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The Future of Electricity Resource Planning
and Integrating DSM into IRP

April 25, 2017

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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

FUTURE ELECTRIC
Utility Regulation

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.

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FEUR Reports

- **Reports published to date:**
  1. Distributed Energy Resources (DERs), Industry Structure and Regulatory Responses
  2. Distribution Systems in a High DER Future: Planning, Market Design, Operation and Oversight
  3. Performance-Based Regulation in a High DER Future
  4. Distribution System Pricing With DERs
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  6. The Future of Electricity Resource Planning **– Today's topic**
  7. The Future of Centrally-Organized Wholesale Electricity Markets

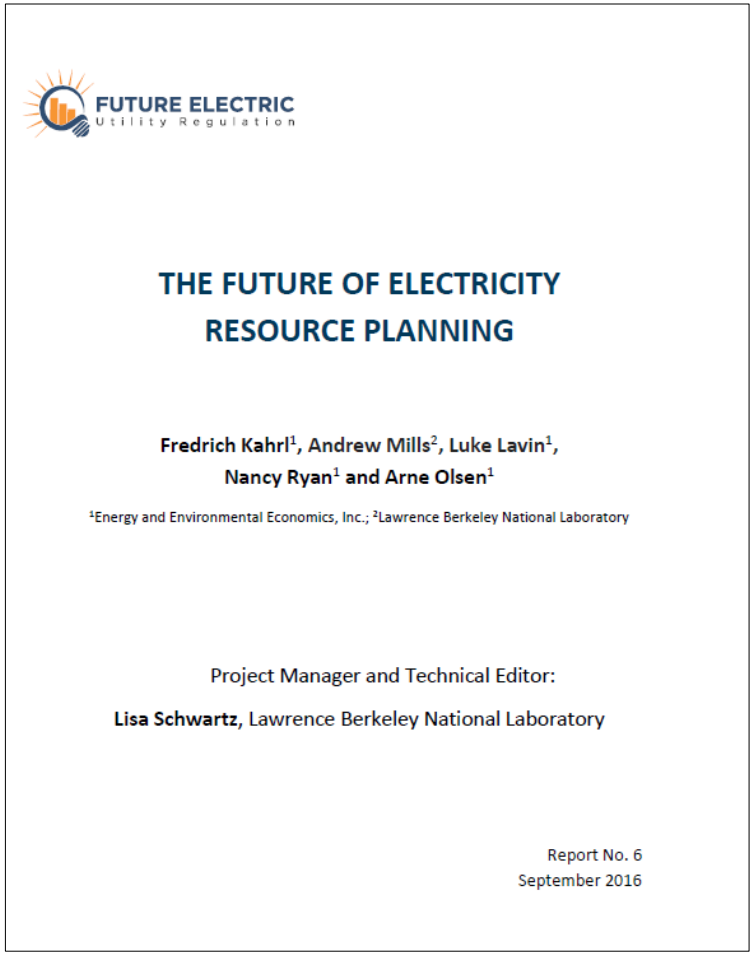
- **Forthcoming reports:**
  8. Regulatory Incentives and Disincentives for Utility Investments in Grid Modernization
  9. Value-Added Electricity Services and Products: New Roles for Utilities and Third-Party Providers

  * 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?



FUTURE ELECTRIC
Utility Regulation

THE FUTURE OF ELECTRICITY RESOURCE PLANNING

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Lisa Schwartz, Lawrence Berkeley National Laboratory

Report No. 6
September 2016

Report Scope

- 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

Utility	RTO/ISO Region	States Served	Plan Type	Plan Year
Consolidated Edison Company of New York (CECONY)	New York Independent System Operator (NYISO)	New York	Long-range resource plan	2012
Duke Energy Carolinas (DEC)	None	North Carolina, South Carolina	IRP	2014
Florida Power and Light (FPL)	None	Florida	Long-range resource plan	2015
Georgia Power Company (GPC)	None	Georgia	IRP	2013
Hawaiian Electric Companies	None	Hawaii	IRP	2013
PacifiCorp	None	California, Idaho, Oregon, Utah, Washington, Wyoming	IRP	2015
PECO Energy Company (PECO)	Pennsylvania-New Jersey-Maryland Interconnection (PJM)	Pennsylvania	Default service plan	2015
Southern California Edison (SCE)	California Independent System Operator (CAISO)	California	Long-range resource plan	2011
Tennessee Valley Authority (TVA)	None	Tennessee, Alabama, Mississippi, Kentucky, Georgia, North Carolina, Virginia	IRP	2015
Northern States Power Company (NSP)	Midcontinent Independent System Operator (MISO)	Michigan, Minnesota, North Dakota, South Dakota, Wisconsin	IRP	2015

