December 13, 2019

The Electricity Sector of the Past, Present, and Future

South Carolina Public Service Commission
“Utility of the Future” Workshop

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Today's Agenda

1. History, Trends, and Challenges facing Regulation and Markets
2. Distributed Resource Capabilities and Value, and Implications for Compensation, Rate Design, and Planning
3. **Best Practices in Resource Planning**
4. Approaches to Dealing with Misalignments in Traditional Regulation and Markets
5. Process Options for Moving Change Forward

Some Conclusions About Rate Design in the Future

Technologies Affect What is Possible and Necessary

Smart Grid Makes Better Rate Design Possible

Distributed Energy Resources (DERs) Make Better Rate Designs Necessary:

- Wind and Solar
- Storage Technologies
- EVs

Rate design in the future

- When are different resources operated?
- Where are different resources most valuable?
- What is the system load profile?
- What is the class load profile?
- Look ahead: Is the load shape changing due to solar?

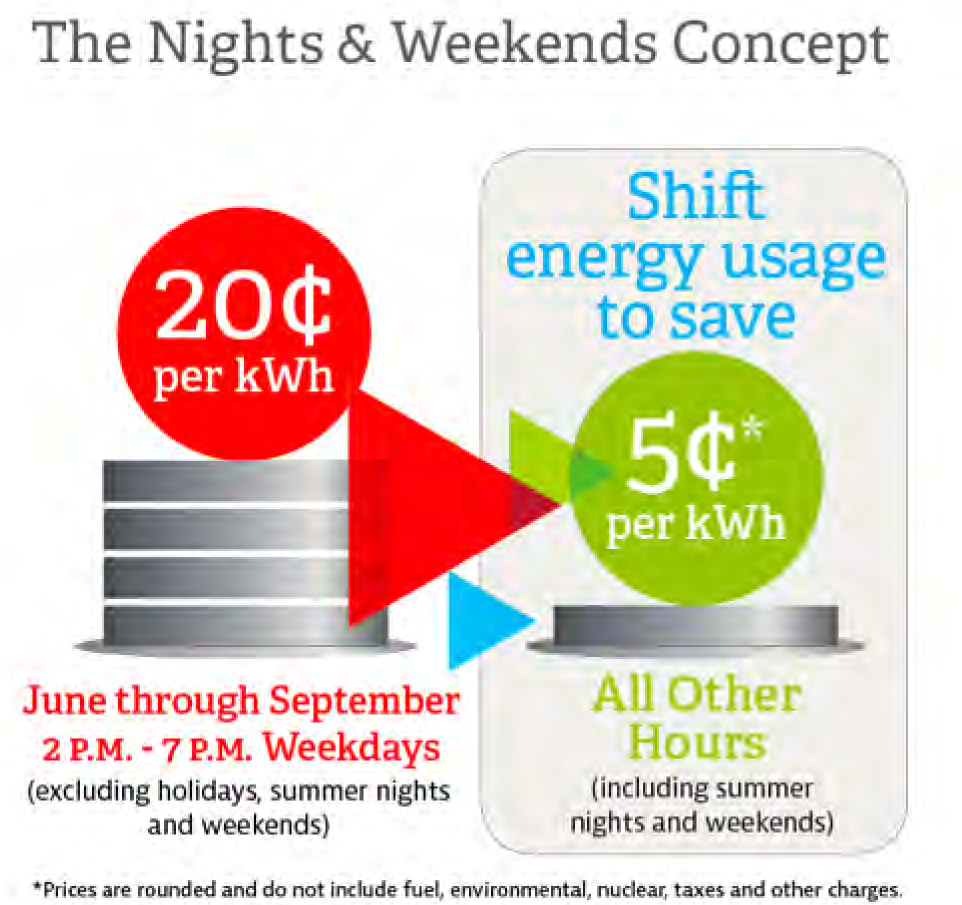
Rate Designs that Address Peak Demand

- Well-designed Time of Use Prices (TOU)
- Critical Peak Price (CPP)
- Peak Time Rebates
- Transparent Real Time Prices (RTP)
- Weak: Coincident Peak Demand Charges

Capturing Locational Value

- Distribution System Planning, and Integrated Resource Planning are key to discover value
- Then:
  - 1) demand response programs where location factors into calls;
  - 2) standard offer to customers who install equipment in high cost parts of the grid
  - 3) procurement of qualifying resources from the sensitive part of the grid

Residential Time of Use (TOU) Rate



Critical Peak Pricing (CPP)

- Definition: A very high rate that is in effect only a few hours per event, a few times per year.
- Goal: Dramatically reduce peak demand in these events.
- Design: Customer receives day-ahead notice when “critical” days will be in effect. On other days, “normal” prices apply.

