Research related to Western U.S. resource planning and adequacy

Peter Larsen
Juan Pablo "JP" Carvallo

Electricity Advisory Committee
May 29, 2020

Background

- Berkeley Lab has conducted research and provided technical assistance to Western U.S. stakeholders on long-term electric utility resource adequacy and planning-related topics since the mid-1980s

RESOURCE PLANNING PORTAL

Western Interstate Energy Board

WECC

Energy Policy 66 (2014) 90–103
Contents lists available at ScienceDirect
Energy Policy
journal homepage: www.elsevier.com/locate/enpol

Survey of Western U.S. electric utility resource plans

Jordan Wilkerson[a,*], Peter Larsen[a,b], Galen Barbose[b]

Energy Policy 119 (2018) 410–422
Contents lists available at ScienceDirect
Energy Policy
journal homepage: www.elsevier.com/locate/enpol

Long term load forecasting accuracy in electric utility integrated resource planning

Juan Pablo Carvallo*, Peter H. Larsen, Alan H. Sanstad, Charles A. Goldman

Applied Energy 269 (2020) 115071
Contents lists available at ScienceDirect
Applied Energy
journal homepage: www.elsevier.com/locate/apenergy

The economic value of a centralized approach to distributed resource investment and operation

Juan Pablo Carvallo[a,*], Nan Zhang[b], Sean P. Murphy[a], Benjamin D. Leibowicz[b], Peter H. Larsen[a]

HIGHLIGHTS

- First whole-system comparison of centralized vs decentralized electricity planning.
- Coordinated planning could save between 7% and 37% of system costs over 15 years.
- Decentralized decision-making leads to suboptimal adoption of rooftop solar.
- Inefficiencies solved by setting rates close to the hourly locational marginal cost.

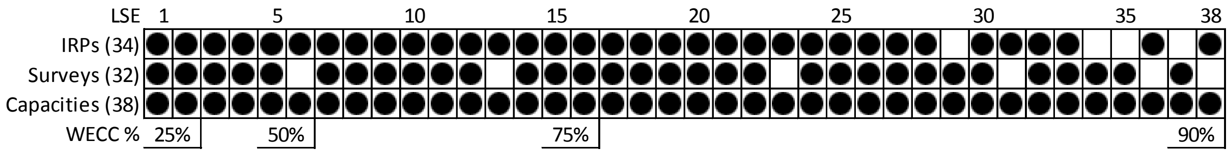
https://doi.org/10.1016/j.apenergy.2020.115071
Received 8 November 2019; Received in revised form 17 April 2020; Accepted 19 April 2020

Overarching research questions

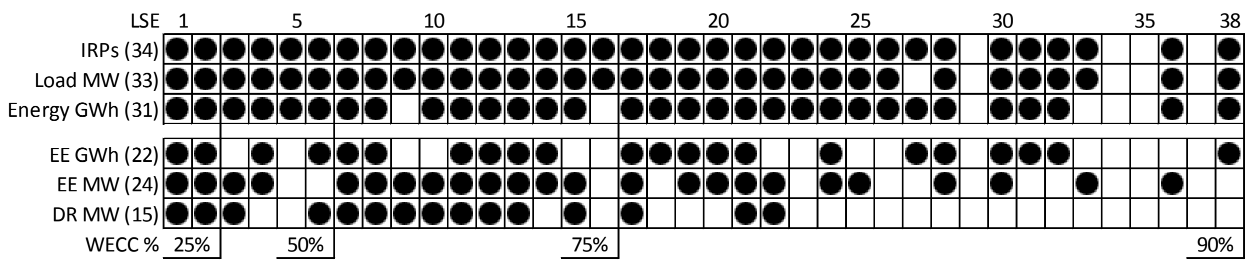
1. How are long-term planning assumptions reported and disseminated?
2. How do long-term planning assumptions compare to actual outcomes?
3. How much are electric utilities relying on the market to supply future resources?
4. What is the value of integrated planning and centralized coordination of distributed energy resources?
5. How might utility planning need to change to integrate with regional resource adequacy assessments?

How are planning assumptions reported and disseminated?