Planning Paradigm Shift

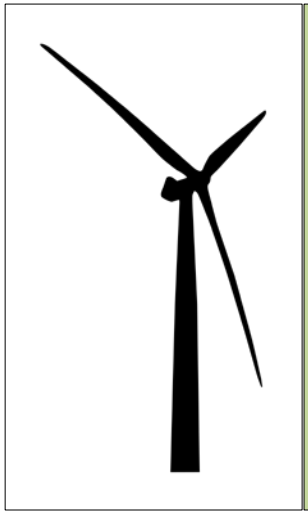
- Six key factors driving major changes in electricity industry
- Changes have significant implications for resource planning, gradual paradigm shift

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

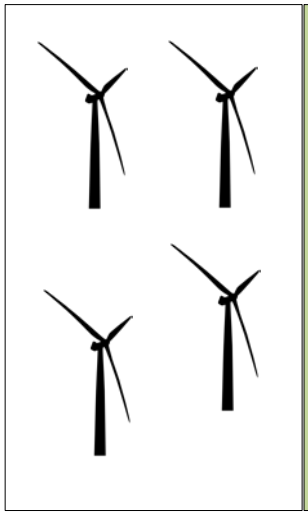
Central-Scale Generation: Emerging Issues

- 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



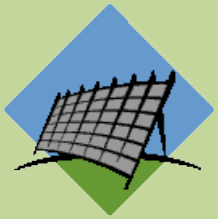
Higher Penetrations

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

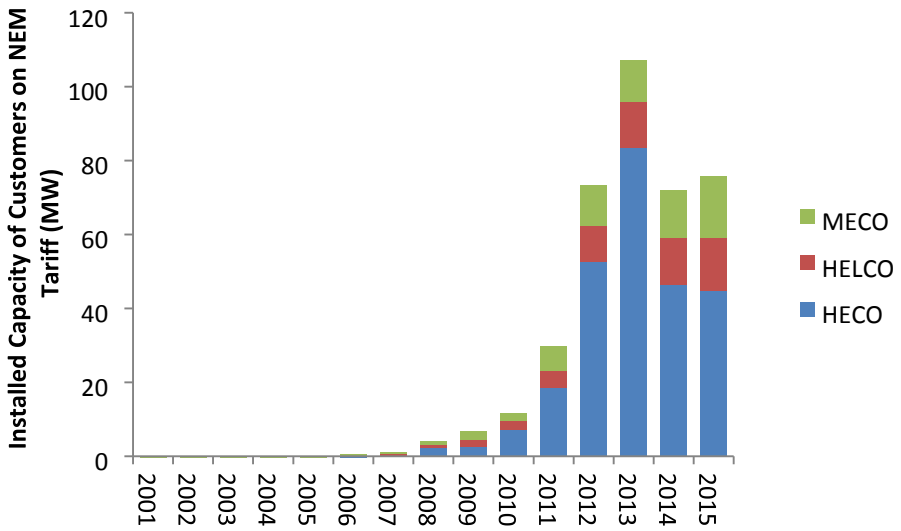


Figure shows net energy metering installations in MECO, HELCO, HECO from 2001 to 2015