CPP Example: Oklahoma Gas and Electric

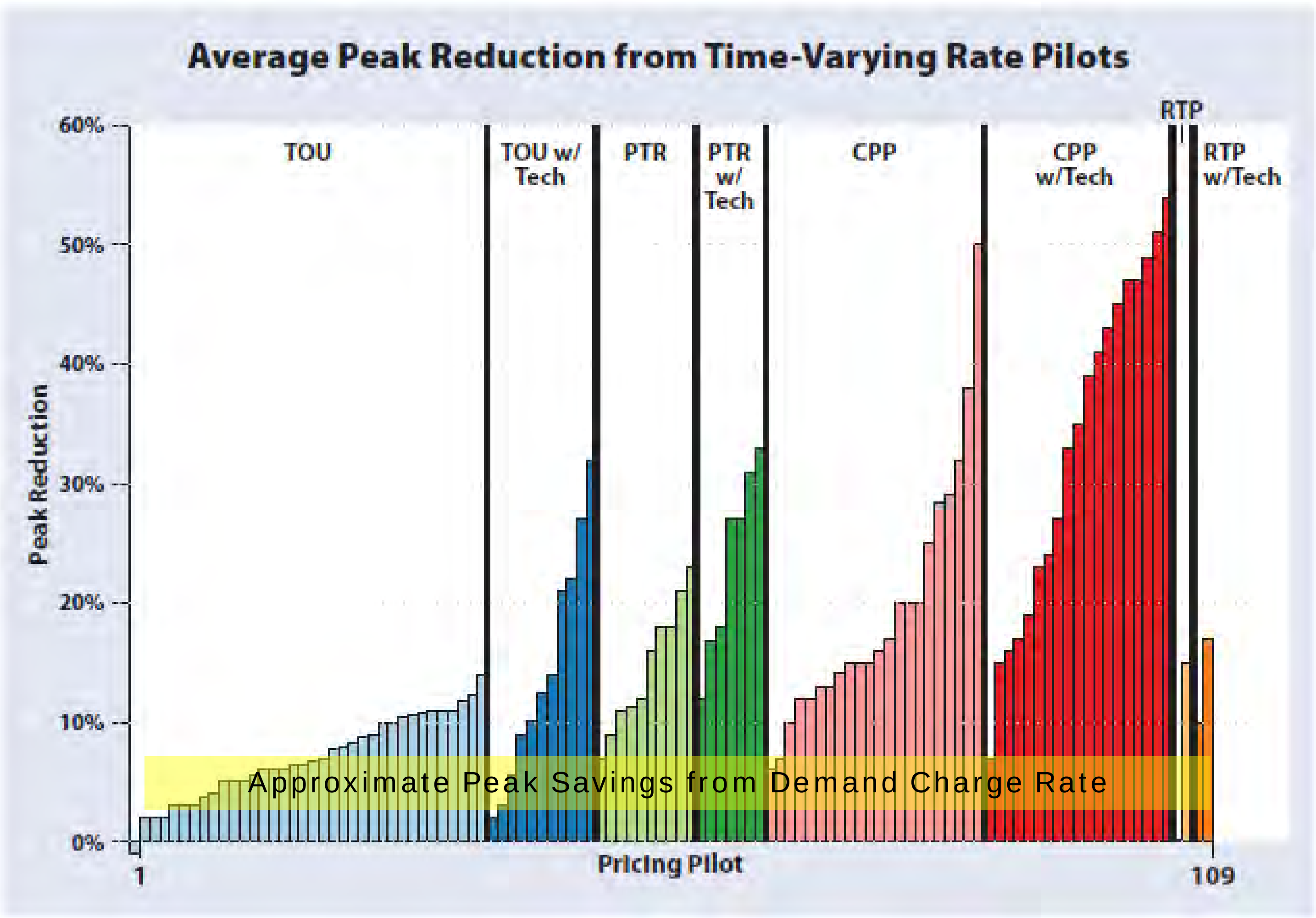
Peak-Time Rewards (PTR): CPP In Reverse

- Standard rate at all normal hours
- Critical events called as needed
- Customers get discount for reduced usage below a calculated baseline
- No surcharge for increased usage
- Requires smart meter data to set baseline

Peak Time Rewards Example: Baltimore Gas and Electric

• Customer Charge:	$7.90/month
• Energy Charge:	$.121/kWh
• Credit During Events:	($1.25/kWh)

TOU & Critical Peak Pricing Work



Technology Can Help

Issues with TOU and Critical Peak Rates

- Customer understanding
- Customer impact
- Cost of advanced metering and billing

- Shadow Billing
- First year “guarantee”
- Start with large customers

Cost Shifting

- Urban vs. Suburban vs. Rural
- Multi-family vs. Single Family
- Overhead vs. Underground

And now…

- Non-solar vs. Solar

TOU Rates and Low-Income

- Low-income customers have smaller dwelling sizes, lower than average users
  - Less likely to have major peak-focused loads like central air conditioning
- More likely to have electric water heat, which can be controlled.
- Most (NOT ALL) low-income customers will benefit from TOU rates.

Smart Rate Design for DERs: Residential

- TOU Rates: Arizona Public Service Time Advantage Plan

Winter (November-April)	$/kWh
on-peak kWh	$0.19847
off-peak kWh	$0.06116
Summer (May-October)	
on-peak kWh	$0.24477
off-peak kWh	$0.06118

Smart Rate Design for DERs: Small Commercial

TOU rates

Burbank Water and Power		
Fixed Charge		$ 10.03
Energy Charges		
Nights and Weekends		$ 0.130
Mid-Peak		$ 0.163
Summer 4 - 7 PM		**$ 0.260**

Smart Rate Design for DERs: Large General Service

Sacramento Municipal Utility District				
Fixed Charge	$/month	$ 106.85		
Demand Charges		Summer		Winter
Distribution Capacity	**$/kW**	**$ 2.82**		**$ 2.82**
2PM - 8 PM Surcharge	$/kW	$ 6.91		$ -
Energy Charges				
Super-Peak 2 - 8 PM	$/kWh	$ 0.1929		n/a
On-Peak	$/kWh	$ 0.1328		$ 0.1017
Off-Peak	$/kWh	$ 0.1022		$ 0.0806

Rate design should make the choices the customer makes to minimize their **own bill**

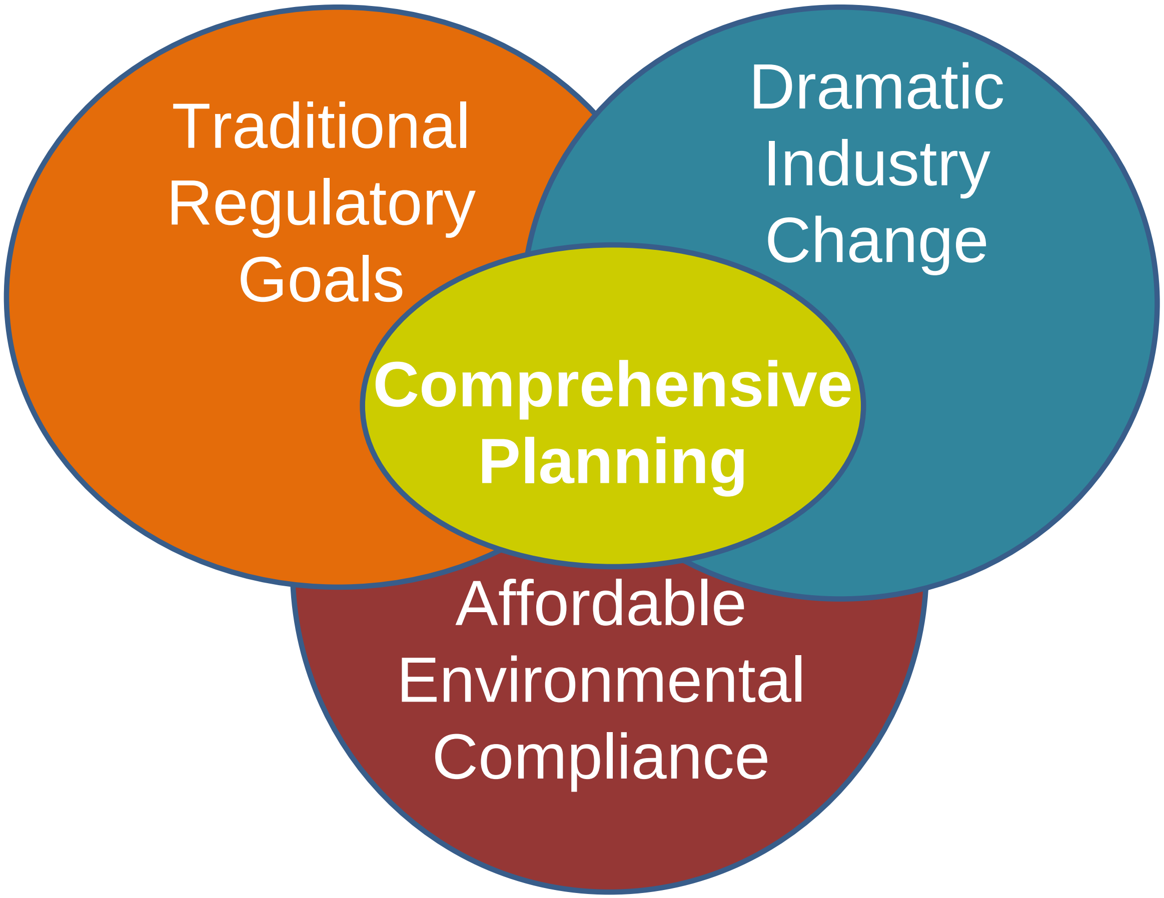
consistent with the choices they would make to minimize **system costs**

Implications for Implementation

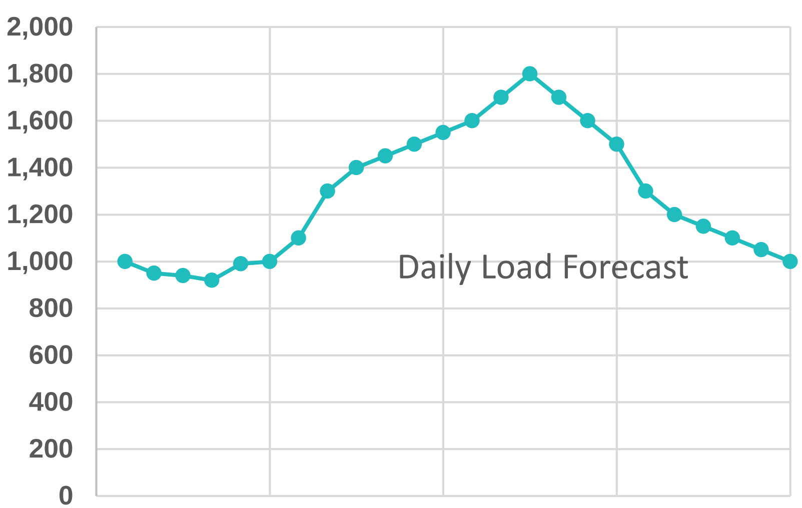
- Are there changes to current tariff structures and rate designs that would make the power system more responsive to technology capabilities, customer preferences, and state goals?
- What options for customers to pay for electric service better align customer choices to system benefits?

