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Helping Utilities Make Smart Solar Decisions

The Treatment of Solar in Utility Resource Planning

7 November 2013

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Logistics

- Recording & slides will be sent to all registered attendees and available on the Resource Library within 2 business days.
- Submit questions in the chat window at any time.
- Questions will be answered at the end of the webinar.

Upcoming SEPA Events

November 14th – Special Webinar

How to Get the Most out of Your SEPA Membership

November 21st – Special Webinar

Tools for Streamlining Interconnection

April 29th – 30th Utility Solar Conference in Newport Beach, California

Call for Speakers is Open! (deadline 5 Dec.)

Registration is Now Open! (early-bird ends 31 Dec.)

www.utilitysolarconference.com

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Speakers

Karlynn Cory
Senior Energy Analyst
NREL

John Sterling
Director, Utility Programs
& Planning, SEPA

Mike Taylor
Director of Research
SEPA
Moderator

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Who is SEPA?

SEPA is an educational non-profit (501 c3)

Researching and disseminating unbiased information and solutions to 1000 members & the public focused on utility-solar nexus

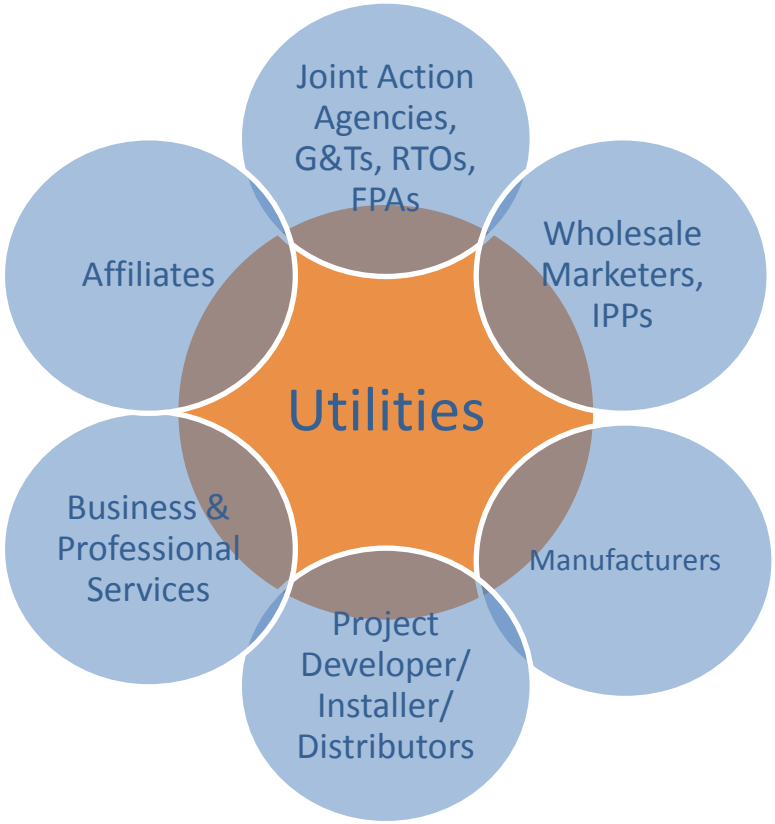
Membership

430+ Utility

460+ solar industry & stakeholder

52% of electricity customers

+90% of installed solar capacity



SEPA Mission

SEPA’s unique mission is aimed at utility issues …

…delivered through tailored education, publications, best practices, & consultation

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Who is NREL?

NREL's Mission: Only National Laboratory Dedicated Solely to Energy Efficiency and Renewable Energy

Energy Efficiency	Renewable Energy	Systems Integration	Market Focus
Residential Buildings	Solar	Grid Infrastructure	Private Industry
Commercial Buildings	Wind and Water	Distributed Energy Interconnection	Federal Agencies
Personal and Commercial Vehicles	Biomass	Battery and Thermal Storage	Defense Dept.
	Hydrogen	Transportation	State/Local Govt.
	Geothermal		International

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WHY ARE WE HERE?

Treatment of Solar Generation in Electric Utility Resource Planning

- Understand utility solar supply planning methods, models and approaches
- Build awareness, capture challenges, and identify solutions for:
  - Approach to long-range resource planning
  - Methods and tools for conducting resource planning
  - How solar is considered in the resource planning process
- Method:
  - Interviews conducted with 13 entities, including 9 utilities
  - Questionnaire covering 28 utilities in 22 states
- Report issued on October 31, 2013
  - http://www.nrel.gov/docs/fy14osti/60047.pdf

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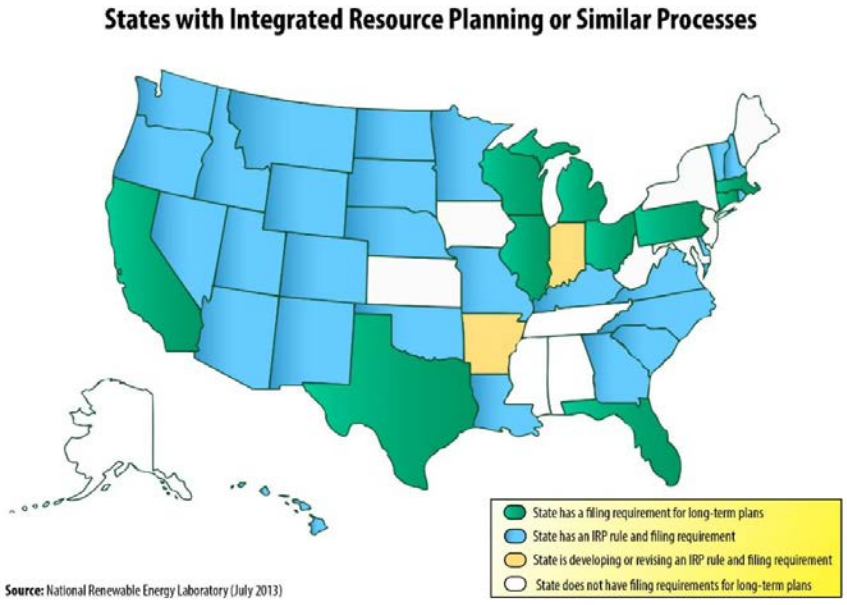
UTILITY SUPPLY PLANNING CRASH COURSE

