issues:

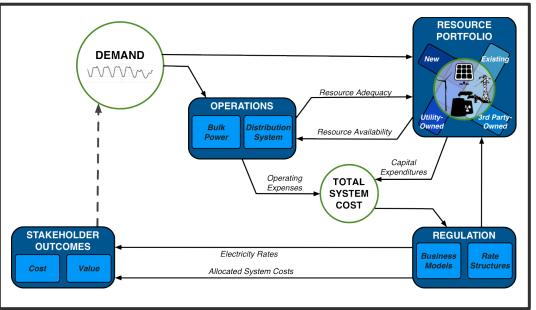
- Completion timeframe of study
- Jurisdictional focus & granularity
- Extensibility of results to specific regulatory or stakeholder concerns
- Treatment of DER other than PV

Source: Denholm, Margolis, Palmintier et al., 2014 – "Methods for Analyzing the Benefits and Costs of Distributed Photovoltaic Generation to the U.S. Electric Utility System" (NREL TP-6A20-62447)

Modeling tools: RMI's EDGE model

With DOE SunShot funding, RMI developed the Electricity Distribution Grid Evaluator (EDGE) model, which aims to model at a high level all aspects of power system planning and operation, focusing specifically on the impact of DERs on stakeholder outcomes.

EDGE is meant to be openly accessible and extensible, allowing application to any regulatory jurisdiction or utility service territory.



Several issues influence EDGE's applicability to the DRP process:

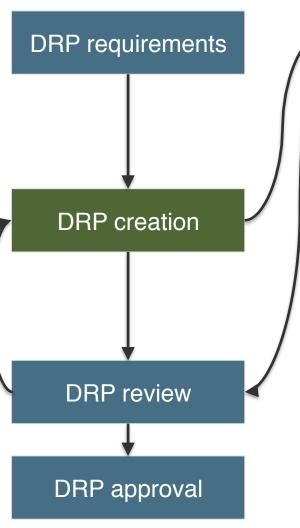
- Data requirements are very high: loads, PV generation, network topology, etc.
- Ease of access by regulators and stakeholders
- Differences in methodology between EDGE and utility-owned tools

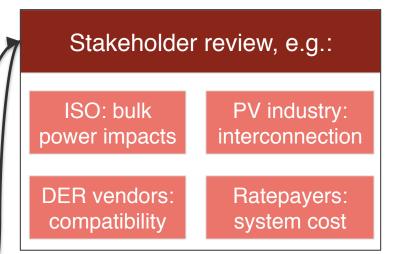
Proposed framework: regulatory process

Regulators should ensure that DRP requirements allow stakeholder vetting and support policy goals

Utilities need better, integrated models to fully address DRP requirements

Regulators will evaluate whether the filed DRP addresses stakeholder concerns and meets policy goals





Stakeholders need access to the same models and data used to create the DRP – or at least a subset – to vet utility plan outcomes and advise regulatory staff on adequacy of the DRP in meeting goals.

For results driven by proprietary tools unavailable to third parties, methodology should be transparent.

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eLab proposed products

- eLab is in a unique position to convene the key stakeholders in these ongoing processes (regulators, utility staff, DER industry, ISOs, software vendors, etc.) in order to gain insight into emerging best practices in creating and evaluating DRPs.
- eLab has convening power and influence at a national as well as regional or state scale; this leads to a choice of the best way to leverage our network for greatest impact:

"Breadth-first" synthesis

- Focus on synthesizing common experiences and best practices from ongoing processes in leading states
- Partner with DER developers, software vendors, and a selection of regulator and utility staff to arrive at broadly-applicable framework and best practices
- Sets the stage for a deep dive project

"Depth-first" working group

- Focus on detailed gap analysis and process building for a specific state
- Partner with key regulatory and utility staff, as well as local stakeholders, to arrive at actionable recommendations for the state in question
- Lends detailed insight to a more broadly-applicable synthesis