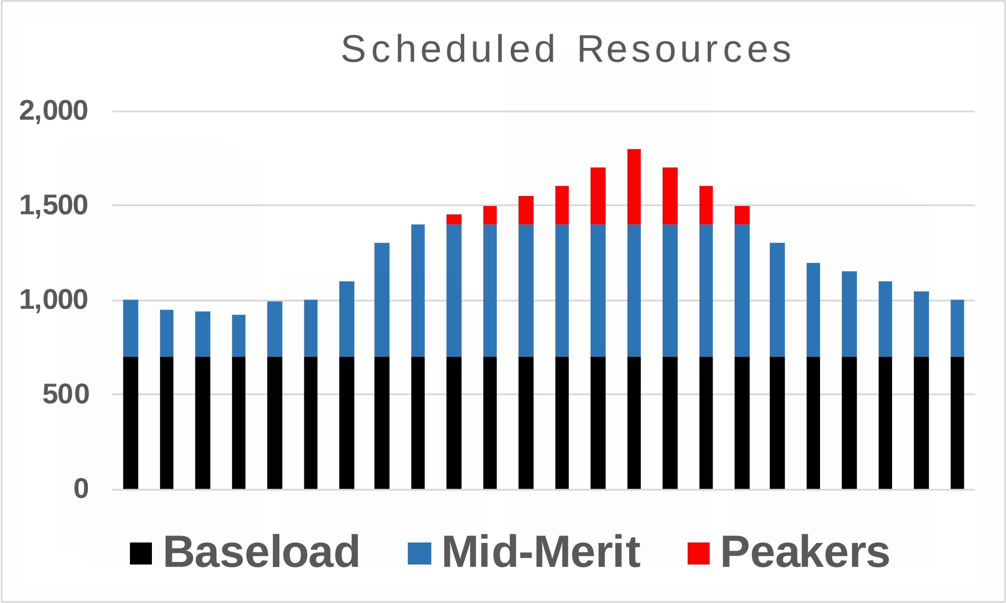
Effective planning creates a context where decentralized energy optimization choices can be consistent with grid-optimized outcomes.

Today's Regulatory/Utility Challenge



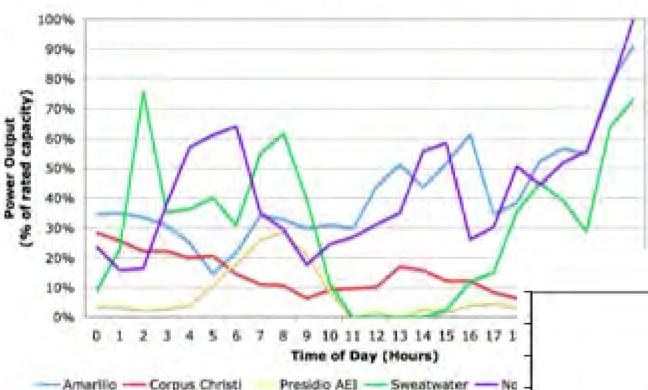
The Past: Forecasting Load and Scheduling Generation

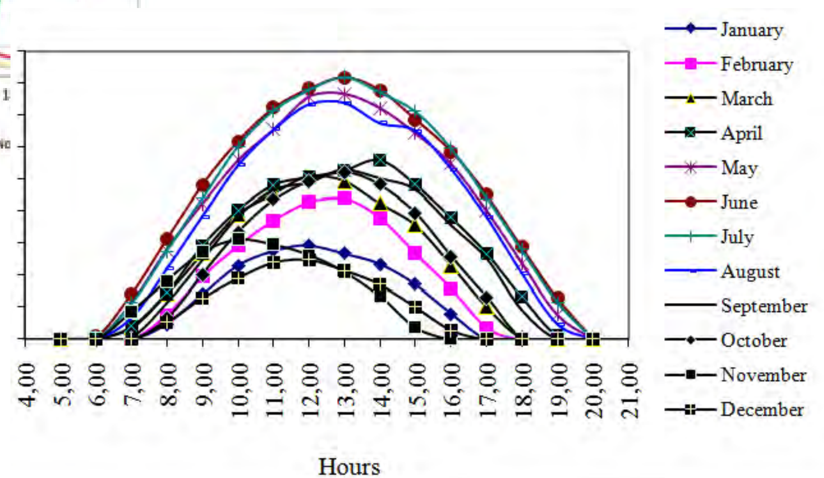




The Future: Forecasting Generation, and Scheduling Load

Figure 3. Daily Variation in Power Output (5 sites in Texas, January 1, 2004)





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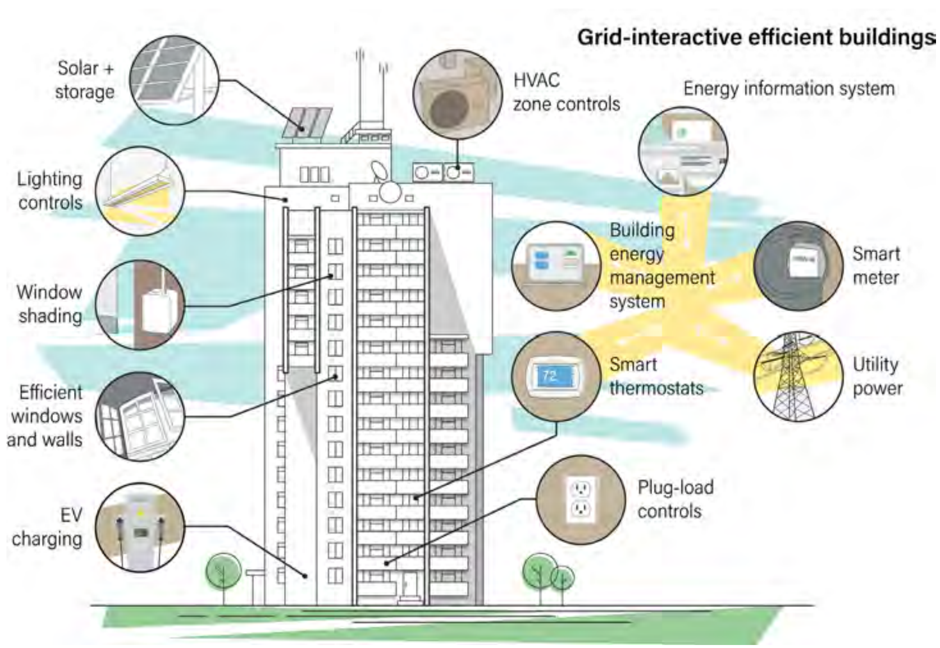
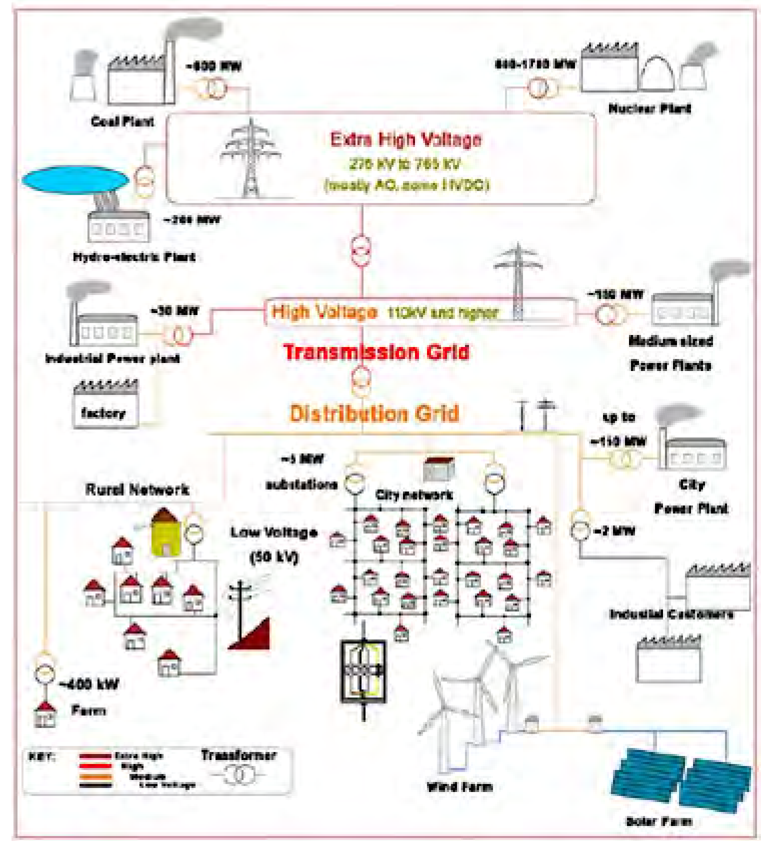
Planning enables optimization of new resources and operations