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

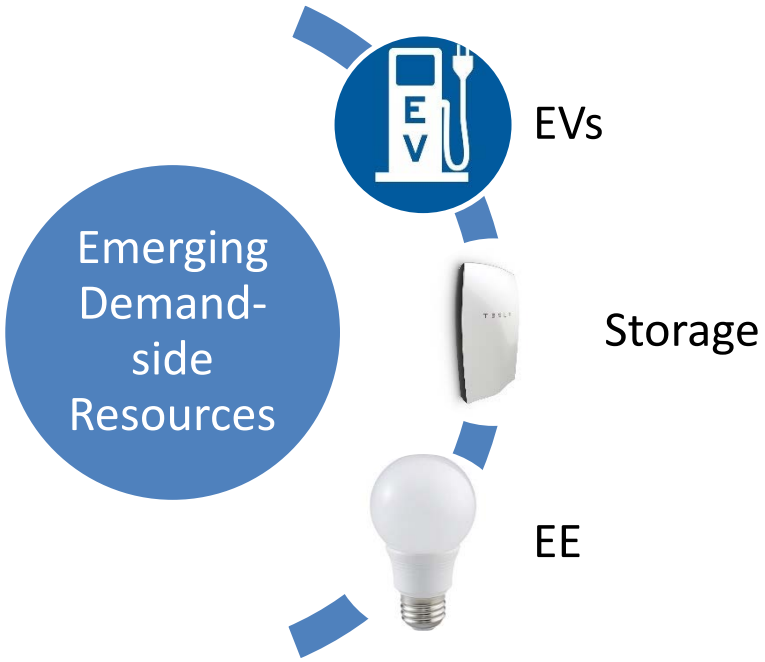
Emerging Best Practices

- 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

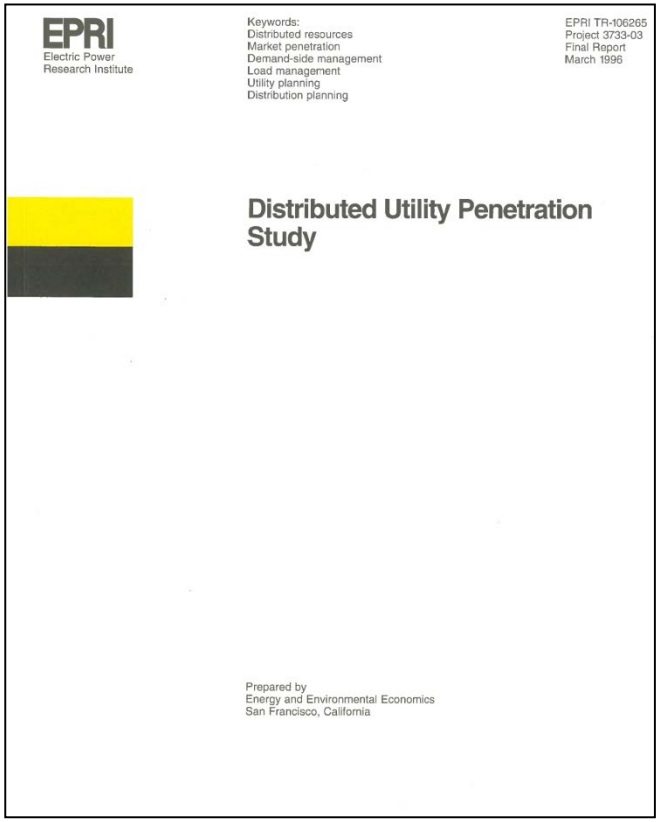
Demand-side Resources: Emerging Issues

- 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
Electric Power Research Institute

Keywords:
Distributed resources
Market penetration
Demand-side management
Load management
Utility planning
Distribution planning

EPRI TR-106265
Project 3733-03
Final Report
March 1996

Distributed Utility Penetration Study

Prepared by
Energy and Environmental Economics
San Francisco, California

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

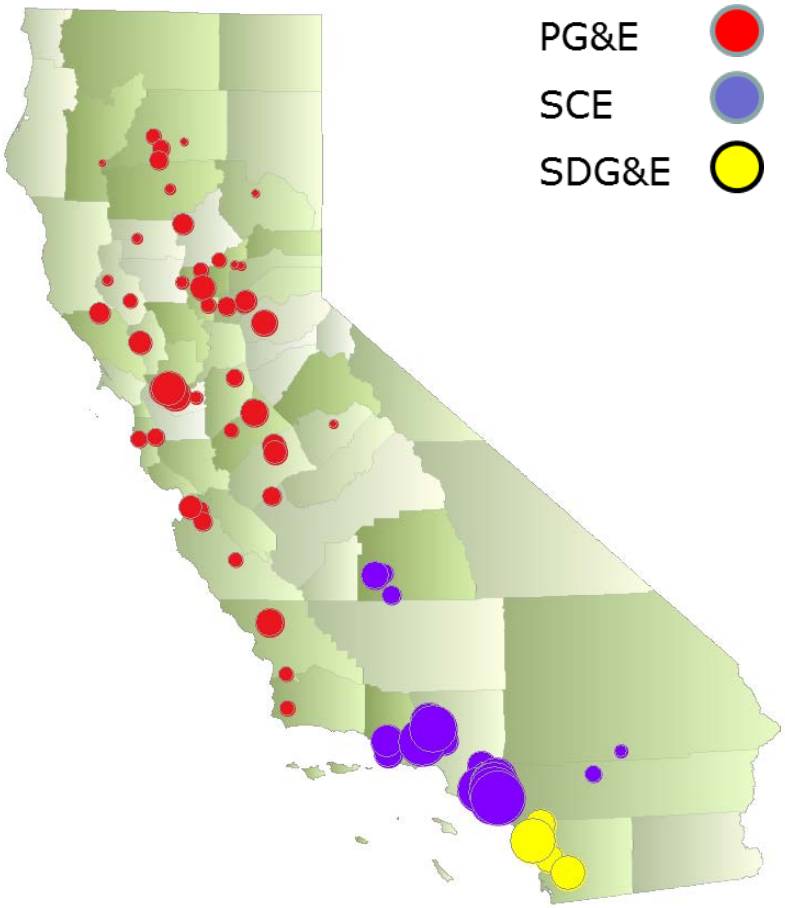
- Incorporating locational benefits of DERs in resource evaluations
- Treating DERs as selectable resources in bulk expansion models
- Integrating evaluation across DERs (including DG)
- Better understanding potential of price responsive loads (e.g., EVs, DG + storage), piloting retail rate designs to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

