Time and Locational Value of Distributed Energy Resources: Methods & Applications

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Our Members…

- 450+ participants in more than 30 countries
- EPRI members generate approximately 90% of the electricity in the United States
- International funding of 25% of EPRI’s research, development and demonstrations
Three Dimensions of EPRI’s Value

Thought Leadership  

Industry Expertise  

Collaborative Model

Independent  

Nonprofit  

Collaborative
Electricity Sector 1.0 - Yesterday’s Power System

- Bulk Power System
- Distribution System

One Way Power Flow

- Residential
- Commercial
- Industrial
Electricity 2.0 – Enter Local Energy Resources

Generation Becomes More Flexible

Consumers Become Energy Producers

T & D Becomes More Controllable and Resilient

Loads Become More Interactive and Dynamic

Two-way Flow
Role of Distribution System is Changing

- Expanding Role
- Increasingly Complex
- Not Fully Prepared to Address
- Understanding is needed as more DER is added

Distribution Planning Tools, Methods and Processes Must Be Updated and Enhanced
DER Proceedings are Proliferating in More Than 20 States

Source: GTM Research, Pace Energy & Climate Center
Example: Average Avoided-Cost Values in Selected Studies

Methodologies and Results Vary Significantly

Source: e-Lab 2013 Solar Study (a collection of several studies by others).
California and New York Taking Progressive Actions

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

– CA PUC Code 769, Aug 2014

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

– NY REV, Feb 2015
What Issues Need to be Addressed?

- **Avoided Costs** – assumption that all DER is economic to the overall system costs
- **Proposals** – no common set of standards to assess & compare increasing amount of proposals
- **Differences** – every feeder is different; every solution is unique

EPRI’s Efforts Will Focus on “What Matters Most” For Assessment – Not “One” Answer
Overview of Distribution Planning Process

Establish baseline assumptions:
- Future load growth and loading profiles
- DER growth
- Distribution project deployment

Assess distribution grid capacity requirements:
- Meet projected load and DER growth
- Maintain safety and reliability for end users

Evaluate alternatives to address grid needs:
- Traditional utility solution
- DER

Projected Distribution Capacity Deficiencies and Plans to Address Projected Deficiencies are Identified
EPRI’s Study: “Time and Locational Value of DER: Methods and Applications”

- Used the EPRI Benefit-Cost Framework
  - Objective, Reproducible
  - Assesses Impacts of Interconnected DER
  - Generates Value/Cost to Society

- Two DER Interconnection Scenarios
  - DER only to meet all Load Growth
  - DER at customer discretion

- Actual Systems
  - Actual Performance Date for baseline


EPRI’s Study Period: 2016-2025 to Align with Timeframe Used by Distribution Planners
EPRI’s Integrated Grid’s Benefit Cost Framework

The Focus of This Study are the Distribution System Elements
### Benefit/Cost Analysis Considerations

#### Modeling and Analysis Outputs
- Capacity requirement (load shape changes)
- Voltage regulation
- Capacity upgrades
- Protection
- Switched capacitor, tap changer and regulator operations
- Distribution energy losses (kW, kWh)

#### Economic Analysis Outputs
- Capacity upgrade deferral ($)
- Capital costs for integration ($)
- Change in O&M expenses ($) and shortened asset life
- Distribution losses (marginal – $/kWh)

#### Normalize to DER Energy Production
- Capacity Deferral ($/kWh)
- Mitigation ($/kWh)
- System Losses ($/kWh)
- Distribution ($/kWh)

### Bottoms-Up and Circuit-by-Circuit
The Scenarios: Mesh Network vs. Radial Topologies

Mesh Network System Illustration (Con Edison)  Radial System Illustration (SCE)

Two Examples Illustrate the Methodology for very different systems
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Electric Distribution System

- NYC Metro Area
- 40% of the NY State electric peak

87% network
13% radial
Con Edison's 64 distribution networks have varying characteristics.

Each network supplied from a substation.

Range of sizes, typically:
- 12-24 feeders
- 250-750 transformers
- 7,500-100,000 customers
- 70-300 MW peak load
Animated illustration of network load changes over 24 hours of a peak day
T&D deferral with DERs - Considering peak day load profiles

**Traditional Approach**

- Expand infrastructure to keep up with load growth
T&D deferral with DERs - Considering peak day load profiles

The Brooklyn-Queens Demand Management Program (BQDM) is securing 41 MW of customer-sited DER to defer T&D investment beyond 2025
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**DER Portfolio Approach**

- Assemble a portfolio of DER technologies to shave peak
- Peak load duration matters

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**Map of Brooklyn-Queens area showing DER portfolio and current demand profiles.**
EPRI modeling reveals significant locational sensitivity in the local distribution system.

Network System: Multi-directional Power Flows

Locational Sensitivity

Further away from violation – the more DER is needed.
EPRI modeling reveals significant locational sensitivity in the local distribution system.

In the network, DER portfolios must be tightly situated near distribution asset to be effective.
Study assembled DER portfolio based on technology, customer, and system load curve characteristics

Illustrative BQDM Example
EPRI study compared costs to meet load growth using BCA criteria: Traditional T&D vs DER portfolio

Systematic Application to DER Value Leads to Comparable Results to Support Policy and Operations Planning
Immediate applications for the insights and methodologies from this work

- Formulating Distributed System Implementation Plans (DSIP) – future “Non-wires Alternatives” projects

Value of DER proceeding
NY PSC Case 15-E-0751

- DER compensation reform – “LMP+D”, where “D” varies by location
-Time and Location Value of DER: Conclusions from Study

- Comprehensive, consistent, and transparent methods are necessary.
- Net benefits of DER as an alternative to conventional grid is hard to generalize.
- Time and locational impacts are key determinants in valuing DER.
- It takes a portfolio of DER to meet system and customer needs and defer traditional assets cost-effectively.
What Is Still Needed?

- **Planning processes and tools** must transition to fully incorporate DER and their potential value.

- **Detailed engineering studies** needed to capture the important nuances in how DER can be accommodated.

- **Grid modernization** will also be a critical to sustain the safety and reliability of the distribution system, minimize overall system cost, and maximize benefits from DER.
Together…Shaping the Future of Electricity

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