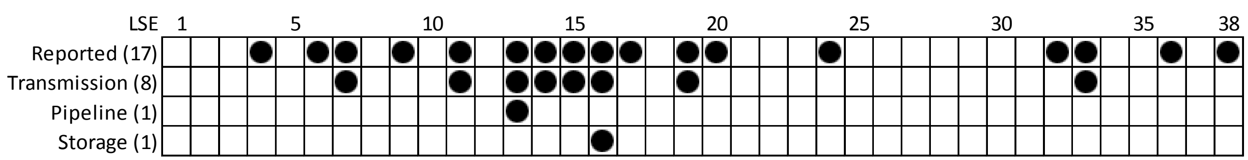
LSEs with publicly-released IRPs, responded to follow-up survey, and reported supply-side capacity information



Load, energy, and DSM forecast data availability

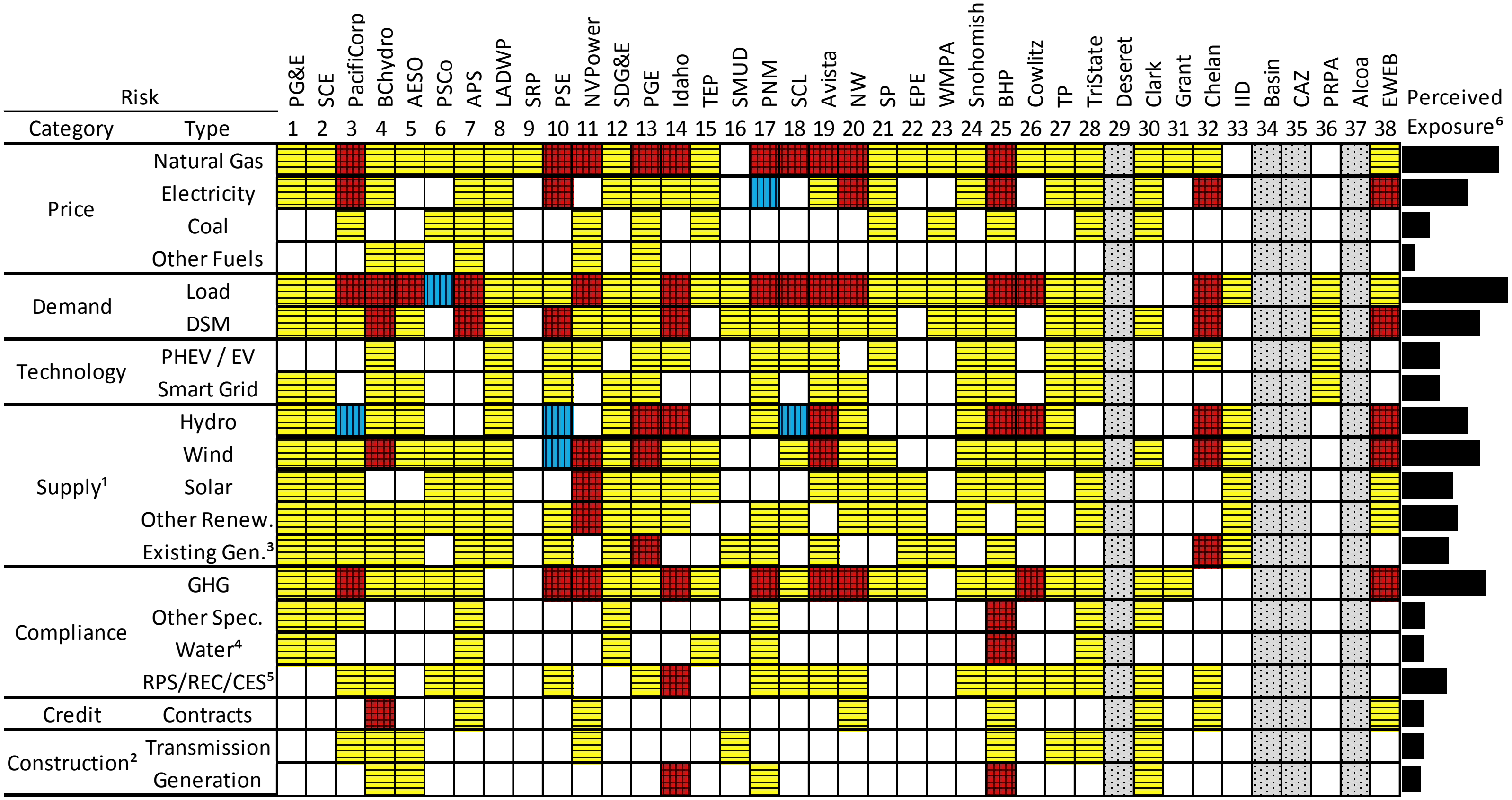


Transmission interconnections, fuel pipelines, and energy storage data availability



How are planning assumptions reported and disseminated?