For examples, see CECONY's IDSM tool, PacifiCorp and TVA plans, SCE DRP

Targeting DER Investment

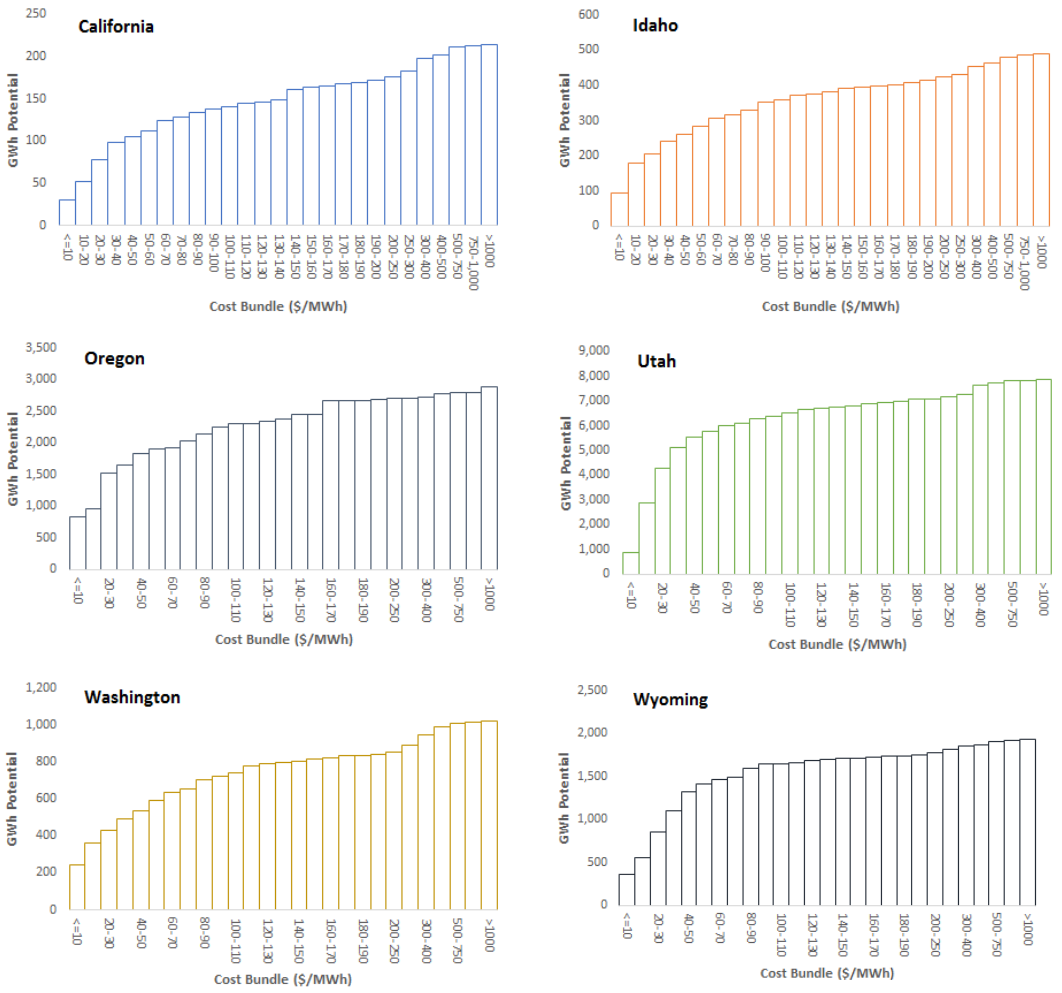
- Bulk and distribution system value of DERs varies significantly across electricity system
- Targeting DER programs and investments can better align DER "expansion" with system value
- Proactive approach to targeting by utilities and regulators
  - Provides best value for customers
  - Makes best use of ratepayer funds

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



Treating DERs as "Selectable Resources"