Integrated Resource Planning



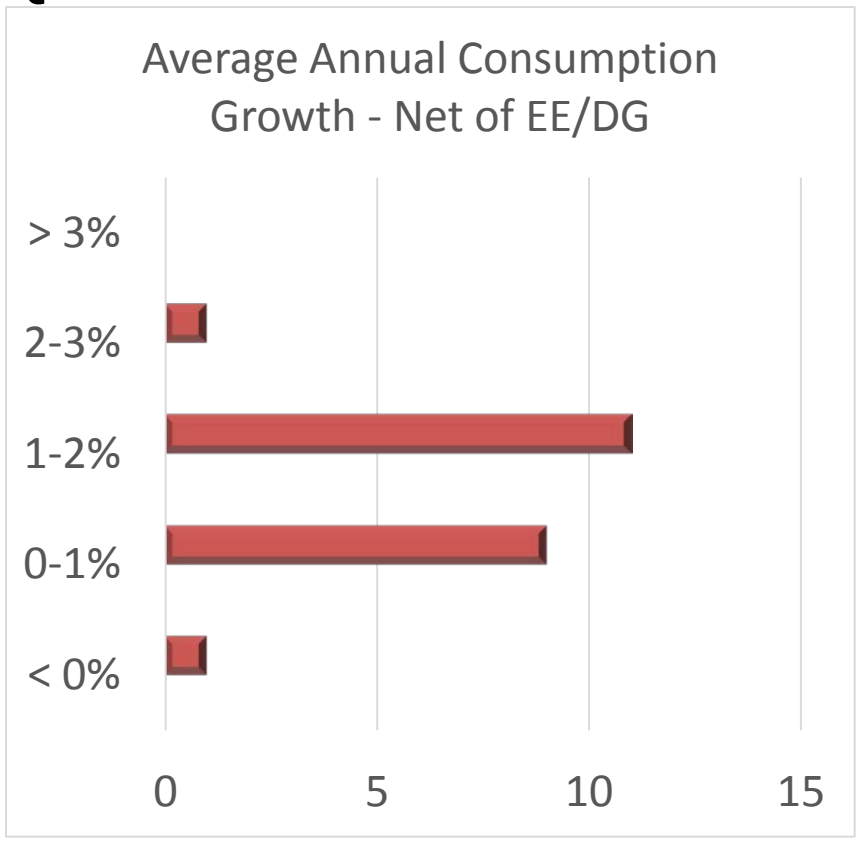
- Resource Planning balances supply-side and demand-side resources over a long-term window to meet anticipated future load requirements (plus reserves)

Load Growth

EIA Data

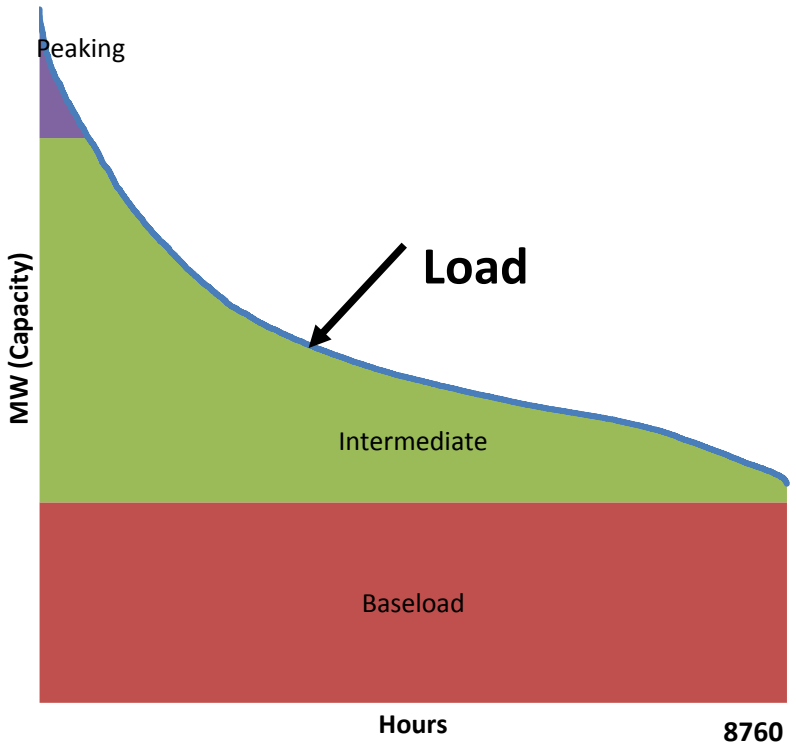
Time Period	Average Annual Load Growth
1981 – 2005	2.3%
2006 – 2012	0.23%
2013 – 2040 (est.)	0.78%

Utility Planning Assumptions – Questionnaire Results



Resource Options & Availability

Load Duration Curve



Resource Considerations

- Existing Assets
  - Planned life
  - Repair or replace
- Contracts
  - End dates
  - Extension options
- EE/DR/DG
  - Customer adoption rates
- New Resources
  - Needs identification