Reported methods to assess uncertainty by risk category

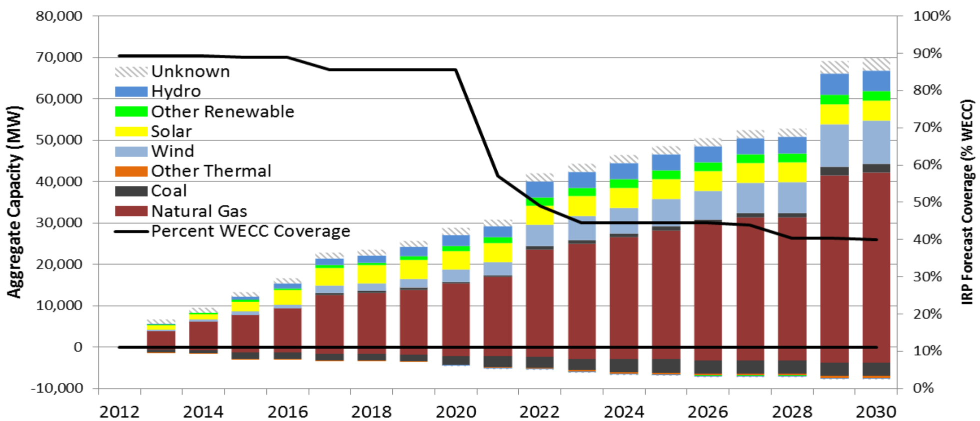


key:
- Scenario or Sensitivity Analysis
- Probabilistic Analysis
- Scenario/Sensitivity and Probabilistic
- Not identified in plan
- Plan not available
- Aggregate of perceived exposure to risk

notes:
[1] All LSEs considered traditional future generation resources, so not summarized here
[2] Risk to construction time or cost overruns
[3] LSE considered changes to existing generation such as early retirements or upgrades
[4] Risk to water contamination or exceeding use limits
[5] LSE considered some form of energy mix compliance or credit including Renewable Portfolio Standards, Renewable Energy Credits, Clean Energy Standards, Installed Tax Credits, Production
[6] Data bar is sum of counts for the number of LSEs that addressed risk in their portfolios. One count for the use of Scenario or Probabilistic Analysis; two counts for those that considered both.

How are planning assumptions reported and disseminated?

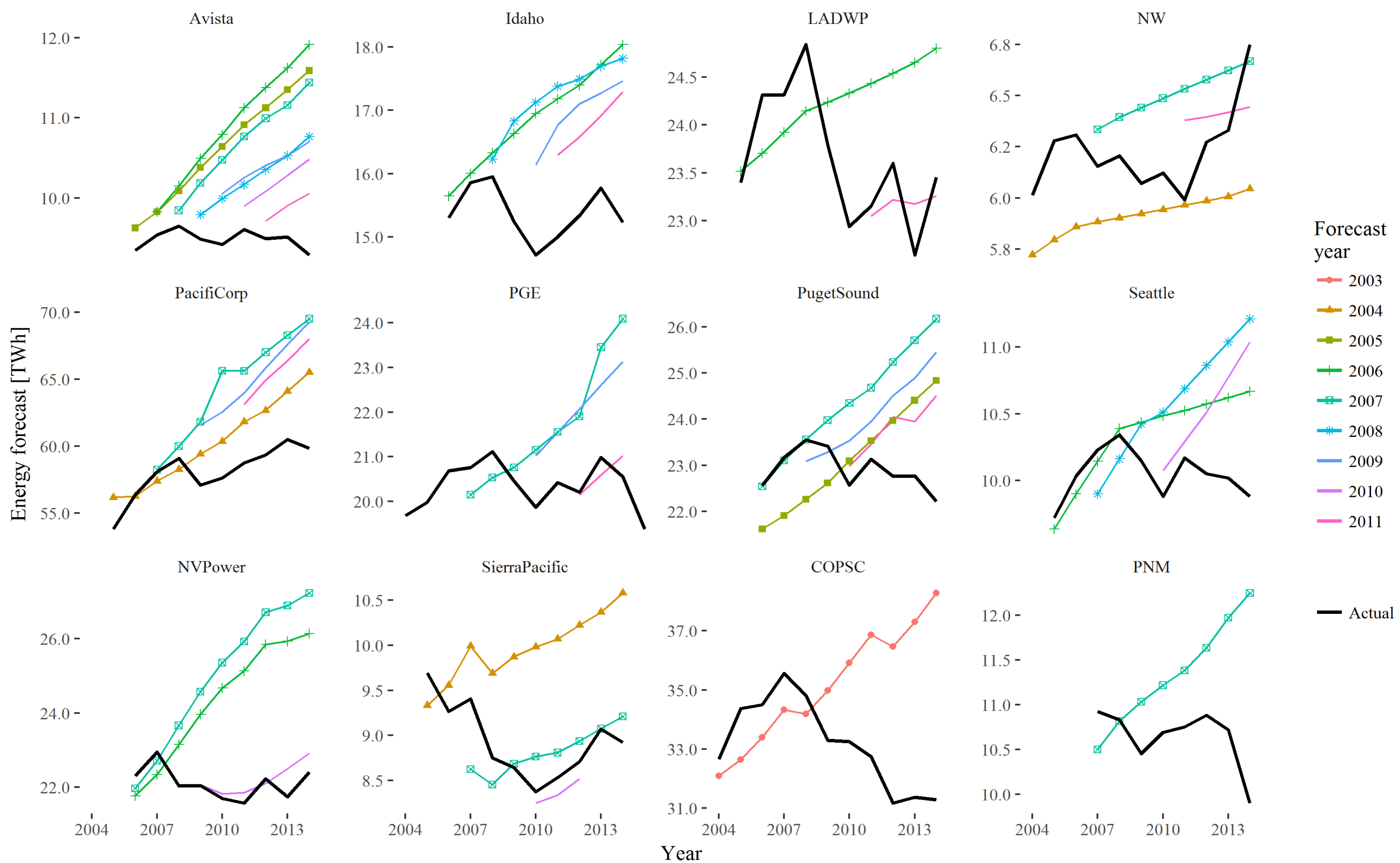
- Berkeley Lab's Resource Planning Portal is an open-source data platform containing long-term planning assumptions from over 130 IRPs filed by 45 utilities



