The Future of Electricity Resource Planning

and Integrating DSM into IRP

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Overview

• Background
• Paradigm Shift
• Emerging Issues and Evolving Practices
• Summary and Considerations for Regulators
Future Electric Utility Regulation Series

- Series of reports from Lawrence Berkeley National Laboratory (LBNL) taps leading thinkers to grapple with complex regulatory issues for electricity
- Expert advisory group provides guidance and review
- Primary funder of initial six reports: U.S. Department of Energy’s (DOE’s) Office of Electricity Delivery and Energy Reliability - Electricity Policy Technical Assistance Program
- Office of Energy Efficiency and Renewable Energy’s Solar Energy Technologies Office is co-funding new reports under DOE’s Grid Modernization Initiative

The Future Electric Utility Regulation Advisory Group is composed of recognized experts including state regulators, utilities, stakeholders, and academia. The Advisory Group provides input to the topics and key issues the series covers and their prioritization, and reviews draft reports.

- Commissioner Lorraine Akiba, Hawaii PUC
- Janice Beecher, Institute of Public Utilities, Michigan State University
- Doug Benevento, Xcel Energy
- Ashley Brown, Harvard Electricity Policy Group
- Paula Carmody, Maryland Office of People’s Counsel
- Ralph Cavanagh, Natural Resources Defense Council
- Steve Cornell, consultant
- Tim Duff, Duke Energy
- Peter Fox-Penner, Boston University Questrom School of Business
- Scott Hempling, attorney
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- Sonny Popowski, Former consumer advocate of Pennsylvania
- Karl Rábago, Pace Energy & Climate Center, Pace University School of Law
- Rich Sedano, Regulatory Assistance Project
- Peter Zschokke, National Grid
FEUR Reports

- **Reports published to date:**
  1. Distributed Energy Resources (DERs), Industry Structure and Regulatory Responses
  3. Performance-Based Regulation in a High DER Future
  4. Distribution System Pricing With DERs
  5. Recovery of Utility Fixed Costs: Utility, Consumer, Environmental and Economist Perspectives
  7. The Future of Centrally-Organized Wholesale Electricity Markets

- **Forthcoming reports:**
  8. Regulatory Incentives and Disincentives for Utility Investments in Grid Modernization

* Additional reports will be announced

- All reports available at: feur.lbl.gov
Report Overview

• How is electricity resource planning changing?
• How might it evolve over the next decade?
• What does this imply for state and federal regulators?
• Analysis based on review of 10 resource plans:
  – 6 formal integrated resource plans (IRPs)
  – 3 long-term resource plans
  – 1 default service plan
  – Other state agency, RTO/ISO planning documents

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Planning Paradigm Shift

• Six key factors driving major changes in electricity industry

• Changes have significant implications for resource planning, gradual paradigm shift
Report Approach

• Report examines emerging issues and evolving practices in five key areas:
  1) Central-scale generation
  2) Distributed generation
  3) Demand-side resources
  4) Transmission
  5) Uncertainty and risk
• Based on analysis, report distills key considerations for regulators
Central-Scale Generation: Emerging Issues

- Greatest changes in planning practices for central-scale generation relate to wind and solar
- Different characteristics than other resources:
  - Physical (variable, uncertain)
  - Economic (high fixed cost, very low variable cost)
- Requires planning innovations

Lower Penetrations
Understanding flexibility of existing system, value proposition of RE

Higher Penetrations
Making larger changes in operations, investments to accommodate RE
Central-Scale Generation: Evolving Practices

• Key areas:
  – How utilities choose amount and composition of renewable resources
  – How utilities/RTOs assess operational impacts, incorporate into planning
  – How utilities/RTOs assess capacity credits and values for renewable energy

Emerging Best Practices

• Treating wind and solar generation in investment models as “selectable” resources
• Including more detailed operational characteristics in investment/procurement (expansion) models
• Using reliability-based approaches (e.g., ELCC) to determine capacity credit of wind and solar generation
• Coordinating planning across utilities and balancing areas

For examples, see DEC, NSP, PacifiCorp, TVA IRPs
Distributed Generation: Emerging Issues