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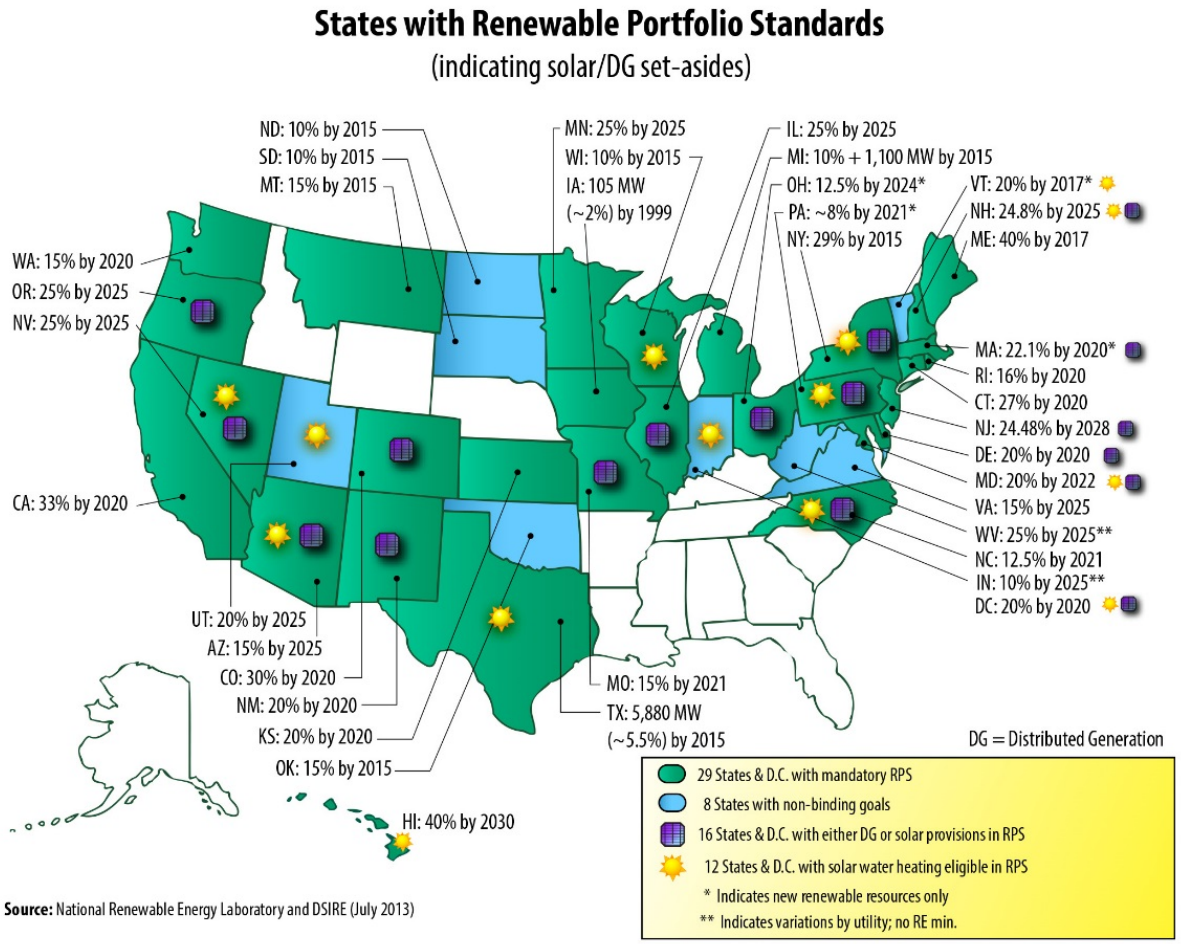
States with RPS



How Utilities Conduct Long-Term Planning

Capacity Expansion Planning

Capacity Expansion Plans

- Creation of a series of future resource plans, often using software tools
- Utility takes an array of assumptions on their generation fleet, growth, fuel costs, etc
- Optimize future resource additions based on lowest potential revenue requirements

Potential Capacity Expansion Constraint Criteria

- Limiting the number of specific resources that can be added in a given window
- Setting a minimum level of capacity or energy from a specific resource type
- Restricting certain resources from being selected
- Requiring a specific resource to be built at a certain point in time
- Forcing a plant retirement prior to the end of its book life

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Resource Characteristics

Plant Statistics

- Nameplate MW
- Summer/Winter Net Dependable Capacity
- Capacity Value (RE only)
- Construction Time
- Useful Life

Plant Operating Characteristics

- Capacity Factor
- Heat Rate (combustion only)
- Water Use
- Emissions
- Ramp rate, minimum load, start times
- Planned/Unplanned Outages

Plant Economics

- Capital Cost ($/kW)
- Incentives (e.g.tax credits, MACRS, state incentives)
- Variable O&M ($/MWh)
- Fixed O&M ($/kW-yr)
- Integration Costs

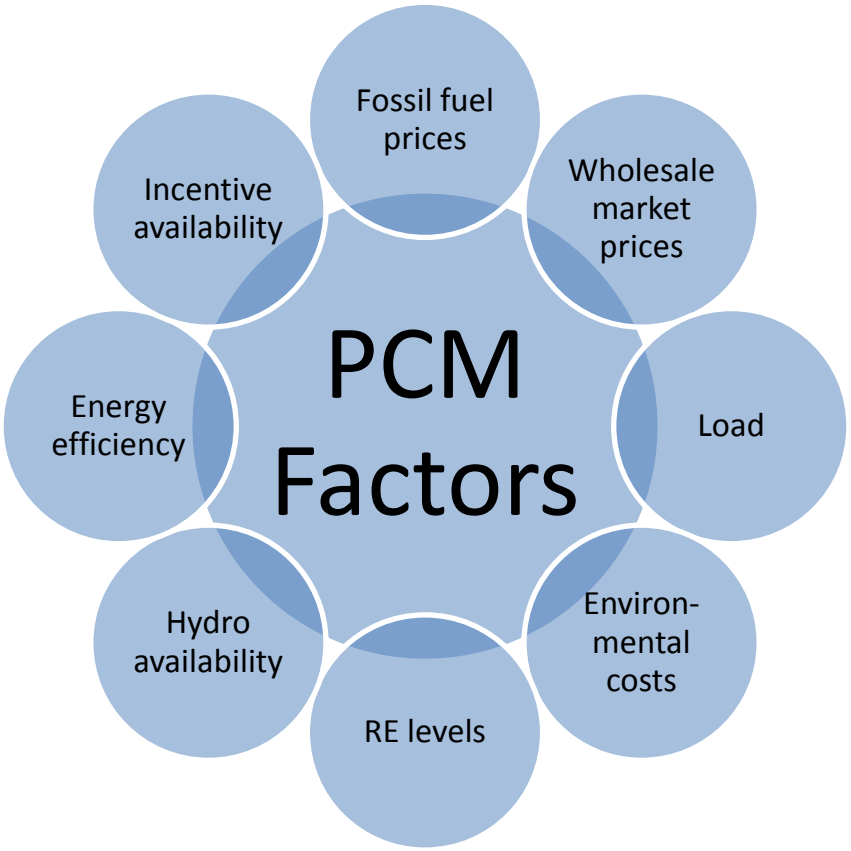
Capacity Expansion Modeling Example Results

Portfolio A	• Gas-heavy
Portfolio B	• Exceeds compliance of RPS
Portfolio C	• Contemplates new nuclear capacity