1. Input electric utility planning information in a consistent format
2. Benchmark planning assumptions across jurisdictions
3. Output results in a standardized format for deeper analysis

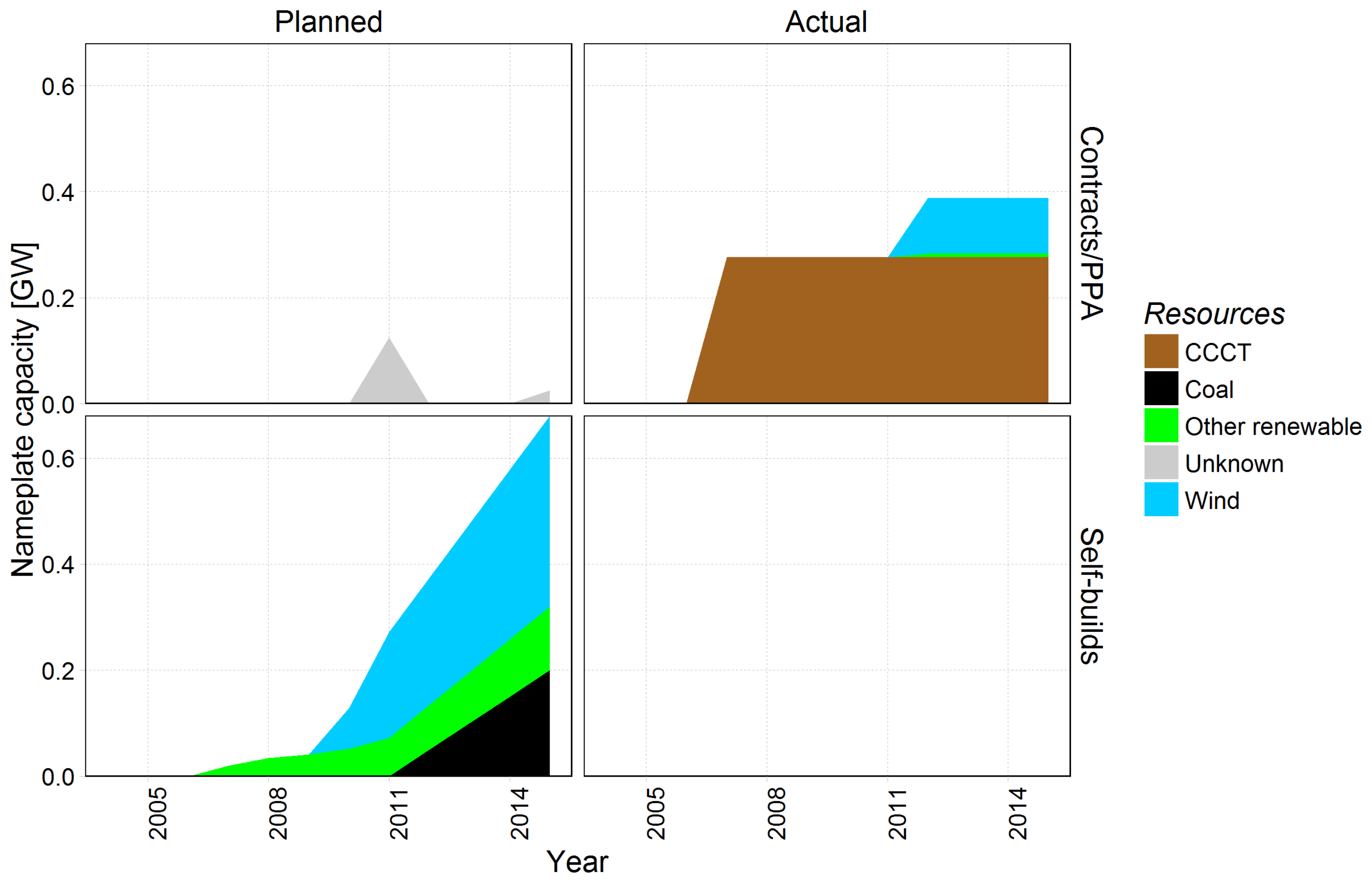
How do planning assumptions compare to actual outcomes?