- DG can have significant impact on system operations, need for and timing of investments in conventional generation and T&D infrastructure
- Utilities have limited direct control over adoption
- That said, utilities:
  - Do have some ability to target DG adoption
  - Can plan for DG uncertainty

Figure shows net energy metering installations in MECO, HELCO, HECO from 2001 to 2015

In five years customers in MECO, HELCO, HECO install 246, 54, and 58 MW, respectively, of NEM DG (22%, 29%, 30% of 2013 system peak)
Distributed Generation: Evolving Practices

• Key areas:
  – How utilities/RTOs are modeling DG adoption and its impact on bulk system planning variables
  – How utilities are valuing DG in resource plans
  – How utilities and regulators are comprehensively assessing DG impacts, beyond traditional resource planning

Emerging Best Practices

• Generating DG forecasts using models of customer adoption behavior in resource planning process
• Assessing locational value of DG, incorporating distribution deferral values in DG evaluation
• Making use of “triggers” and “signposts” to revisit plans if adoption is significantly different than anticipated

For examples, see CECONY, NSP, PacifiCorp, TVA plans; SCE DRPs
Demand-side Resources: Emerging Issues

• Value of demand-side resources (DERs)—EE, DR, storage—will likely increase over next decade
  – Driven by public policy goals

• New opportunities:
  – New kinds of DER resources (EVs, distributed storage), new IT, new business models

• However, DER planning often not well integrated into supply planning, not included in risk analysis
DERs and Resource Planning

- DERs are by no means a new planning issue for utilities
- But the context is changing:
  - Slowing demand growth
  - State DG, EE, DR policies
  - Technology (esp. PV, storage) cost reductions and improvements
  - Changing customer preferences
  - Evolution of information and communication technologies

*EPRI, Distributed Utility Penetration Study, 1996*
Demand-side Resources: Evolving Practices

• Key areas:
  – How DER planning is integrated into resource valuation and selection, including risk analysis
  – How retail rates and rate design impacts are incorporated into DER modeling, load forecasts

Emerging Best Practices

• Incorporating locational benefits of DERs in resource evaluations
• Treating DERs as selectable resources in bulk expansion models
• Integrating evaluation across DERs (including DG)
• Better understanding potential of price responsive loads (e.g., EVs, DG + storage), piloting retail rate designs to provide resource benefits

For examples, see CECONY’s IDSM tool, PacifiCorp and TVA plans, SCE DRP
Targeting DER Investment

• Bulk and distribution system value of DERs varies significantly across electricity system

• Targeting DER programs and investments can better align DER “expansion” with system value

• Proactive approach to targeting by utilities and regulators
  – Provides best value for customers
  – Makes best use of ratepayer funds

Location of “Hot Spots” from Avoided Cost Data by Utility in California

Energy Analysis and Environmental Impacts Division
Treating DERs as “Selectable Resources”

- Treating DERs as supply-side resources in capacity expansion models
  - Levelized cost
  - Fixed load shift/reduction profile
- Internally consistent optimal portfolios
- Enables seamless integration into uncertainty and risk analysis

PacifiCorp 2015 EE Supply Curves
Integrating DER Assessment

- Integrated assessment across DERs — EE, DR, storage, DG — can encourage least-cost utility portfolio of DER programs

- Capacity expansion models, IDSM tools provide platforms for integrated DER assessment, address different kinds of questions

Analytical Framework for ConEd Integrated Demand-Side Management (IDSM) Tool
Transmission: Emerging Issues

• Transmission provides a number of resource benefits
  – Lower costs for capacity, energy, and ancillary services, increased flexibility

• Value of transmission will also likely increase over next decade
  – Public policy goals

• Transmission planning generally not well integrated with resource planning
  – Different questions for RTO and non-RTO jurisdictions
Emerging Best Practices

- Evaluating multiple benefits of transmission (not just reliability or congestion)
- Incorporating value of reduced wind and solar curtailment
- Coordinating inputs in resource and transmission plans
- Undertaking, and potentially institutionalizing, non-wires alternatives analysis