Source: ACEEE



Source: National Renewable Energy Laboratory

Planning Overview

Numerous Planning Processes

- Distribution System Planning (DSP)
- Integrated Resource Planning (IRP)
- (Procurement?)
- Transmission Planning

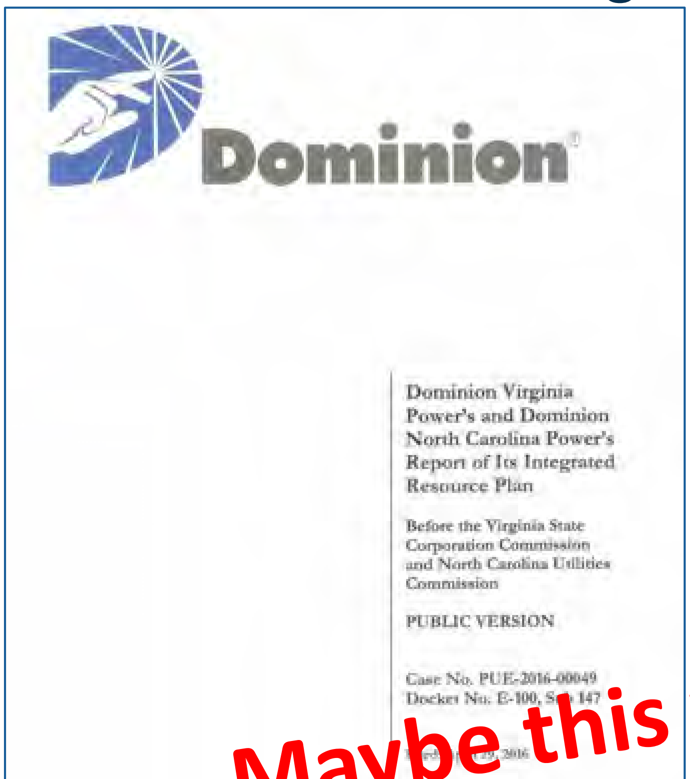
1

Distribution System Planning

Integrating distribution system planning

Regulators and Stakeholders View of Utility Planning

Resource Planning



Dominion

Dominion Virginia Power's and Dominion North Carolina Power's Report of Its Integrated Resource Plan

Before the Virginia State Corporation Commission and North Carolina Utilities Commission

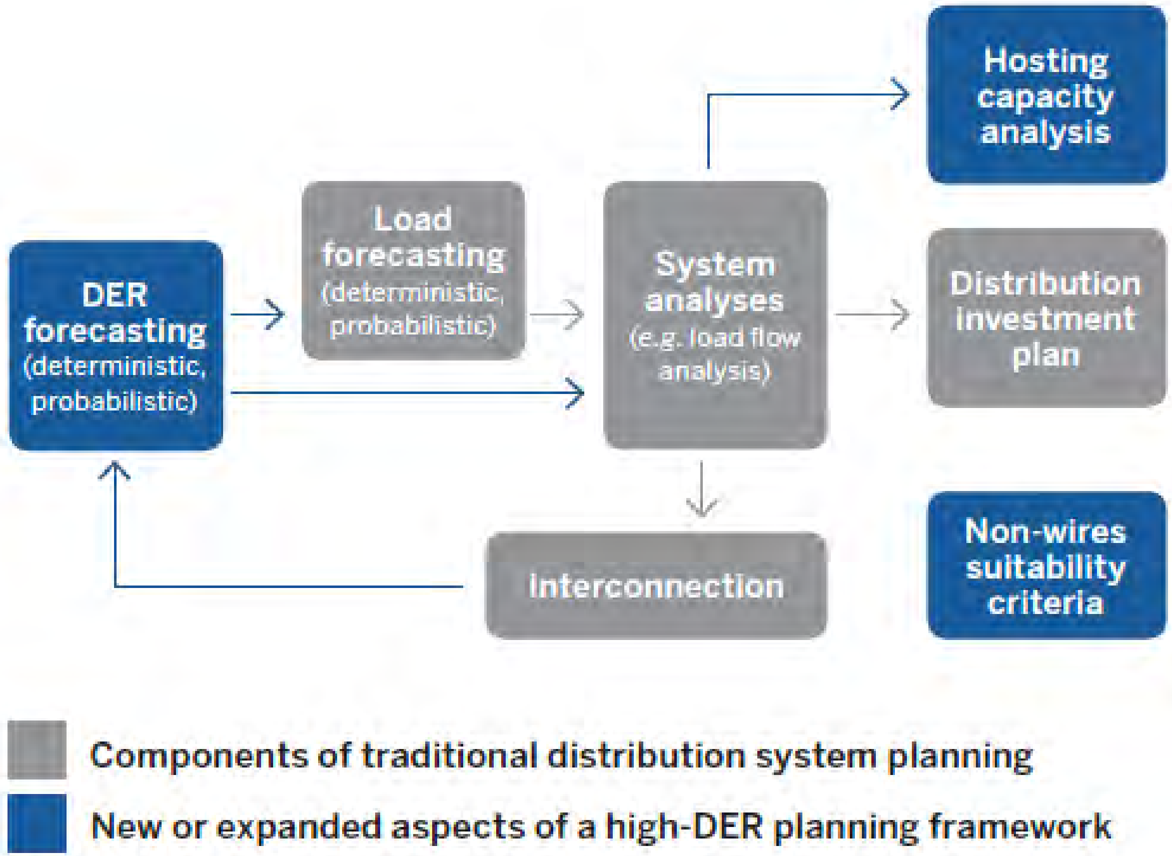
PUBLIC VERSION

Case No. PUE-2016-00049
Docket No. E-100, Sub 147

Distribution Planning

Maybe this worked fine in the past…

Distribution system planning is changing



Source: Joint Utilities. (2016). Supplemental Distributed System Implementation Plan.