Western U.S. electric utility energy forecasts versus actual energy consumed



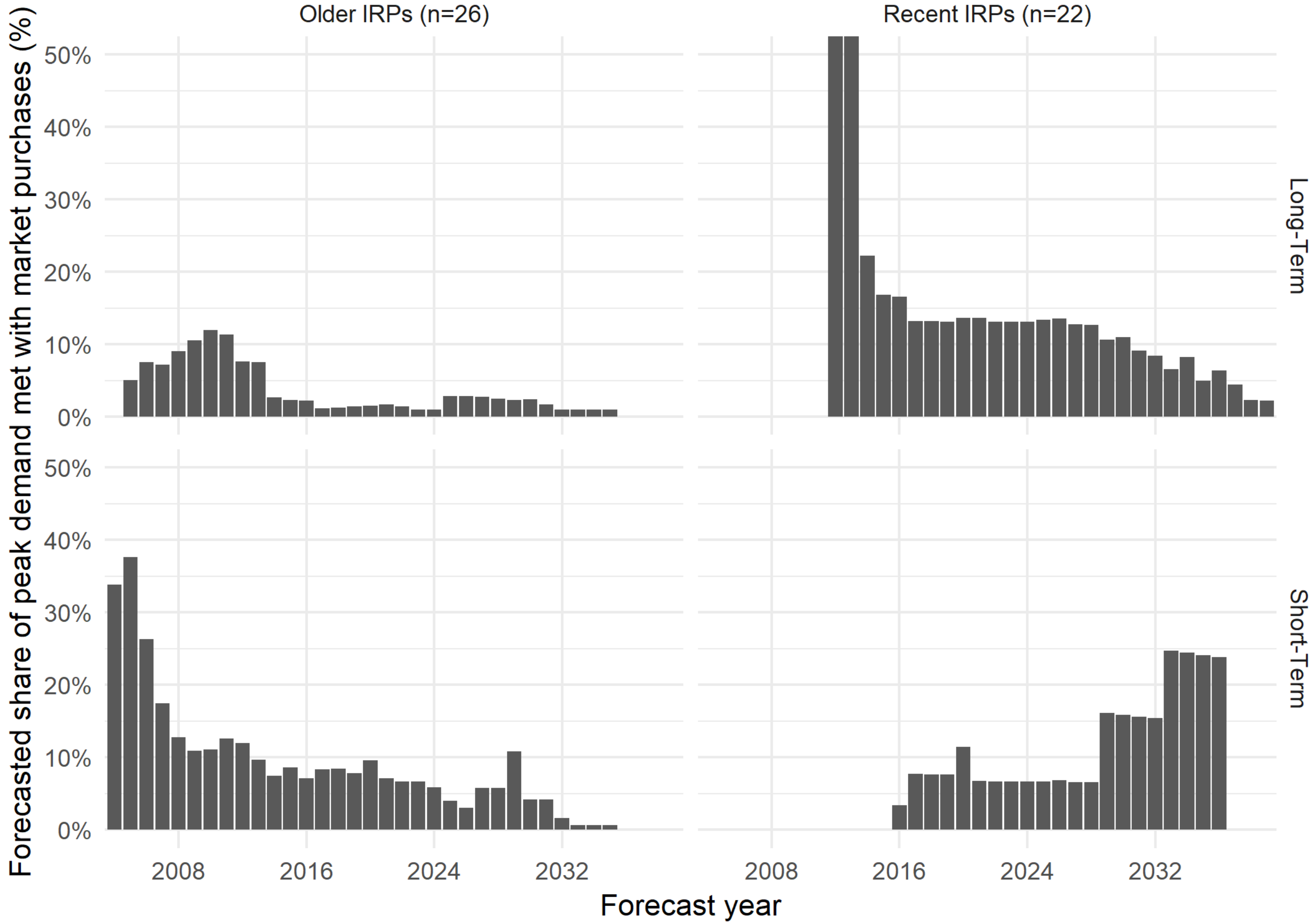
How do planning assumptions compare to actual outcomes?