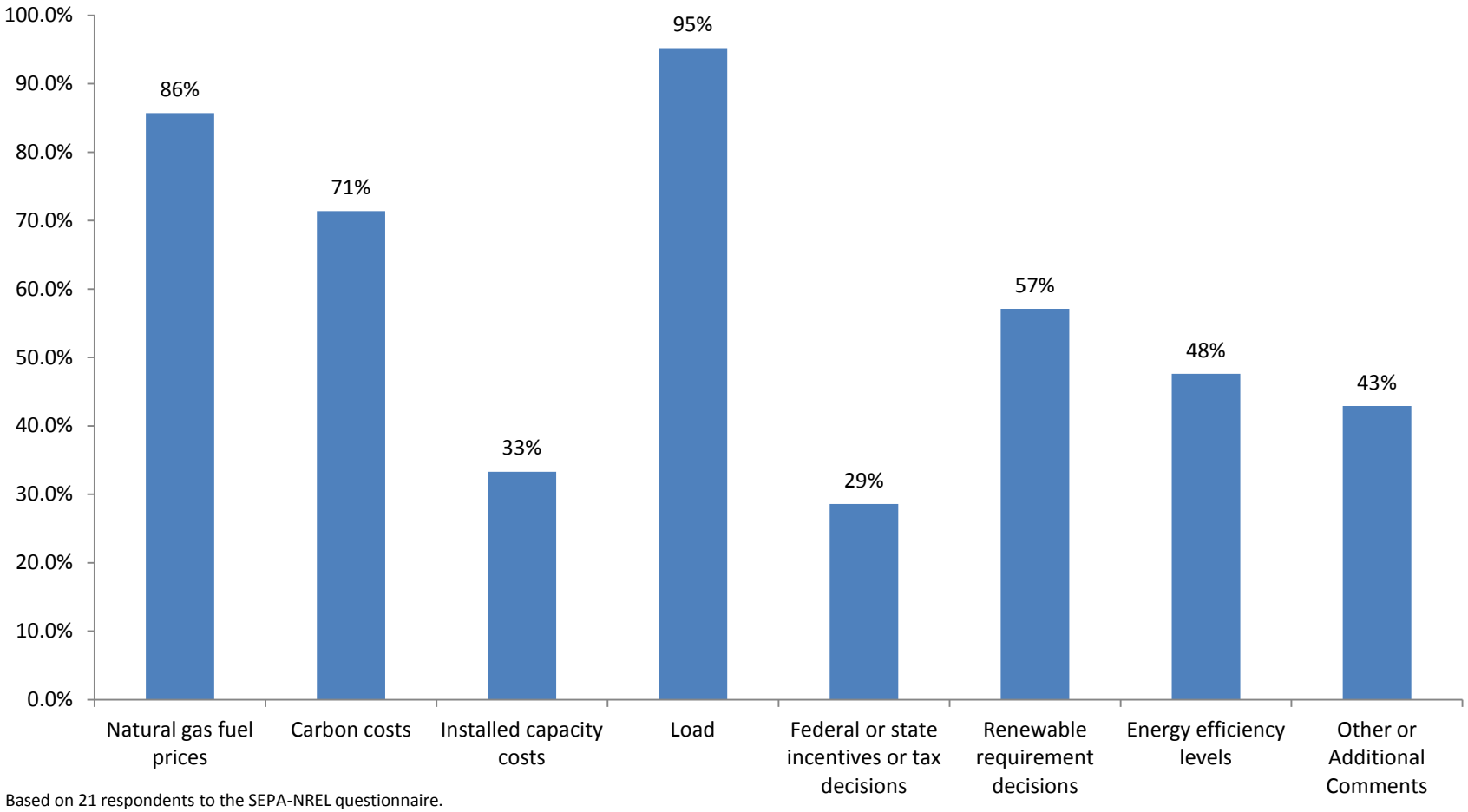
How Utilities Conduct Long-Term Planning

Production Cost Modeling

- Production cost models take the set of future plans created in the Capacity Expansion process and runs them through an hourly dispatch model across the planning horizon (15+ years)
  - Can identify fuel mix, gas burn, emissions, and cost information
- Utilities often run sensitivity analytics around key variables, where future values are uncertain
- The goal here is to identify portfolios that are more robust against upward risk



Commonly Stressed Variables



Based on 21 respondents to the SEPA-NREL questionnaire.