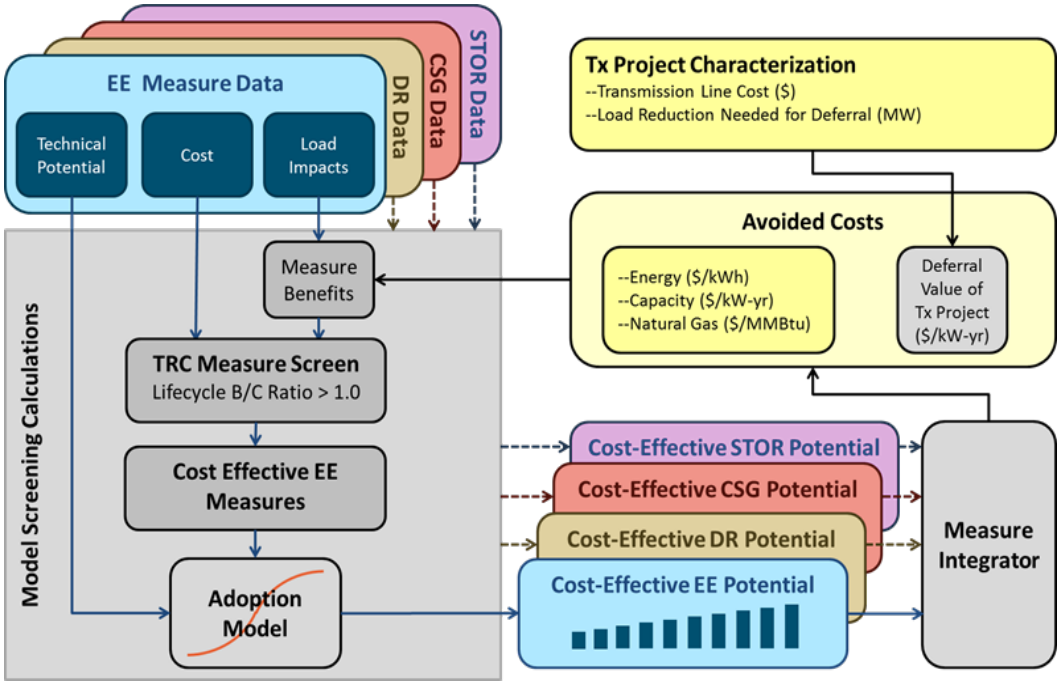
- Treating DERs as supply-side resources in capacity expansion models
  - Levelized cost
  - Fixed load shift/reduction profile
- Internally consistent optimal portfolios
- Enables seamless integration into uncertainty and risk analysis



