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Financial Impacts of Net-Metered PV on Utilities and Ratepayers:

A Scoping Study of Two Prototypical U.S. Utilities

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— Report Summary —
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SunShot U.S. Department of Energy

Outline

- **Project overview**
- Base case results
- Sensitivity analysis
- Mitigation analysis
- Conclusions

Project overview

- Scoping analysis that:
  - characterizes the scale of financial impacts of customer-sited PV on utilities
  - assesses the dependence of those impacts on underlying utility conditions
  - explores the efficacy and tradeoffs of potential mitigation approaches
- Leverages LBNL pro-forma financial model of utility costs and revenues
- Impact of PV measured in terms of estimated changes to three metrics:
  - utility achieved return-on-equity (ROE)
  - utility achieved earnings
  - customer average all-in retail rates

Structure of the analysis

Two "prototypical" investor-owned utilities

- Southwestern vertically integrated utility
- Northeastern wires-only utility and default service provider

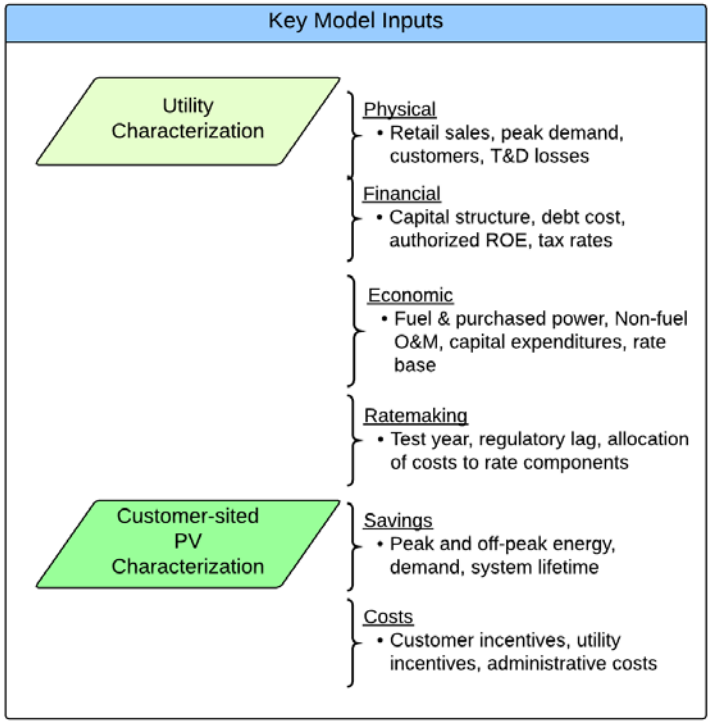
Analytical elements

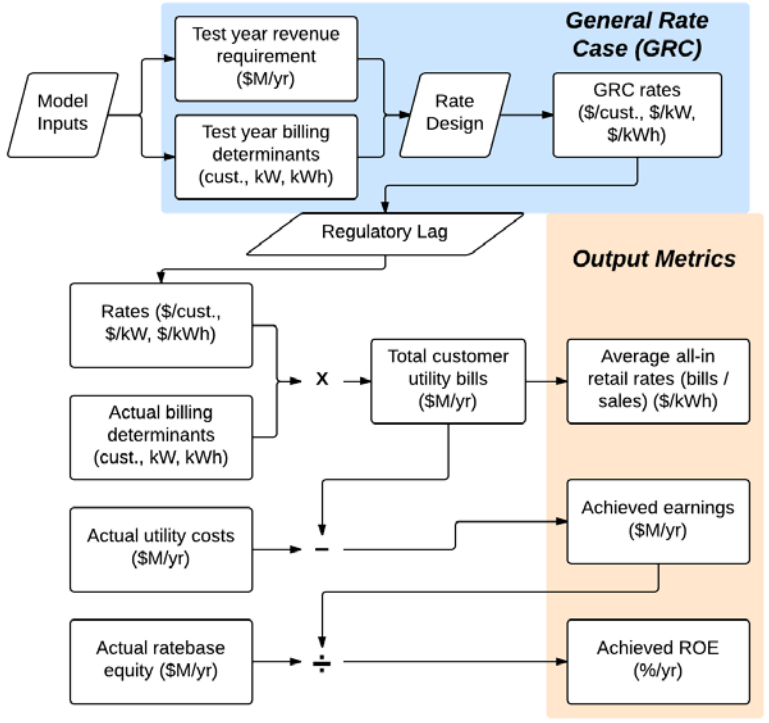
- **Base case**: A reference point against which sensitivities and mitigation measures can be measured
- **Sensitivity cases**: How do the impacts of PV depend on the utility operating and regulatory environment?
- **Mitigation cases**: To what extent can the impacts of PV be mitigated through regulatory and ratemaking measures?