Comparison of planning and procurement outcomes for a Western utilities



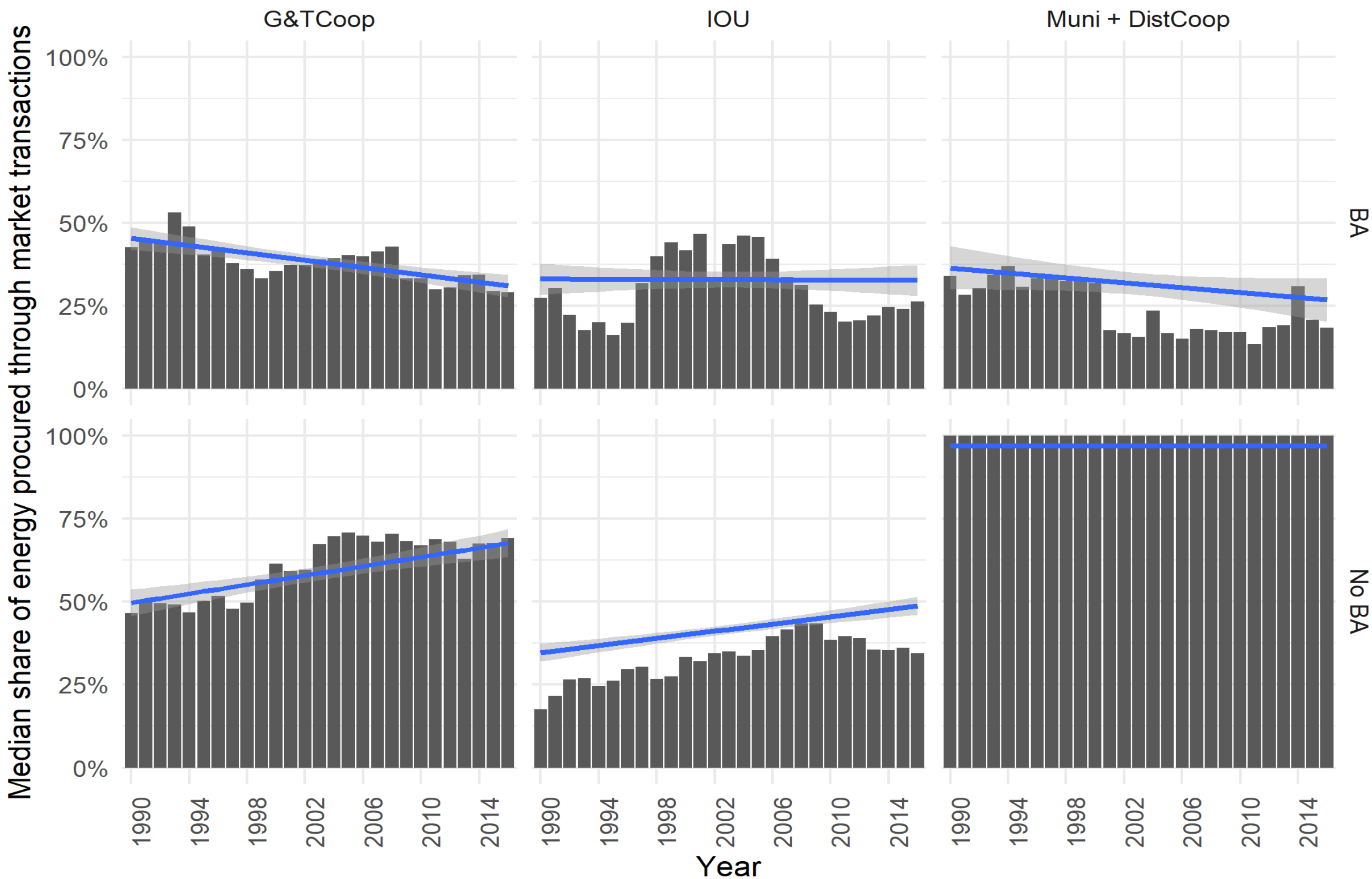
How much are utilities relying on the market to supply future resources?

Forecasted share of peak demand met with market purchases—older versus more recent IRPs