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

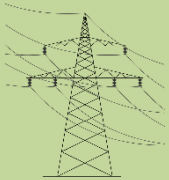
Transmission: Emerging Issues

- 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

Transmission: Evolving Practices

- 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

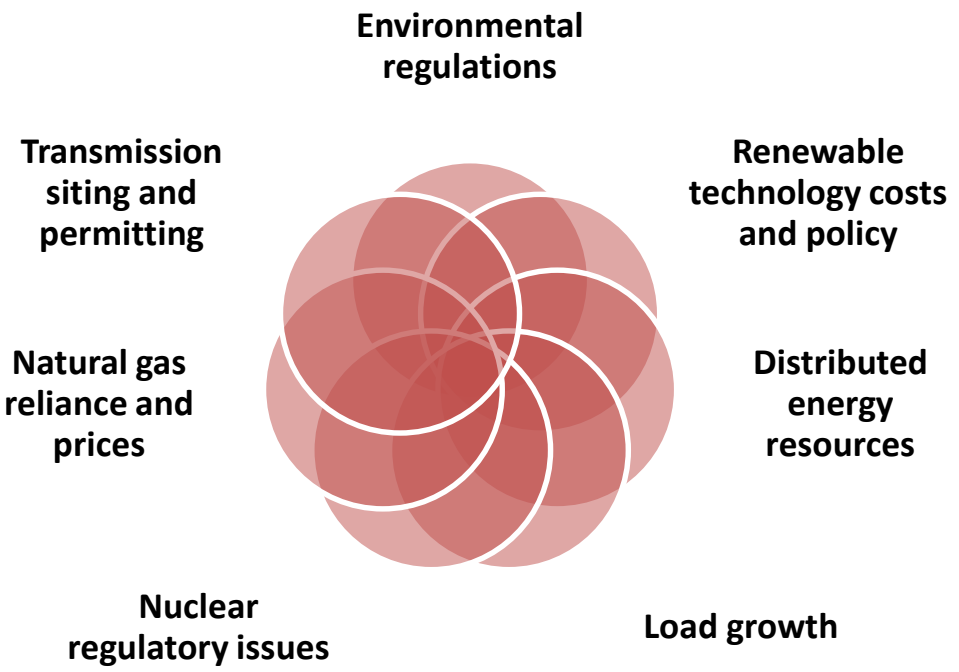
Emerging Best Practices



- 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

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

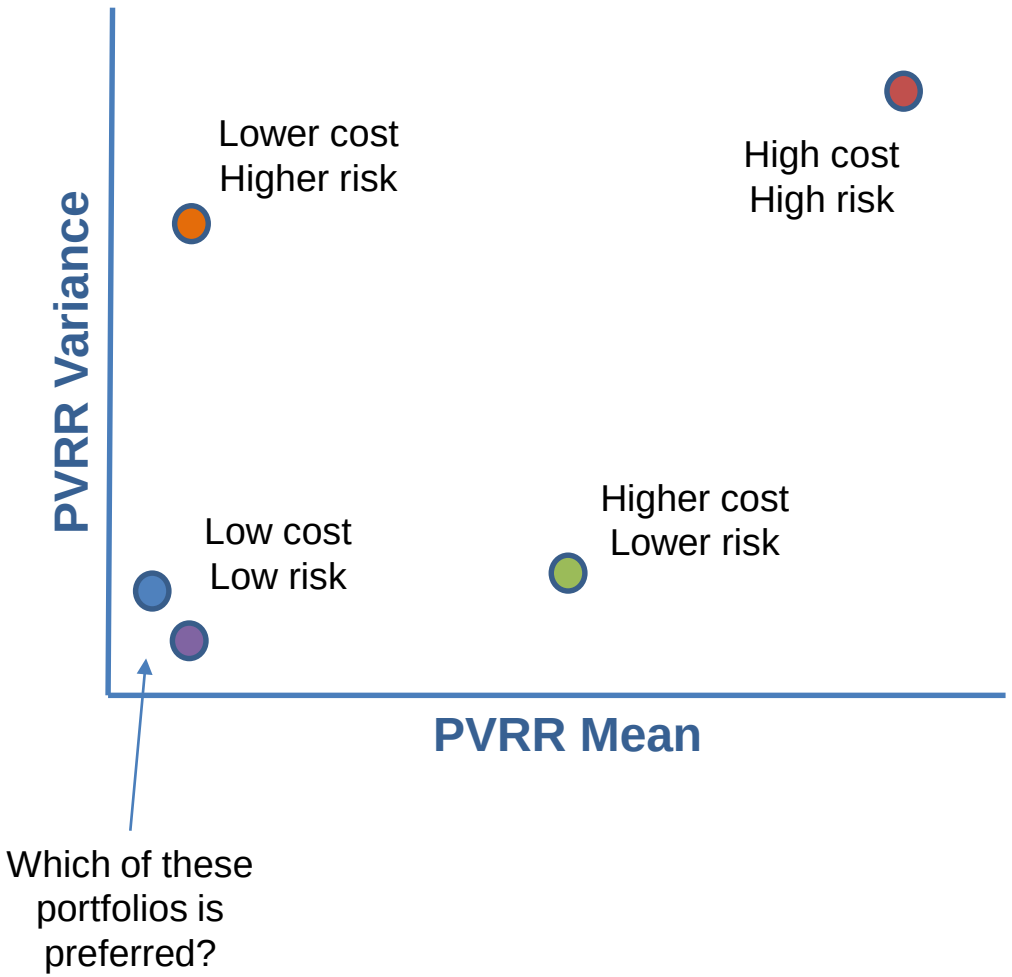
Emerging Best Practices

- 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



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

10 Considerations for Regulators

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

10 Considerations for Regulators

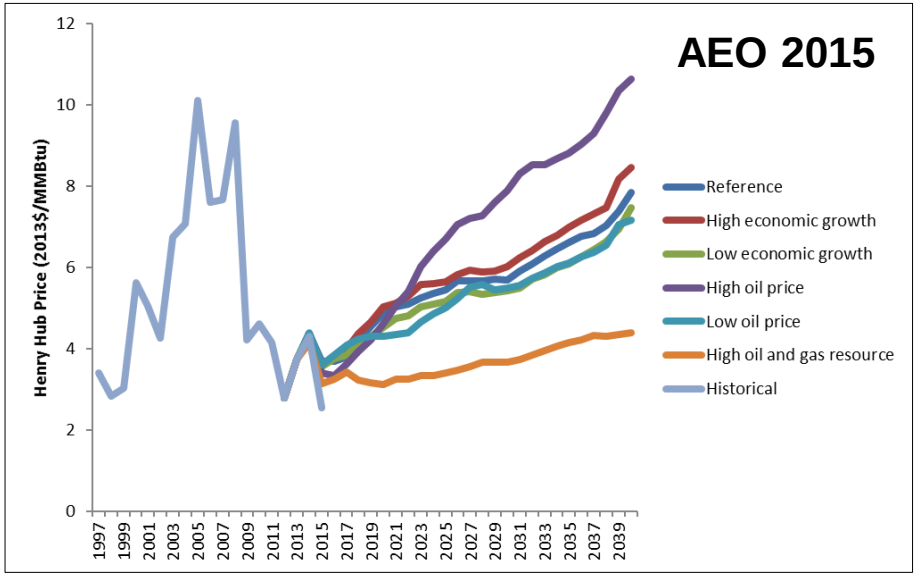
9) Exploring new opportunities for information sharing and collaboration
   - Diversity of inputs and practices, some convergence would be beneficial