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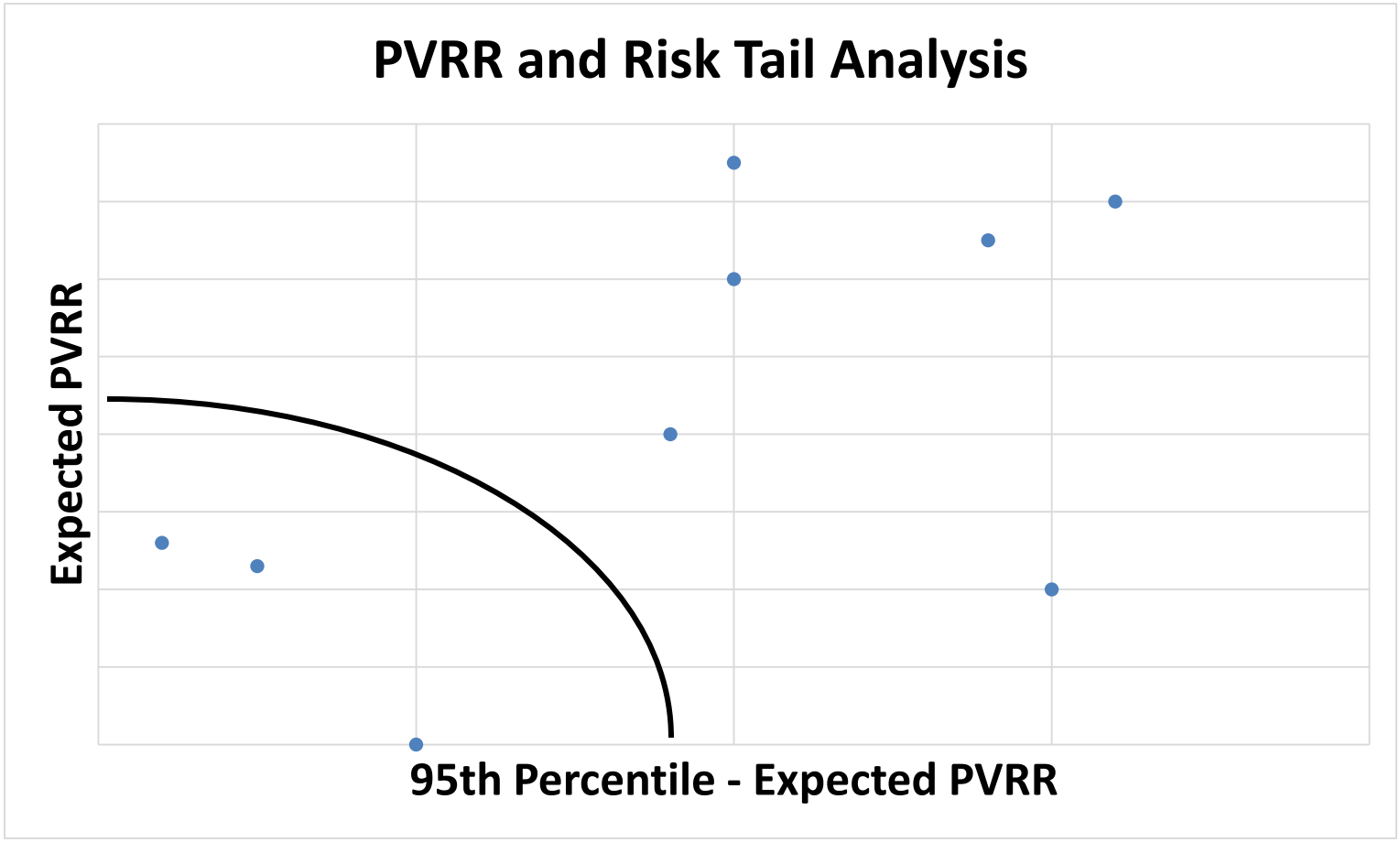
Risk Analytics



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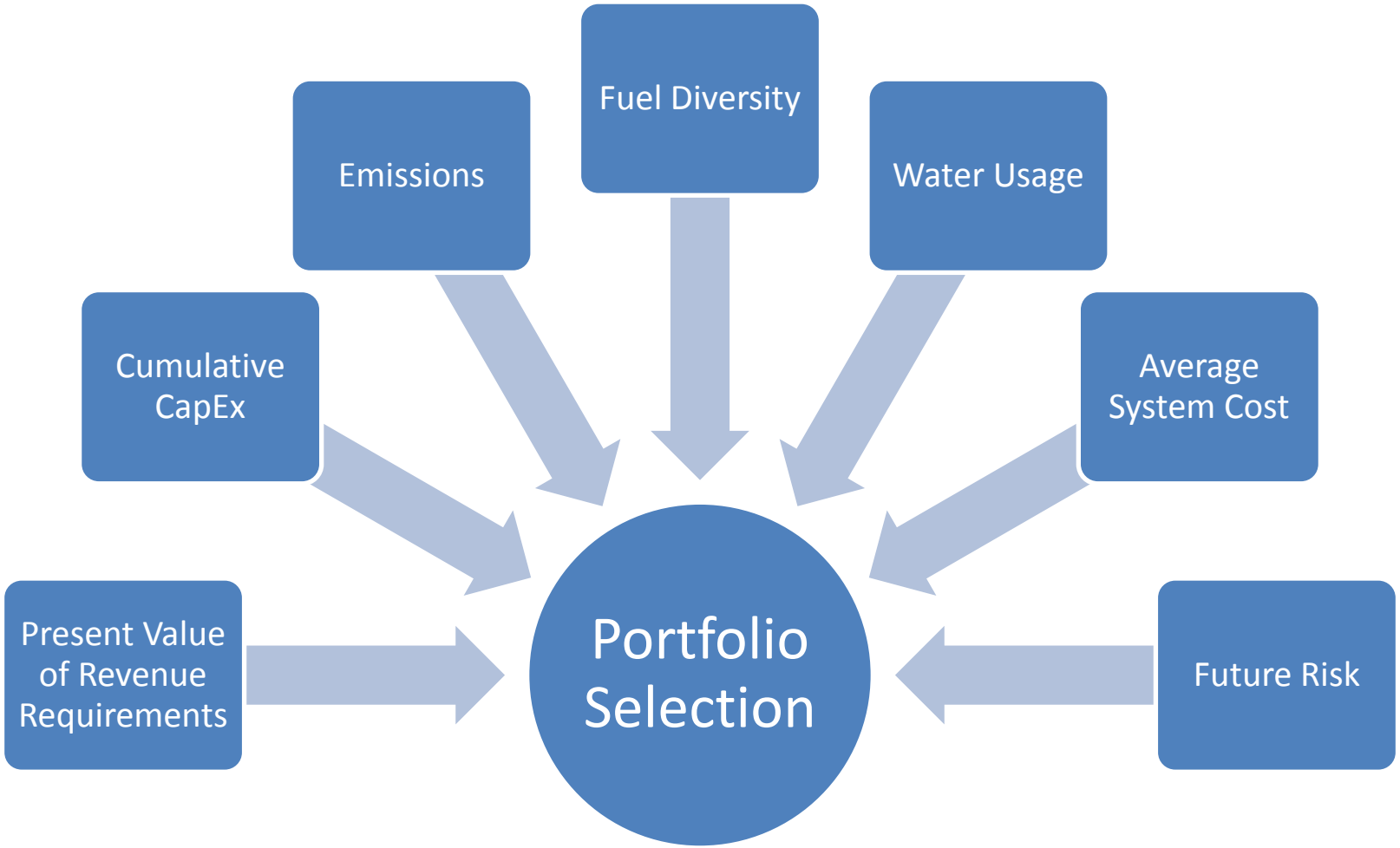
Production Cost Modeling

Key Metrics



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What do utilities think about solar energy today?