Dimensions of the analysis

- Customer-sited PV ramps up over 10 years, reaching 2.5% to 10% of retail sales (Sensitivity and Mitigation cases focus on 10% PV penetration)
- Utility costs and revenues modeled over 20 years to capture end-effects

Model description





- Pro-forma financial model originally developed to quantify financial impacts of utility EE programs
- Quantifies utility annual costs and collected revenues over a long-term (e.g., 20-year) analysis period

Key boundaries of study scope and method

- Analysis is based on a financial modeling and does not constitute a detailed analysis of the value of PV
- Financial impacts captured at the utility-level, not customer-level; does not quantify cost-shifting or cross-subsidization among customer classes
- Is not a cost-benefit analysis of PV or of net-metering
- Does not consider impacts in combination with other distributed resources (storage, energy efficiency)
- Considers two different utilities, many sensitivity and mitigation scenarios, and multiple PV penetration levels, but does not cover every possibility

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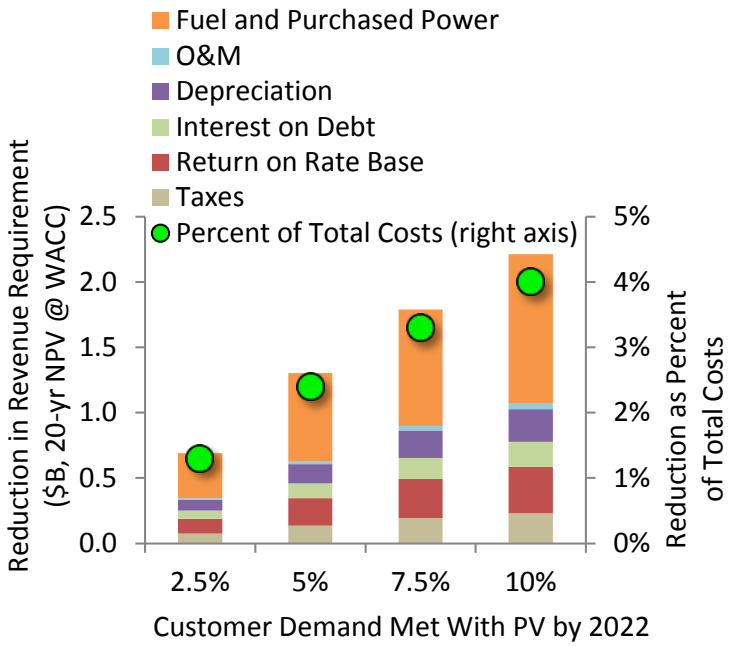
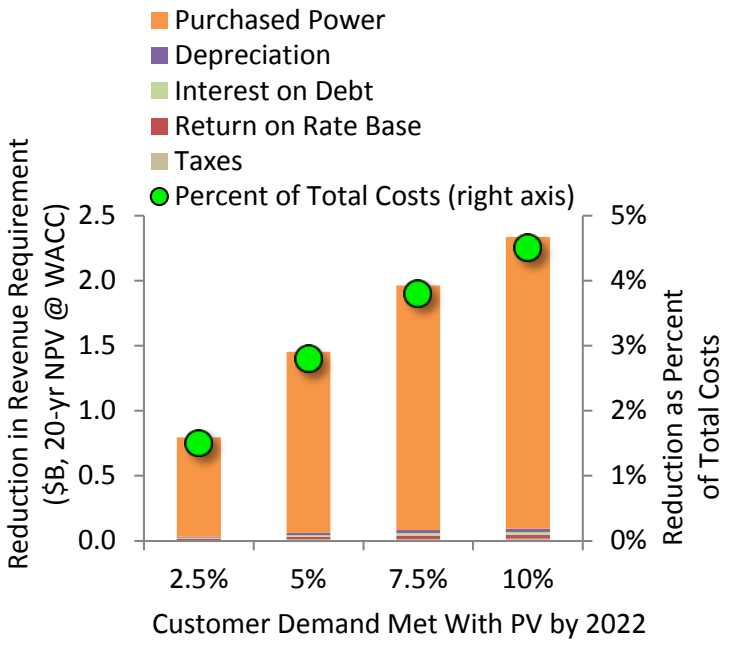
Utility cost reductions from PV