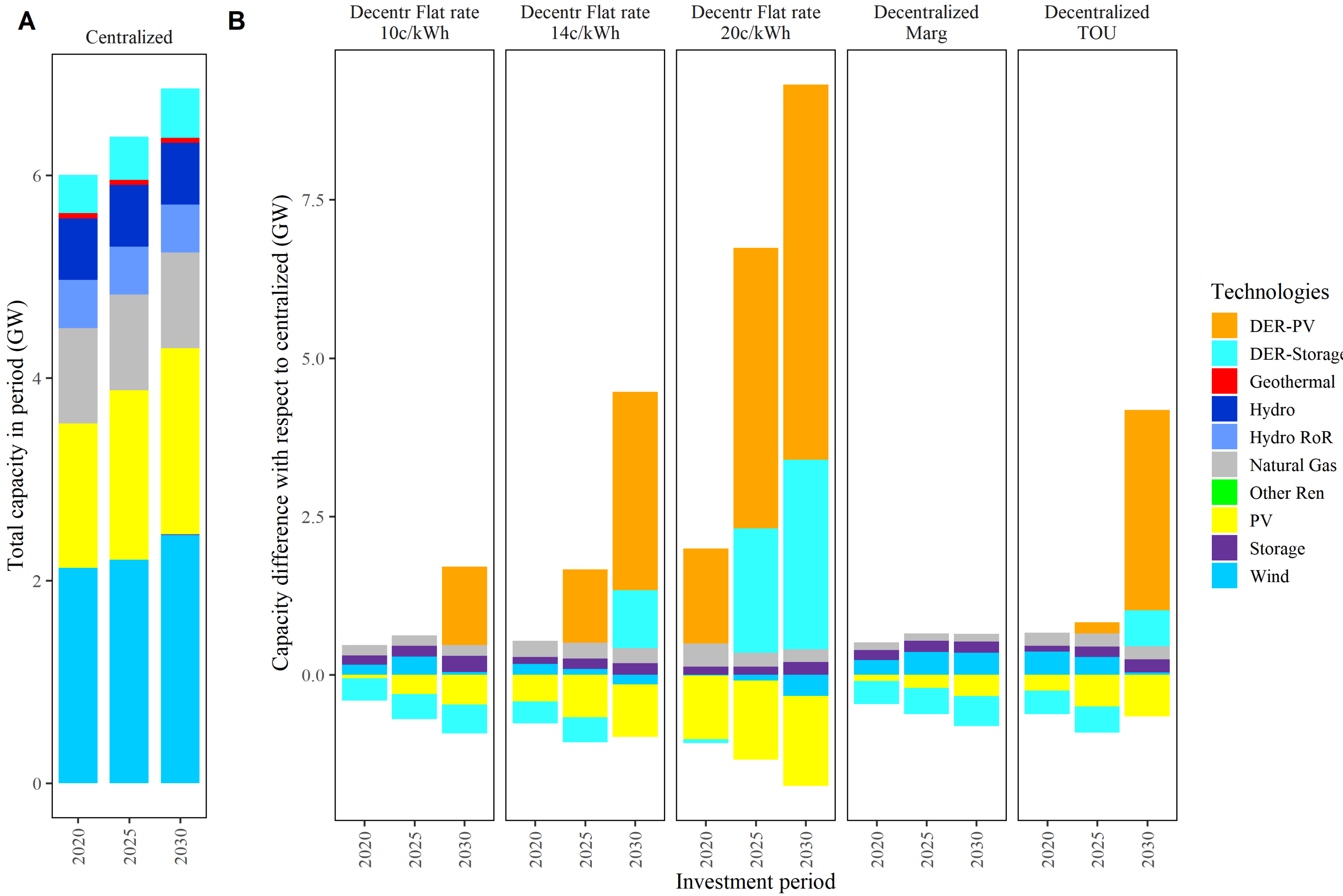
How much are utilities relying on the market to supply future resources?

Share of energy procured through market transactions by utility type and balancing authority participation



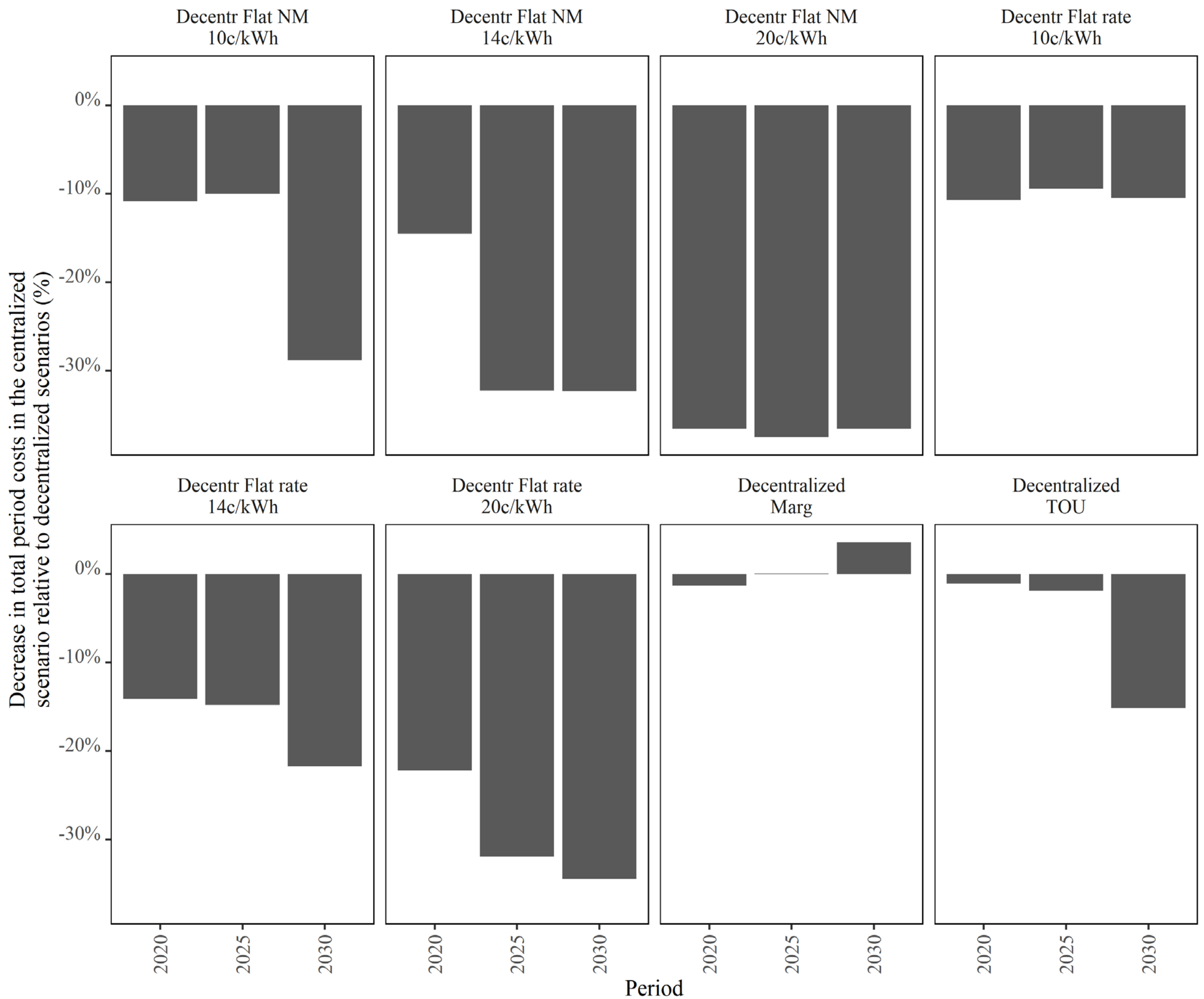
What is the value of integrated planning and centralized coordination of distributed energy resources?