Utility Perspectives on Solar

Benefits of Solar

- Meet renewable standard requirements
- Fuel diversification
- Cost stability
- Geographic dispersal benefits and incrementality
- Partial correlation to peak demand
- Environmental compliance risk mitigation
- Avoid line losses (DG only)

Challenges of Solar

- Integration and variable output
- Economics
- Lack of current capacity need
- Cross-subsidization
- Ramping issues
- Reduced capacity benefit over time with increasing penetration

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CONSIDERATIONS FOR IMPROVED INTEGRATION OF SOLAR INTO RESOURCE PLANNING ANALYTICS

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Where are there gaps between utility practices and solar incorporation?

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Top Considerations

1. Estimate solar capacity value
2. DG treatment in planning
3. Incorporate solar cost and performance
4. Modify how solar is analyzed in existing planning tools

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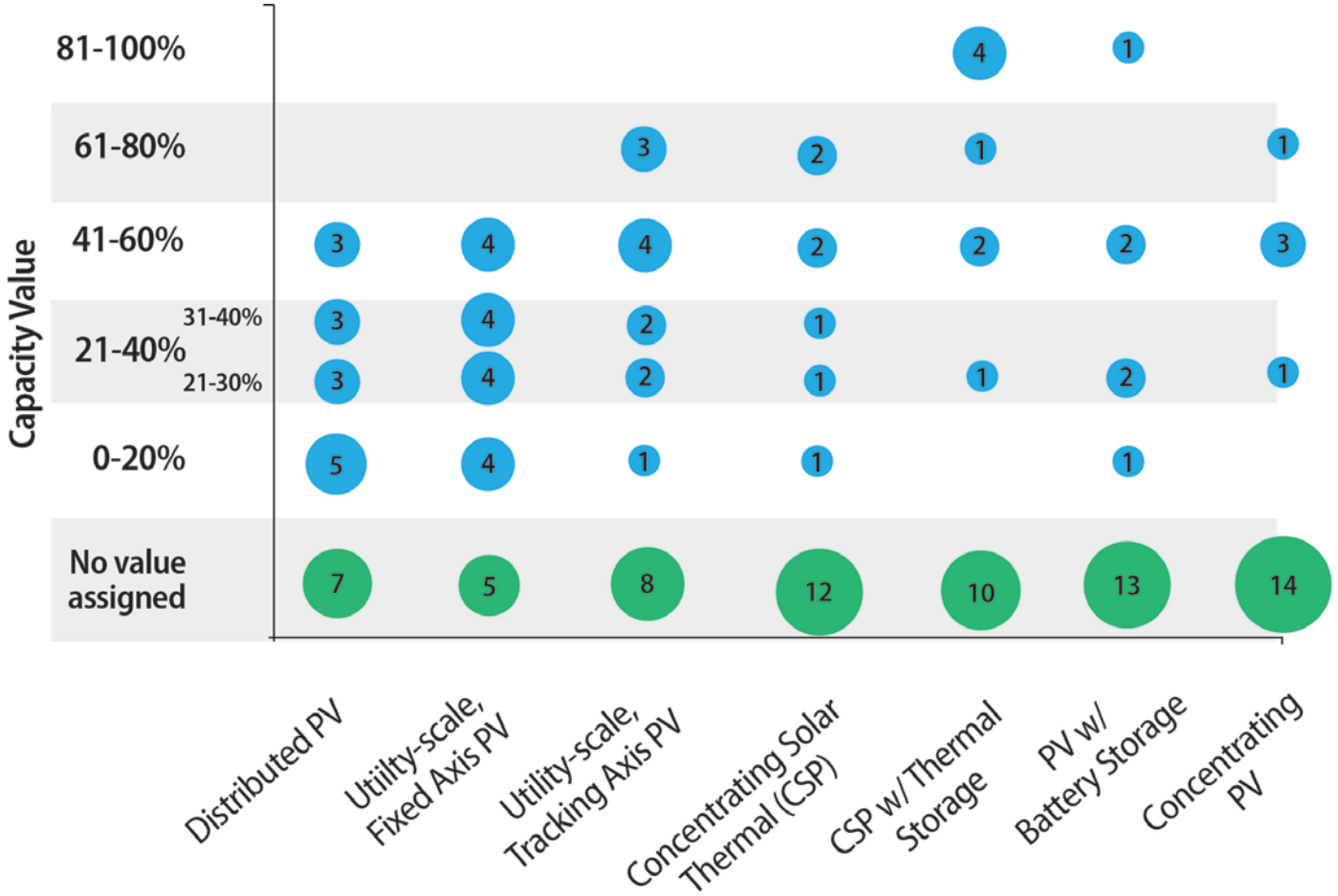
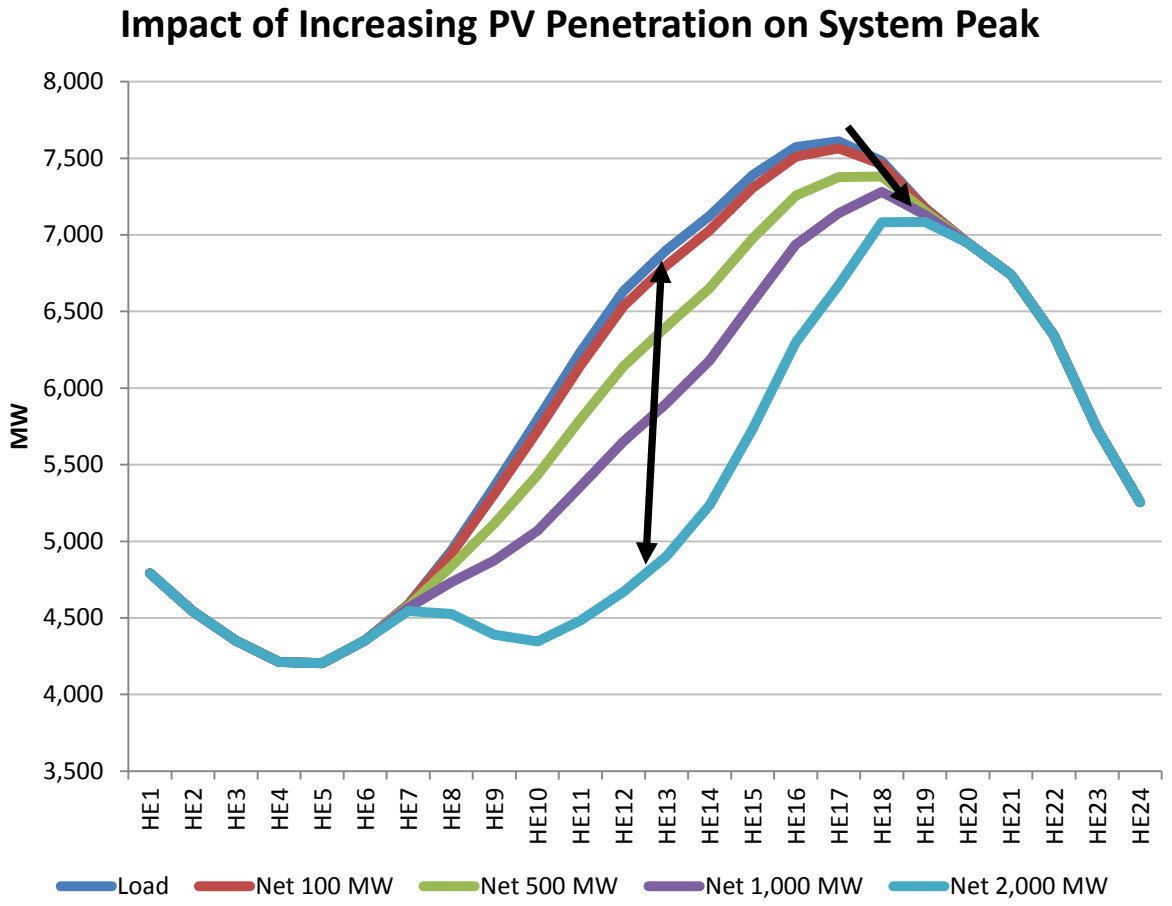
Solar Capacity Value