Southwest Utility

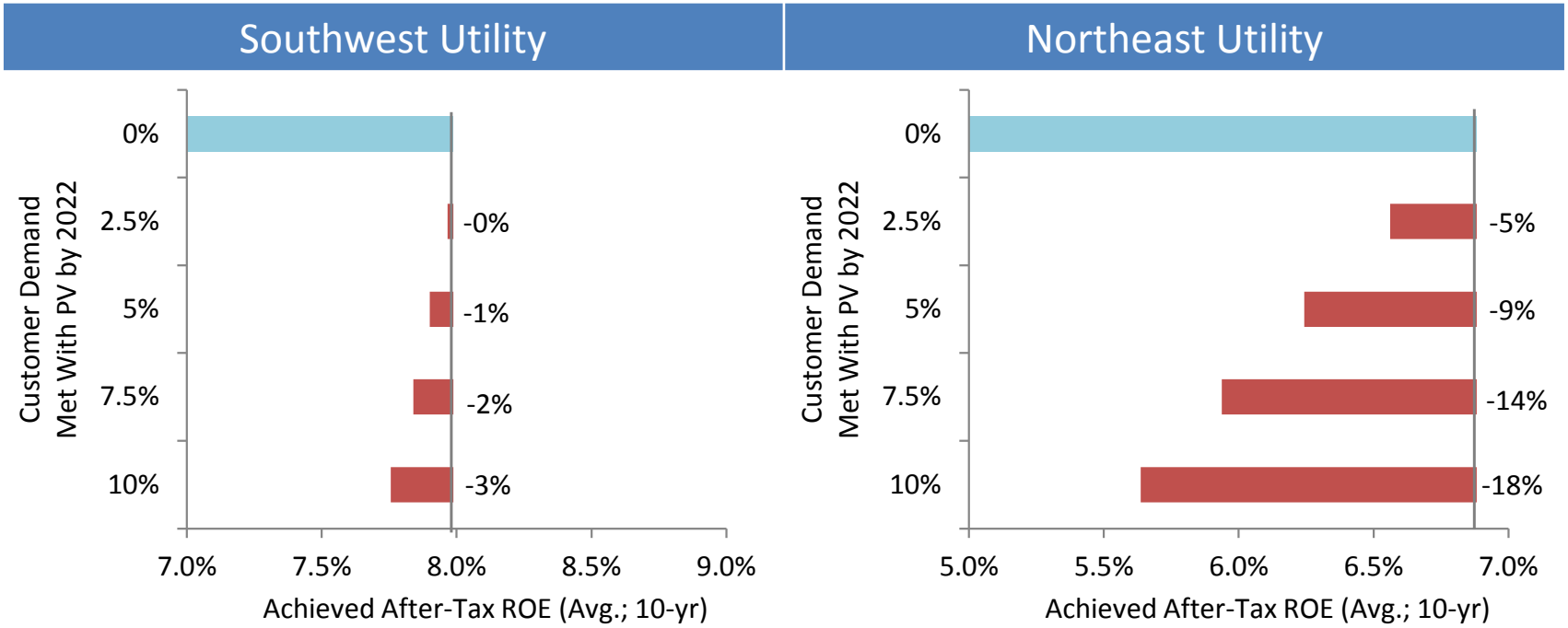


Northeast Utility



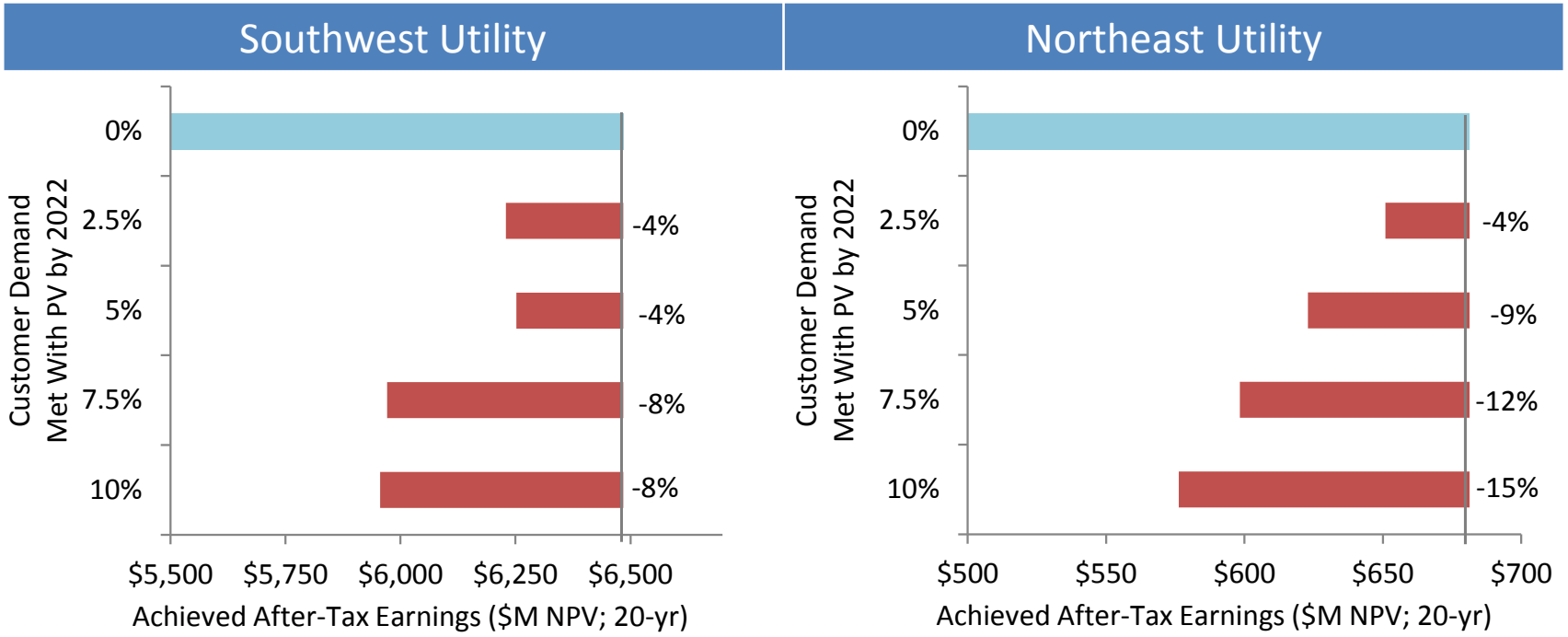
- Differences in composition of cost reductions between utilities are due to their differing cost structures: i.e., SW Utility owns generation while NE Utility procures all generation requirements via purchased power
- Assumptions related to deferral of generation and T&D investments, and to fuel and purchased power costs, are explored further in sensitivity analysis