What’s changing?

Just a few of the big challenges ahead for utilities and regulators:

1. Need to replace aging infrastructure
2. Cost-effectiveness and growing deployment of distributed energy resources (DERs)
3. Greater emphasis on reliability given increased impacts of outages on customers
4. Need for resilience at distribution system level

What’s changing?

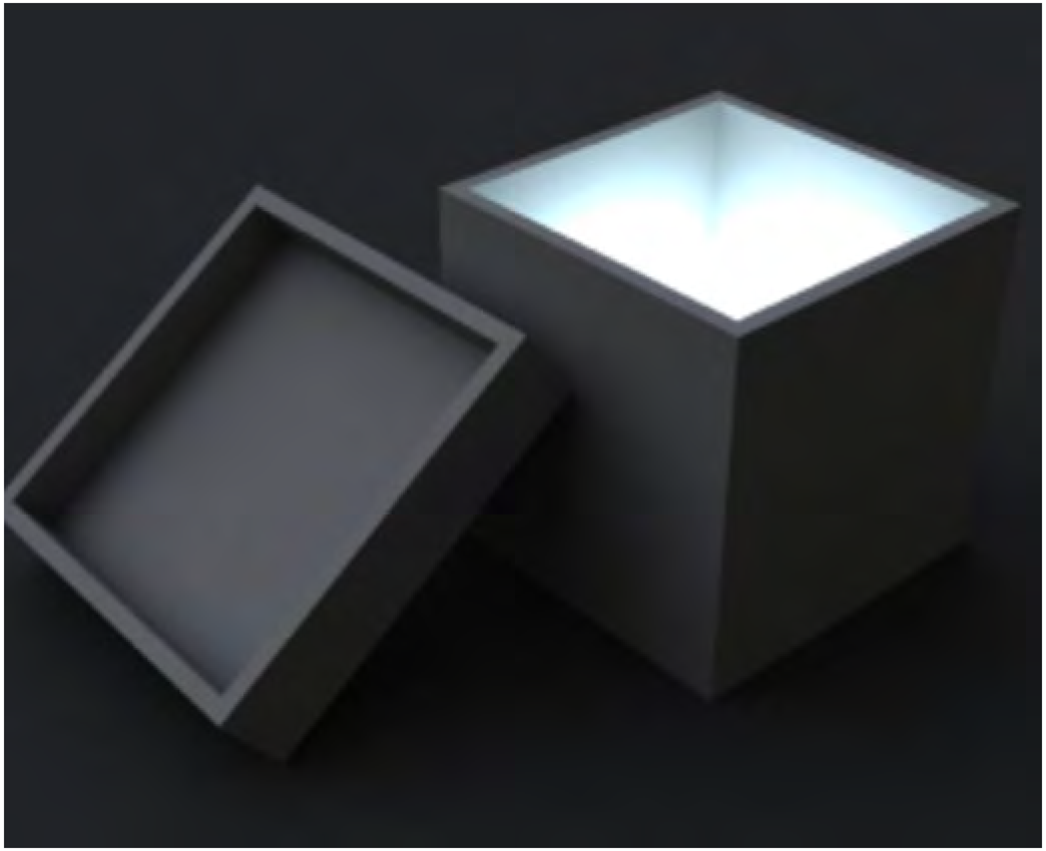
Just a few of the big challenges ahead for utilities and regulators:

5. Incorporation of new utility scale technology:
    - automated metering infrastructure (AMI)
6. Need to accommodate two-way power flows on distribution systems that were originally designed for one-way flows
7. Increased stakeholder interest in distribution planning and utility distribution investments

Why do distribution system planning (DSP) or integrated distribution planning (IDP)

1. Minimize T&D costs/protect customers?
2. Better inform IRP?
3. Address growing uncertainties about impacts of new technologies, variable loads, and variable generation?
4. Enable customer choices and adoption of clean resources?
5. Plan for the future/modernize the grid? Better understand utility grid modernization proposals?
6. All of the above? Other reasons?

In short, regulators are realizing they need visibility into the black box



Elements of Successful DSP/IDP

- Advanced forecasting and system modeling
- Hosting Capacity Analysis
- Disclosure of Grid Needs and Locational Value
- Identification of New Solutions
- Meaningful Stakeholder Engagement

Source: Integrated Distribution Planning: A Path Forward, GridLab

ConEd’s Brooklyn-Queens Demand Management Project

- $1 billion traditional solution avoided with a $200 million approved investment
- $70 million spent through 2017, $95 million in net benefits
- Customer and utility side demand reductions
- Incentives for ConEd to achieve demand reductions

2 Integrated Resource Planning

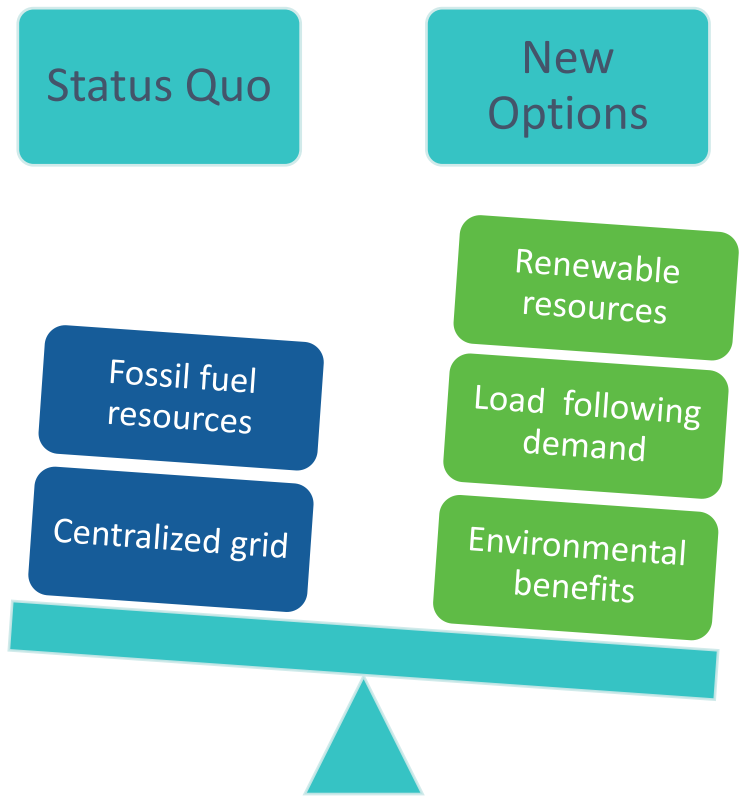
Energy Transition and Optimization through Planning

Integrated Resource Planning (IRP) :

A public planning process and framework within which the costs and benefits of both demand and supply-side resources are evaluated to develop the least total-cost mix of utility resource options. Also known as least-cost planning.