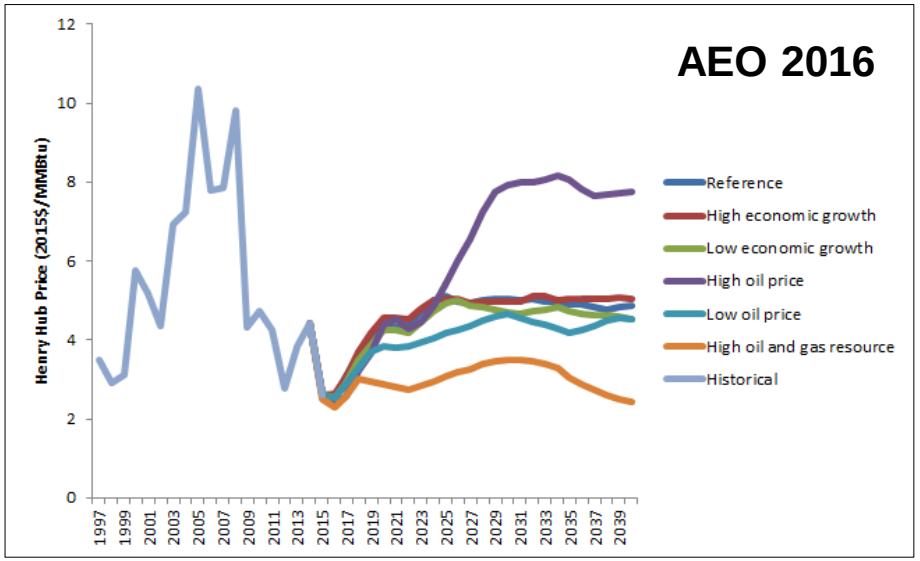
10) Regional coordination in resource planning
   - Value of coordination and cooperation increases in transition periods

Additional Slides

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?

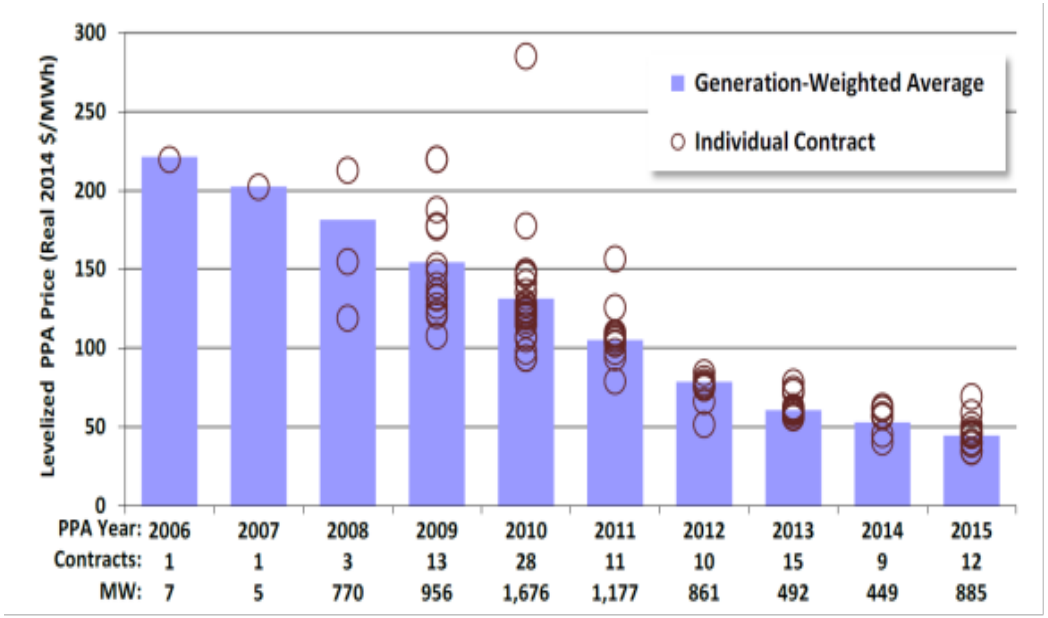
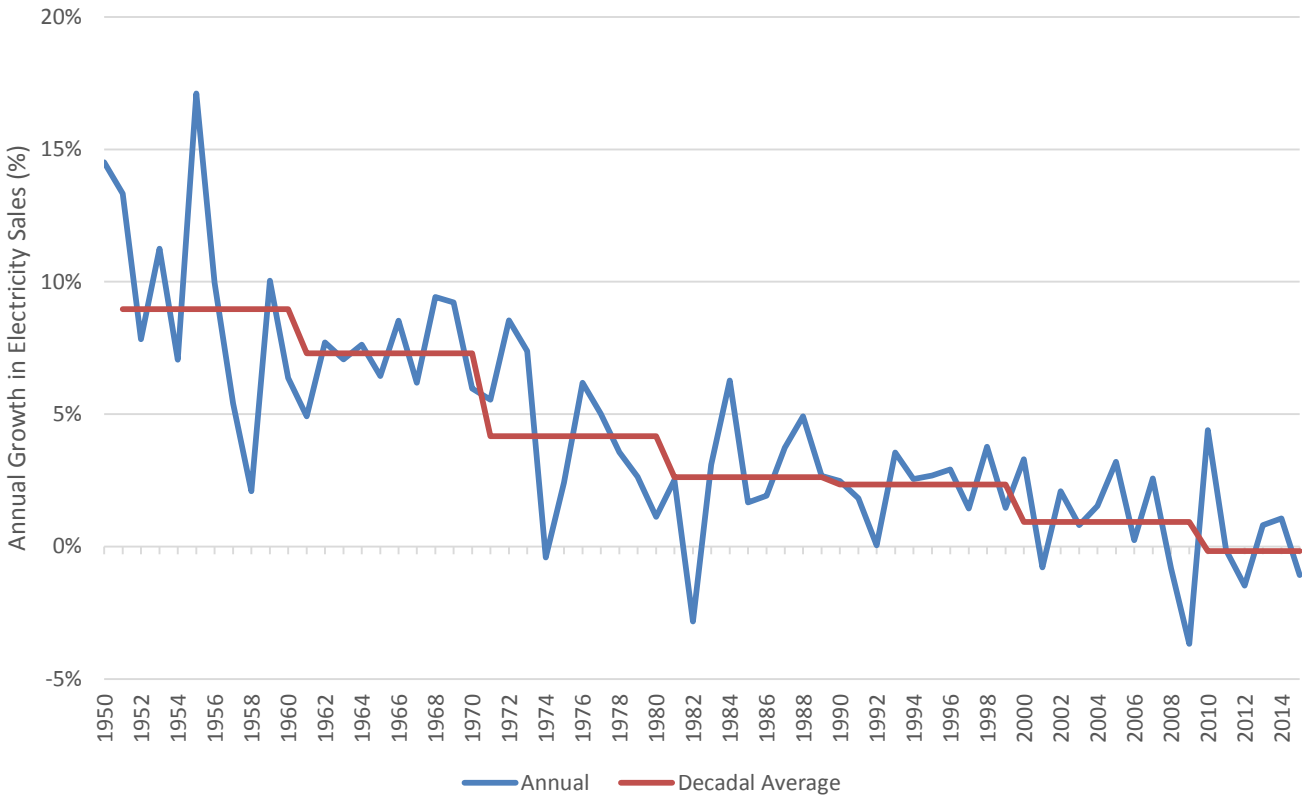