Under base-case assumptions, PV reduces achieved ROE



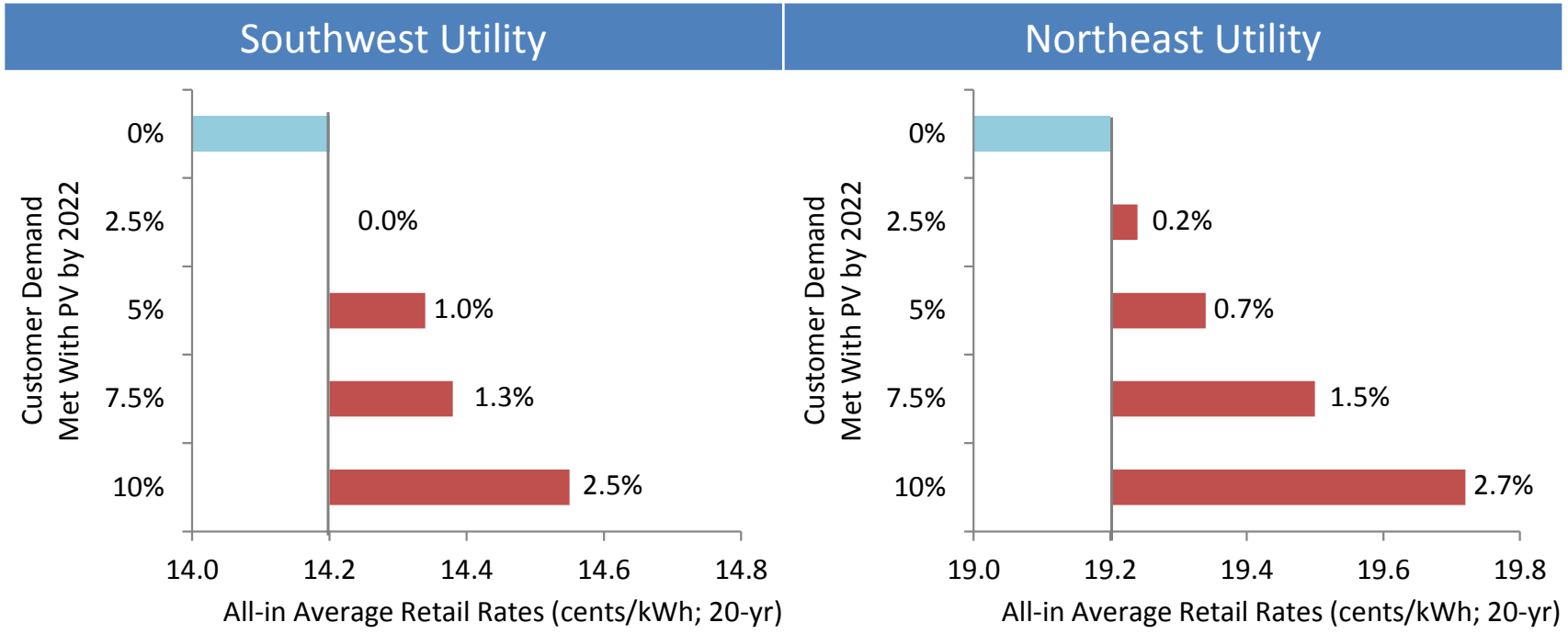
- Customer-sited PV reduces revenues by a greater amount than it reduces costs, leading to reduction in ROE ("revenue erosion effect")
- Impacts are larger for the NE utility, because of its higher assumed growth in fixed costs and its proportionally smaller rate base

Achieved earnings reduced by lost future investment opportunities



- PV reduces earnings as a result of both revenue erosion and also deferred capital investments ("lost earnings opportunity effect")
- Earnings impacts from deferred capital investments are most relevant to the SW Utility, which owns generation and transmission, though both utilities also experience earnings erosion from deferred distribution investments (in the base case)

Average customer rates increase slightly under base case assumptions



- Under base case assumptions, PV reduces sales and peak demand by a greater amount than it reduces costs, which causes average retail rates to increase
- Note, though, that these estimated rate impacts represent average impacts across all customers, thus do not directly measure cost shifting between PV and non-PV customers or for any individual customer class

Summary of base case results

	ROE Impacts (Avg. 10-yr)		Earnings Impacts (NPV 20-yr)		Average Retail Rate Impacts (Avg 20-yr)	
PV Penetration	***2.5%***	***10.0%***	***2.5%***	***10.0%***	***2.5%***	***10.0%***
Southwest Utility	-0.3%	-2.9%	-3.9%	-8.1%	0.0%	2.5%
Northeast Utility	-4.7%	-18.1%	-4.5%	-15.4%	0.2%	2.7%

Under base-case utility characterizations:

- PV reduces utility revenues, collected largely based on customer sales and demand, by a *greater* amount than it reduces utility costs
- Utility shareholders experience revenue erosion and lost earnings opportunities, leading to reduced ROE and achieved earnings
- Ratepayers experience increase in average retail rates, though those effects are generally less pronounced than shareholder impacts