Utility Treatment Today



Note: Numbers in circles represent the number of utility responses to the SEPA-NREL questionnaire.

Capacity Value Changes Based on Penetration



Key Points

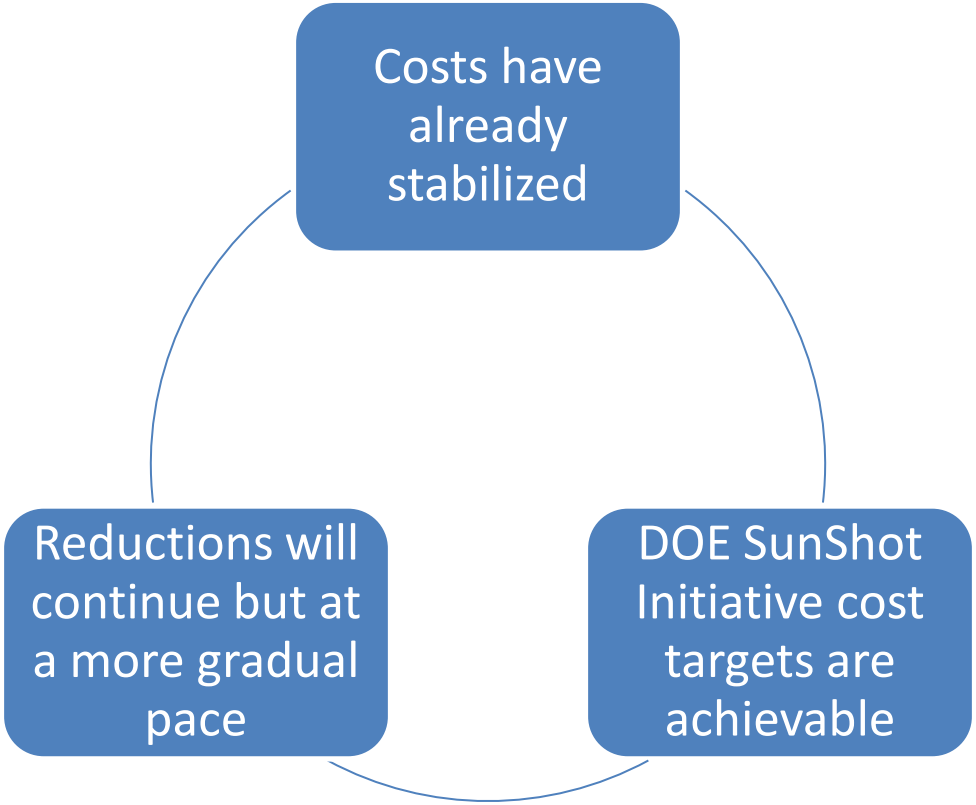
- Capacity Value is location-, technology-, and utility-specific
  - No "one size fits all" value that can be applied
  - Utilities should perform their own analysis for different technology types and locations
- Capacity Value is not static
  - The more solar that gets added to the system, the lower that incremental solar's Capacity Value will be – unless storage is available

Distributed Generation

- Virtually all utilities treat distributed PV as a net load reduction
  - Simple, and at low penetration levels an appropriate approach
- Utilities could consider treated DG as a resource
  - Could allow the utility to optimize the level of DG included in their resource plan
  - Can allow for sensitivity analytics around the solar price curve