Figure shows solar PPA prices from 2006 to 2015, based on LBNL sample, from Tracking the Sun

Load Growth



Figures shows U.S. electricity industry annual sales growth and decadal averages; data are from EIA

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

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)

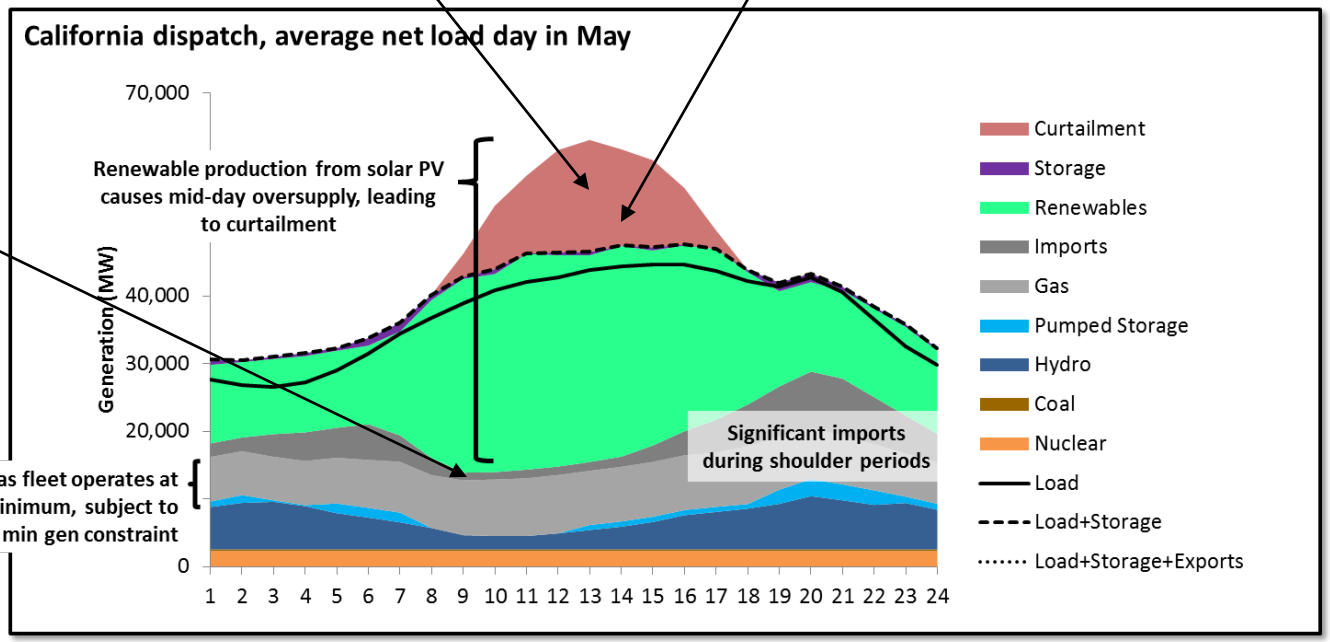


Figure is from E3's Western Interconnection Flexibility Assessment, https://www.wecc.biz/Administrative/Flexibility%20Study%20-%20E3.pdf