Key areas:
- How the capacity, energy, and flexibility benefits of transmission are valued in markets and planning tools
- How alternatives to transmission are considered in transmission valuation and selection
Uncertainty and Risk: Emerging Issues

• Electricity industry has always faced uncertainty and managed risk

• Current levels of uncertainty akin to previous transition periods
  – **Drivers of uncertainty** often interrelated

• Regulators and utilities should be proactively managing risks
Uncertainty and Risk: Evolving Practices

• Key areas:
  – How utilities are incorporating risk into resource valuation and selection
  – How metrics are interpreted and incorporated into preferred plan

Emerging Best Practices

• Using quantitative risk analysis and risk-adjusted metrics in development of preferred resource portfolio
• Developing clear criteria for how risk-adjusted metrics will be used in evaluating different potential resource portfolios

For examples, see NSP, PacifiCorp, TVA IRPs
Risk Analysis

- Increased computing power allows screening of portfolios based on average cost and cost variance
  - Systematic sensitivity analysis on resource portfolios
- Selection of preferred portfolio still requires significant judgement

![Diagram showing PVRR Mean and PVRR Variance with points indicating lower and higher cost and risk combinations.]

Which of these portfolios is preferred?
Summary

• Electricity industry is changing, resource planning must evolve to keep pace
  – Evolution needs to be in form, function, and methods

• Planning innovations and best practices are emerging, regulators can encourage and support their use

• With better data, new methods, and more computing power, important not to lose sight of the role of judgement in planning
10 Considerations for Regulators

1) More integrated approaches to resource evaluation and acquisition
   - Value of integrated planning increases during transition periods

2) More comprehensive consideration of investment drivers
   - Shifting from reliability to reliability, environment, risk management

3) More accurate representation of solar and wind generation in resource planning models
   - Focus on uncertainty and operational detail, requires industry-wide effort
10 Considerations for Regulators

4) Greater attention in resource planning to customer behavior, retail rate designs and the distribution system
   ➢ New opportunities for reducing utility costs and risks, but also new sources of uncertainty and risk

5) Risk analysis and use of risk-adjusted metrics
   ➢ Attention to methods and how analysis and metrics are used in portfolio selection
6) Balancing precision and transparency in planning models
   - Intuition is still critical, still need back-of-the-envelope analysis and simpler analytical tools

7) Coherence between planning and long-term policies and regulations
   - For utilities, understanding costs and non-compliance risks, emphasis on transition

8) Deeper expertise at state regulatory commissions and energy agencies
   - Agencies dealing with more complex technical issues, building expertise may require high-level policy support
9) Exploring new opportunities for information sharing and collaboration
   ➢ Diversity of inputs and practices, some convergence would be beneficial

10) Regional coordination in resource planning
   ➢ Value of coordination and cooperation increases in transition periods
Natural Gas Prices

- Natural gas prices currently at historic lows
- Industry becoming increasingly reliant on natural gas generation
- How should natural gas prices be incorporated in resource plans?

Figures show EIA 2015 and 2016 AEO Henry Hub gas price forecasts
Renewable Energy Technology Costs

- Technology costs ($/kW) for solar have fallen dramatically, wind costs have also come down.
- Will these trends continue?
- At what point do we change how we think about them as a resource?

*Figure shows solar PPA prices from 2006 to 2015, based on LBNL sample, from Tracking the Sun.*
Load Growth

- Industry has seen steady decline in sales since 1970s, but now potentially negative
- How do flat/declining sales affect resource decisions?

Figures shows U.S. electricity industry annual sales growth and decadal averages; data are from EIA
Questions for Higher Renewable Penetrations

- Higher penetrations of solar and wind change scope of relevant resource planning questions

  Is there flexibility in neighboring systems to absorb additional imports?
  Are there cost-effective investments that will reduce curtailment?

Is there more flexibility in current system (e.g., in scheduling, reserves)

Figure is from E3’s Western Interconnection Flexibility Assessment, https://www.wecc.biz/Administrative/Flexibility%20Study%20-%20E3.pdf