Integrated Resource Planning = Clean Slate

Balance the status quo with new options

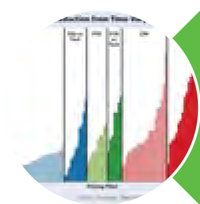


Power Sector Transformation: Regulatory Opportunities

Enabling more choices for “prosumers” - energy efficiency, dynamic pricing, distributed generation, demand response

Enabling new technologies and services to connect the customer to the grid in an exchange of benefits

Preparing the distribution system for new customer choices and to optimize grid benefits



Providing appropriate price signals to consumers that match rates with system costs

Providing incentives to utilities to align their interests with the public interest

Energy Resource Decisions are About Benefits, Costs, and System Risks

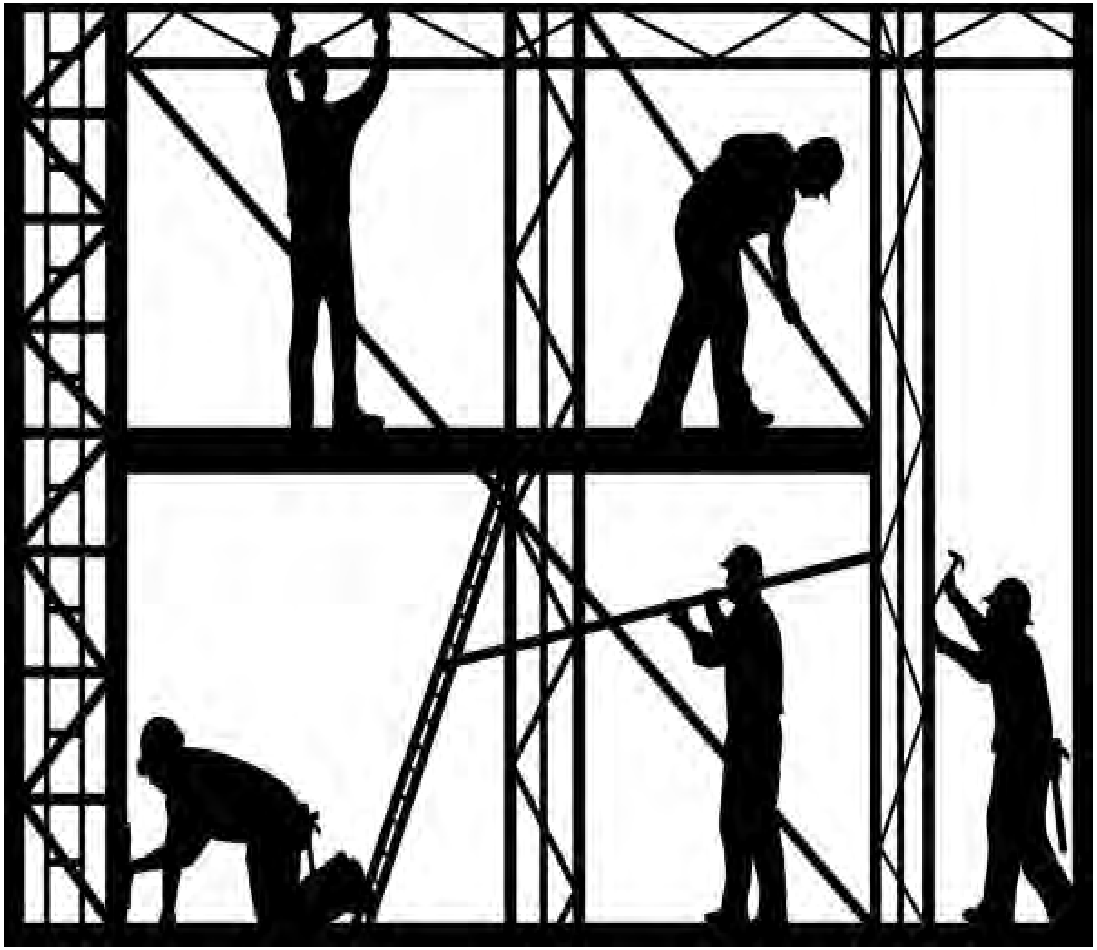
There are varied risks to consider in system resiliency and reliability:

- Ability to serve peak load
- Ability to serve load (peak and otherwise) due to nonperformance of generation or transmission
- Failure of generation or transmission due to extreme weather or malicious acts

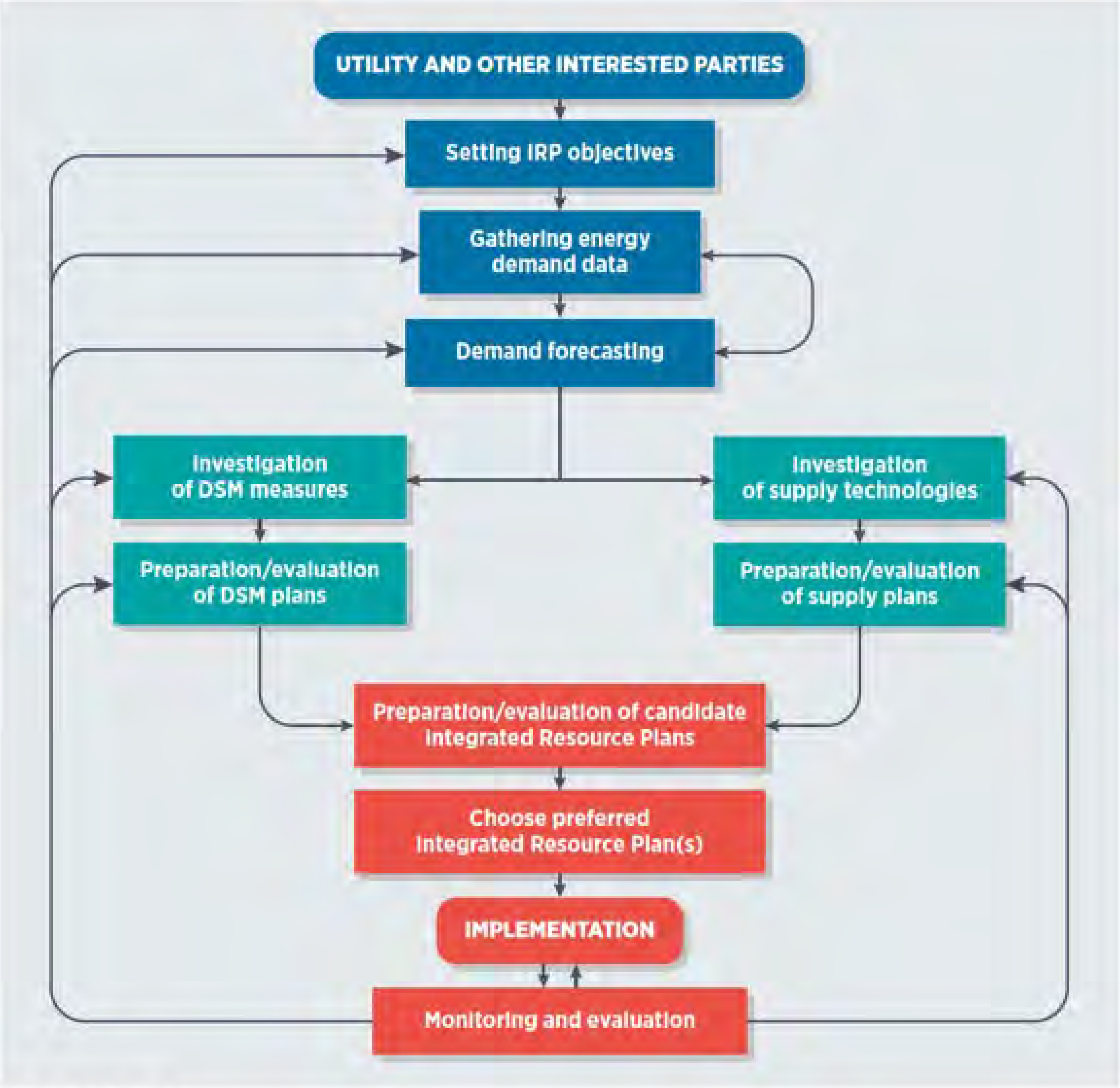
Options for Consideration in Meeting Forecasted Energy Needs

- Energy Efficiency
- Demand Response
- Distributed Energy Resources
- Transmission/distribution system upgrades
- Renewable Energy
- Power plant upgrade to extend useful life
- Storage
- Construction of new capacity

Integrated Resource Planning – Structure



Integrated Resource Plan Process



Source: Tellus (2002)

DSM = demand-side management

Energy Freedom Act: Integrated Resource Plan Requirements

a) Long-term forecast of sales and peak demand

b) Generation proposed, including fuel costs

c) Projected energy purchased

d) Transmission investments planned

e) Several resource portfolios

f) Data regarding current portfolio

g) Plans for meeting current and future capacity needs

h) An analysis of the cost and reliability impacts

i) A forecast of the utility's peak demand, and reduction efforts

Aspects of IRP –

What do we need to know in order to plan?