Mix of capacity in the centralized scenario and differences that emerge in selected decentralized scenarios



What is the value of integrated planning and centralized coordination of distributed energy resources?

Percentage decrease in total period costs in the centralized scenario relative to decentralized scenarios



How might utility planning need to change to integrate with regional resource adequacy assessments?

- New DOE-funded research effort that explores the following questions:
  1. *What resource adequacy-related policies and practices are identified in electric utility integrated resource planning?*
  2. *What changes are needed in IRP processes and methods to coincide with regional resource adequacy programs in the Western U.S.?*

- Western Interstate Energy Board (WIEB) and University of Texas-Austin are key research partners

Additional research opportunities

Topic	**Challenge**
Regional resource adequacy assessment	Can the Resource Planning Portal be upgraded to estimate resource adequacy across the Western U.S.?
Resilience oriented planning	Existing long-term planning methods, models, and processes *do not* consider resilience of the capacity expansion portfolios. Applied research and development activities are needed to enhance IRPs by including metrics for resilience

Additional research opportunities

Topic	Challenge
Contribution of DER to distribution system reliability and resilience	Limited research into how DER—especially solar PV and battery storage—can improve or hinder reliability and resilience, how these outcomes depend on who owns and operates these resources, and how these impacts should be incentivized or penalized
DER integration with bulk power system planning	DERs, including centralized control of these resources, are not currently integrated into bulk power system planning models and frameworks

References and contact information

Carvallo, J.P., A. Sanstad, and P. Larsen. 2020. The use of wholesale market purchases by U.S. electric utilities. Under review at *Energy Strategy Reviews*.

Carvallo, J.P., N. Zhang, S. Murphy, B. Leibowicz, and P. Larsen. 2020. The Economic value of integrating distributed energy resources into electric utility resource planning. *Applied Energy* 269 (2020) 115071. https://doi.org/10.1016/j.apenergy.2020.115071

Carvallo, J., A. Sanstad, and P. Larsen. 2019. Exploring the relationship between planning and procurement in Western U.S. electric utilities. Energy: *The International Journal* 183 (2019): 4-15. https://doi.org/10.1016/j.energy.2019.06.122

Carvallo, J., P. Larsen, A. Sanstad, and C. Goldman. 2018. Long term load forecasting accuracy in electric utility integrated resource planning. *Energy Policy* 119 (2018): 410-422. https://doi.org/10.1016/j.enpol.2018.04.060

Wilkerson, J., P. Larsen, and G. Barbose. 2014. Survey of Western U.S. electric utility resource plans. *Energy Policy* 66 (2014): 90-103. https://doi.org/10.1016/j.enpol.2013.11.029

Peter Larsen, PhD
Research Scientist/Deputy Department Head
Email: PHLarsen@lbl.gov

Juan Pablo Carvallo, PhD
Sr. Scientific Engineering Associate
Email: JPCarvallo@lbl.gov