Solar Costs

Opinions we have heard on where solar costs are going



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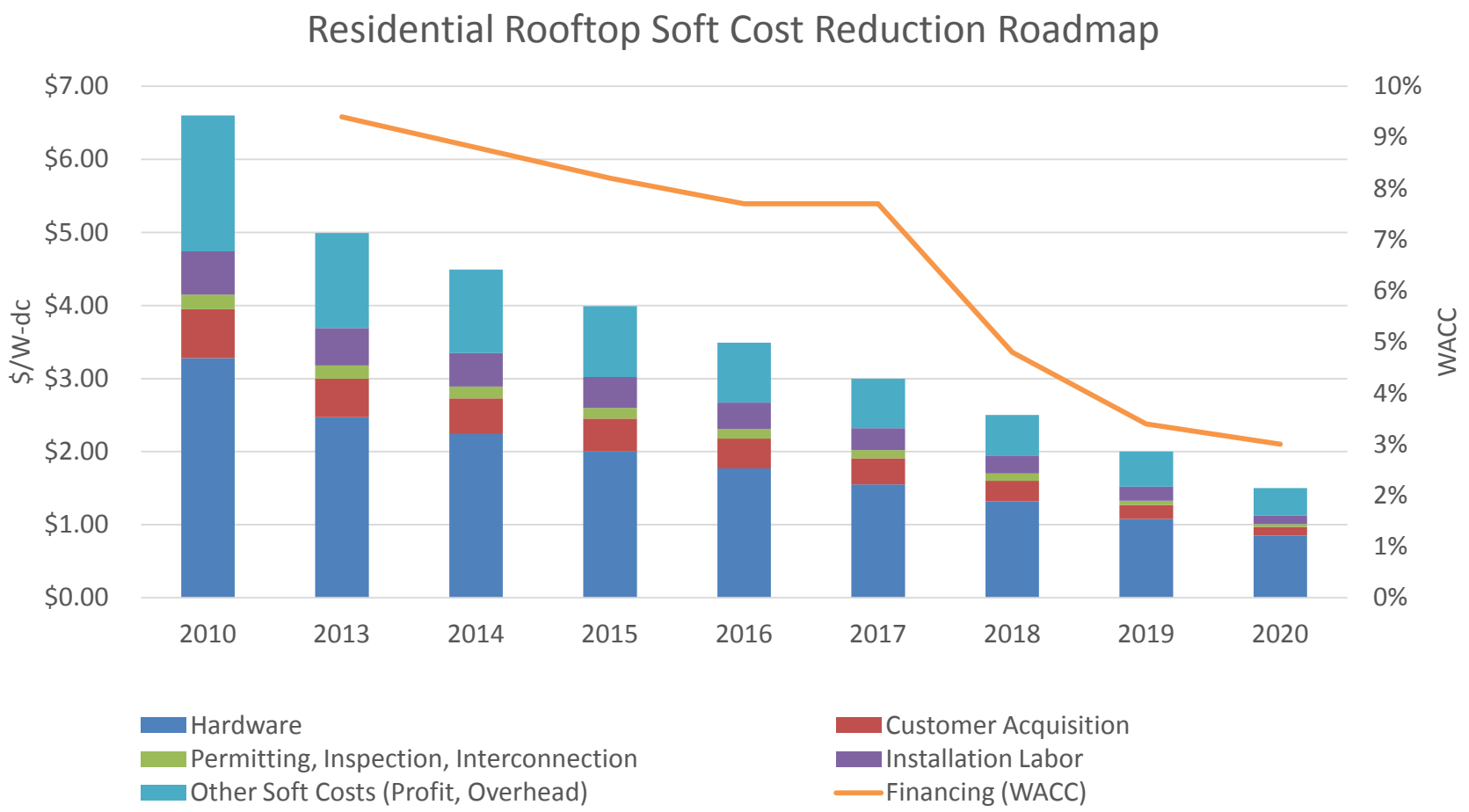
Cost Declines Key Focus of DOE



Non-Hardware ("Soft") Cost-Reduction Roadmap for Residential and Small Commercial Solar Photovoltaics, 2013-2020 (NREL/RMI Report, Aug 2013)

Solar Cost Data

- NREL's Transparent Cost Database –utility scale data http://en.openei.org/wiki/Transparent_Cost_Database
- NREL's Energy Technology Cost and Performance Data for Distributed Generation http://www.nrel.gov/analysis/tech_cost_data.html
- NREL's Open PV Project, which captures voluntary historical cost and performance data https://openpv.nrel.gov/
- LBNL's *Tracking the Sun* report http://emp.lbl.gov/sites/all/files/LBNL-5919e-REPORT.pdf

Regularly Updated

- U.S. Department of Energy November Technical Report: *PV Pricing Trends: Historical, Recent, and Near-Term Projections* http://www.nrel.gov/docs/fy13osti/56776.pdf
- U.S. Department of Energy November Technical Report: *Benchmarking Non-Hardware Balance of System (Soft) Costs for U.S. Photovoltaic Systems Using a Data-Driven Analysis from PV Installer Survey Results* http://www.nrel.gov/docs/fy13osti/56806.pdf
- *Western Wind and Solar Integration Study - Phase 2* (integration costs) http://www.nrel.gov/electricity/transmission/western_wind.html

Snapshots In Time

Solar Cost Models

Analysis Tools

- NREL's System Advisor Model - advanced tool for estimating levelized cost of energy (LCOE) http://sam.nrel.gov/
- NREL's Cost of Renewable Energy Spreadsheet Tool - simplified spreadsheet tool for estimating levelized cost of energy (LCOE) https://financere.nrel.gov/finance/content/crest-cost-energy-models
- NREL's PVWatts - tool for modeling production profiles of solar resources at different geographic locations http://www.nrel.gov/rredc/pvwatts/about.html

Modifying Planning Analytics

- Analyze solar on an aggregate and geographically disperse basis
- Enhanced risk/uncertainty analysis methods and/or updated modeling software
  - Ex: ability to run sub-hourly dispatch sensitivities
- Linking supply planning to other utility planning, procurement, and operations procedures
- Solar – battery storage nexus

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TAKE AWAYS

Project Learnings

- Significant sophistication in modeling resources exists at all utilities
- Utilities universally see solar as providing:
  - Stable-priced energy
  - Fuel diversification
  - Risk mitigation for natural gas price volatility and potential future carbon costs
- General agreement that the future cost curve for solar will continue to decline, but at a flatter rate than was experienced over the last several years
- Certain utilities are much further along in their inclusion of solar than others
  - Primary drivers: cost efficacy of utility-scale generation and robustness of customer-sited PV adoption

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Areas of Focus for Solar Analytics

Profiles matter	• The more specific the 8760 profile is to a utility's system, the better • Ability to disperse solar over wide geographic areas requires a blending of profiles • Dynamic system size instead of fixed blocks can be used to fit needs more closely
Solar provides capacity value	• Utilities still analyzing the right approach to allocate capacity value to solar • Utility-, site-, and technology-specific values can differ
Technology and design flexibility drives cost-effectiveness	• Fixed vs. tracking • Orientation • Inverter clipping
Treatment of customer-sited solar	• Majority of utilities treat it as a net load today • Increased penetration and transition from NEM to other models (like Feed-in Tariffs or Value of Solar) may warrant treating as a resource
Intra-hour dynamics	• At low levels of penetration, not a concern • With increasing penetration, utilities may start looking at capacity expansion implications due to intermittency

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THANK YOU

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