Load Forecast

Fuel-Cost Forecast

Cost-Effectiveness Analysis

Existing Resources

New Generation Resources

New Transmission Resources

New Distribution Resources

New Energy Efficiency Resources

New Demand Response Resources

New Technologies

NOW--With all that Information? You Integrate *Supply and Demand*

Large utility IRPs include significant computer modeling for ***portfolio optimization***

Integrating *Supply and Demand*

- Risk models account for unknowables, such as economic conditions, fuel costs, and weather
- Hundreds of resources may be examined for cost and load shape

Who’s involved?
Public Involvement

- Utility customers know things the utility does not know…and that its consultants do not know.
- Public involvement <u>early</u> in development of an IRP yields many benefits:
  - New ideas
  - Sense of what customers want
  - Sense of their willingness to sacrifice
  - Rankings of priorities: cost, environment, equity, and reliability

Public Involvement

- Public review of RFP responses before selection of contractors to conduct IRP
- Kick-off meeting
  - Immediately followed by stakeholder meetings
- Written input early enough to influence **what** is examined, and **how** it's examined
- Stakeholder advisory group?
- Ability to review drafts before they solidify
- Public meetings **prior** to adoption of a plan, strategy, or policies

Does the IRP articulate a short-term action plan? (2–5 years)

Perhaps the most important element of an IRP:

- What existing resources will we retire?
- What new resources can we use?
- What energy efficiency and demand response programs will we launch?
- What will we ask customers to do differently?
- What options will we study for the next cycle?
- How will we measure our success?

Resource Procurement

- CCNs
- Competitive Procurement
- Acceptance, Approval, Presumptions

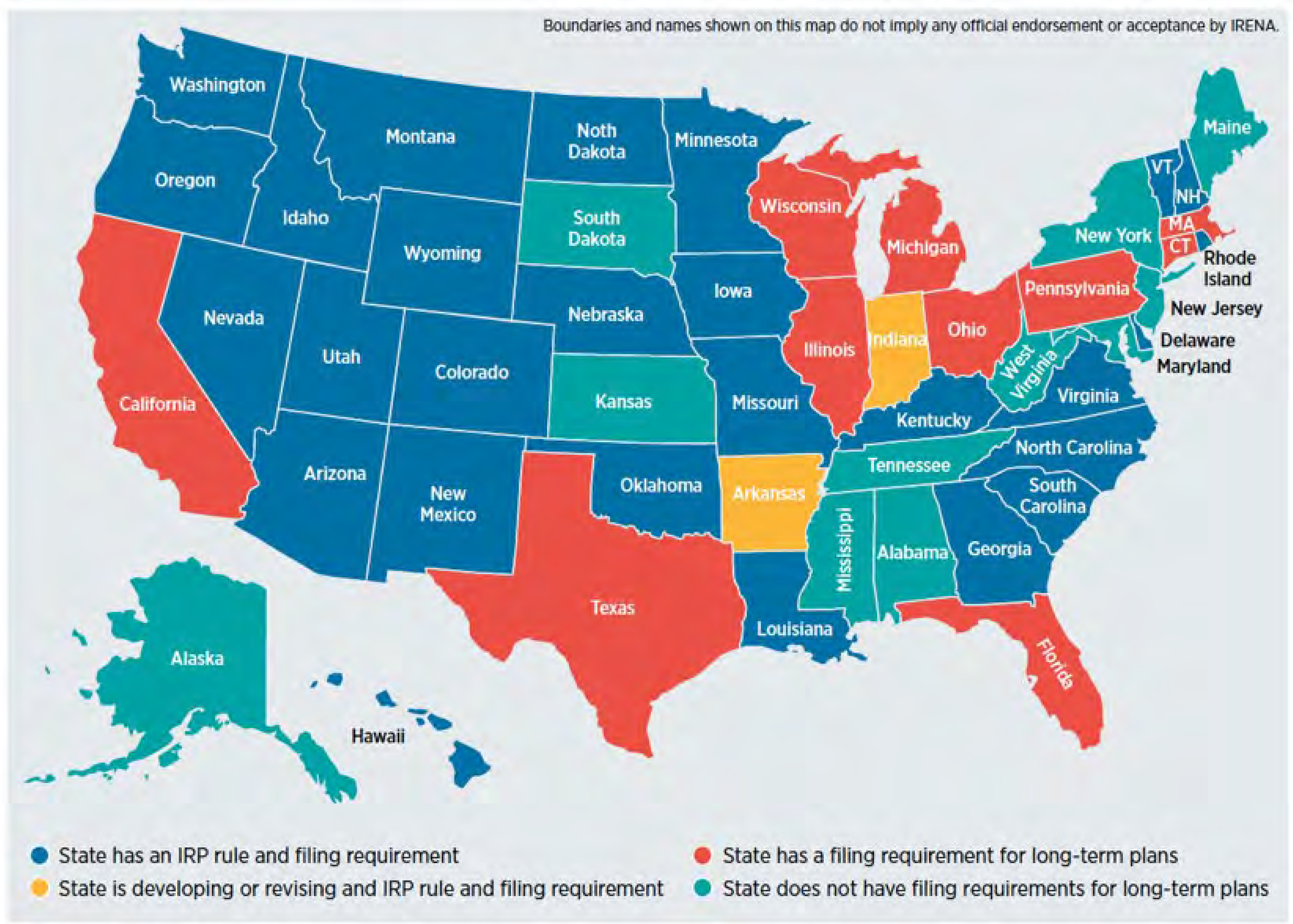
Remember

- Resource choices are not made simply on basis of costs (or prices); *lower-cost* resource is not always the *most valuable* resource
- How do we *determine the value* to us?
- *Resource planning* is the *public process* by which resource options are aggregated and compared to meet demand for service to produce highest value for lowest cost

2 Examples

Best practices

States with IRP or Similar Processes



Source: Wilson and Biewald (2013)

Overarching Principles

- Clear guiding objectives
- Consideration of all resources
- Use of best available data
- Public and stakeholder participation
- Focus on the outcomes, not just the plan

Source: IRENA, Insight on Planning for Power System Regulators

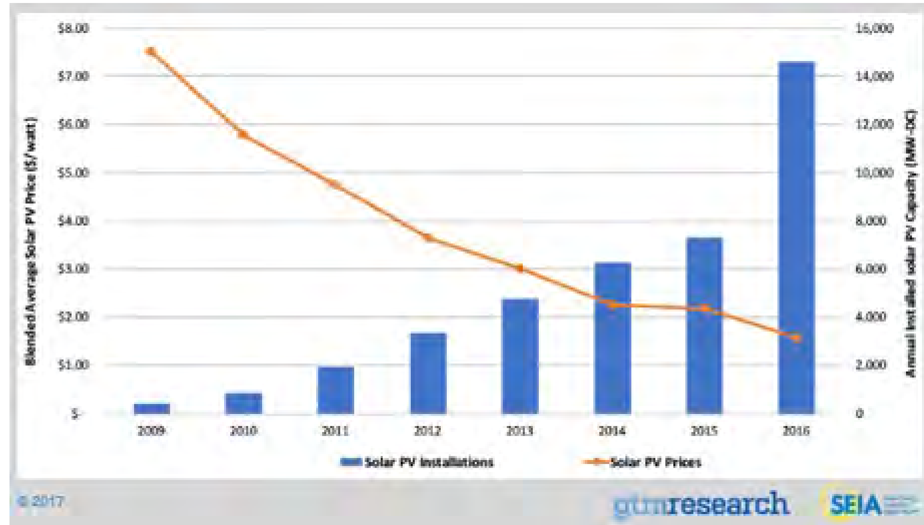
Clear Guiding Objectives

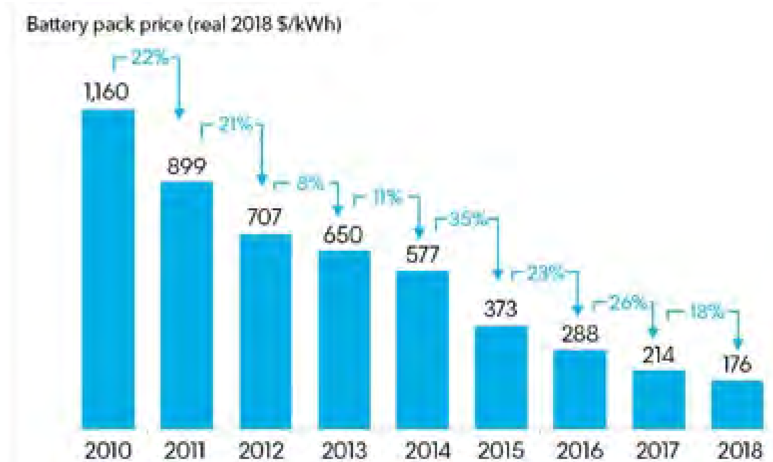
- Minimizing Cost
- Reliability
- Environmental goals
- Carbon reductions
- Competitive Procurement

Consideration of all resources

- Demand-side and supply-side resources
- Distributed generation
- Storage
- Attributes of different resources: ancillary services such as fast-ramping, frequency regulation, voltage control

Use of best available data





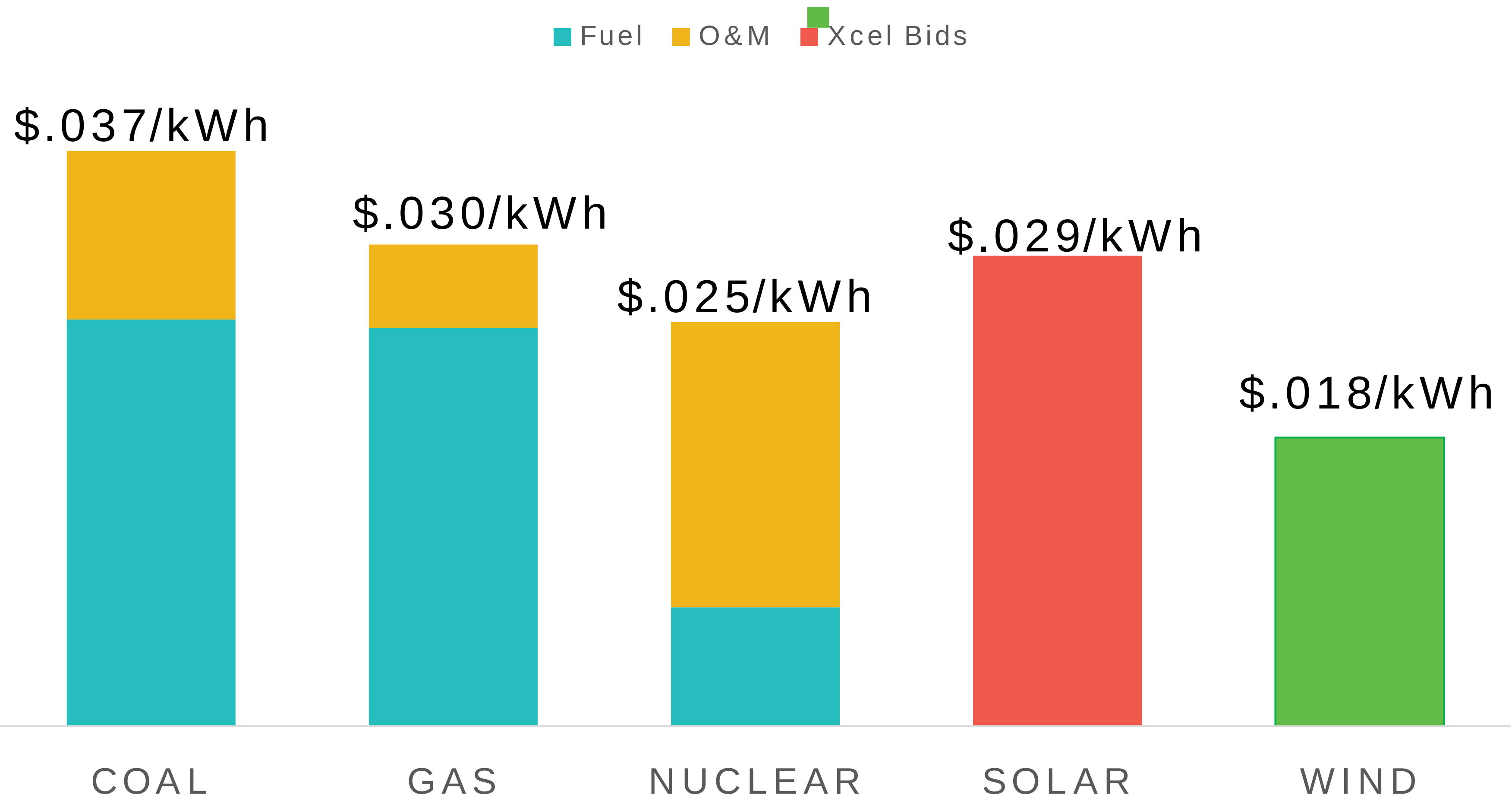
Public and Stakeholder Participation

- NW Power and Conservation Council: Significant stakeholder involvement in planning; expert advisory groups; and public outreach in all states
- Vermont: ratepayer-funded public advocate to provide technical expertise
- Arizona: regulator recommends that utility form a group of customers, IPPs, stakeholders
- NM: public meetings, presentations, but unfunded

Competitive Procurement

- Colorado Electric Resource Planning (ERP)
- Procurement follows planning process

Existing Plants vs. Xcel Colorado Bids



Existing Plant Average Fuel and O&M from USEIA Table 8.4 Electric Power Annual 2016

Achieving outcomes

- Achieving objectives
- Reducing investment risk
- Public involvement/acceptance of plan
- Support for infrastructure investments

Implications for Implementation

- How could a robust stakeholder process contribute to the development of utility IRPs? (e.g. assumptions, data, and scenario development)
- What information does the Commission need to consider portfolios of new versus existing resources to serve customers?
- What are the conditions that would indicate that the Commission should consider the integration of distribution system planning into other planning processes?

For More Information

- Best Practices in Electric Utility Integrated Resource Planning Examples of State Regulations and Recent Utility Plans, Rachel Wilson and Bruce Biewald, 2013
- The Treatment of Energy Efficiency in Integrated Resource Plans: A Review of Six State Practices," Dave Lamont and John Gerhard, 2013
- Preparing for EPA Regulations: Working to Ensure Reliable and Affordable Environmental Compliance, Dave Farnsworth, 2011
- Electricity Regulation in the US: Second Edition, Jim Lazar, 2016
- Insights on Planning for Power System Regulators, International Renewable Energy Agency (IRENA), 2018