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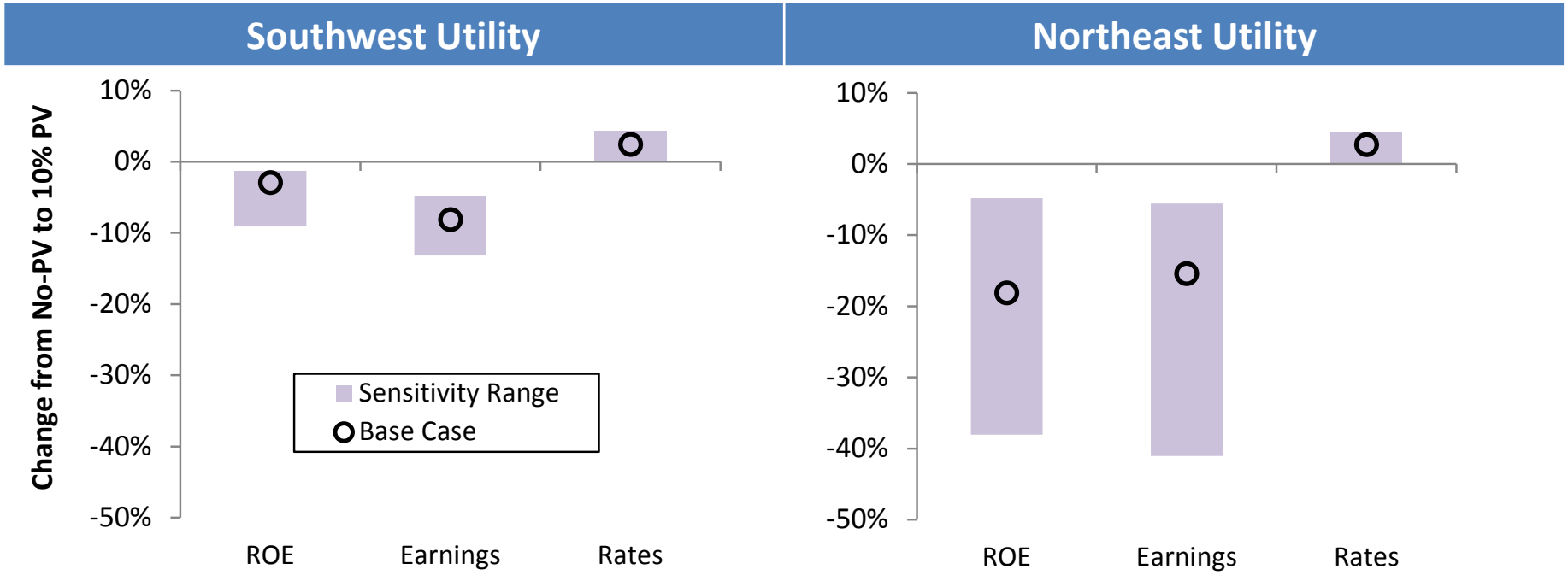
Sensitivity analysis overview

Objective: Illustrate the extent to which impacts of customer-sited PV on shareholders and ratepayers depend on underlying utility conditions

Sensitivities		Description	SW Utility	NE Utility
Utility Operating Environment	Value of PV	Higher/lower PV capacity credit and ability of PV to offset non-generation capital expenditure (CapEx)	●	●
	Load Growth	Higher/lower load growth	●	●
	Fixed O&M Growth	Higher/lower growth rate of fixed O&M costs	●	●
	Non-Generating CapEx Growth	Higher/lower growth rate of non-generation CapEx	●	●
	Fuel Cost Growth	Higher/lower growth rate of fuel costs or wholesale energy market prices	●	●
	Coal Retirement	Early retirement of existing coal generation	●	
	Utility-Owned Generation Share	Higher share of utility-owned generation	●	
	Utility-Owned Generation Cost	Higher/lower cost of utility-owned generation	●	
	Forward Capacity Market Cost	Higher/lower market clearing price in the ISO-NE forward capacity market		●
Utility Regulatory Environment	Rate Design	Higher/lower fixed customer charges	●	●
	Rate Case Filing Period	Shorter/longer period between general rate cases	●	●
	Regulatory Lag	Shorter/longer period from the filing of a general rate case to implementation of new rates	●	●
	Test Year	Use of current or future test year during general rate cases, instead of historical test year	●	●
	PV Incentives	$0.5/Watt rebate provided by the utility to customers with PV	●	●

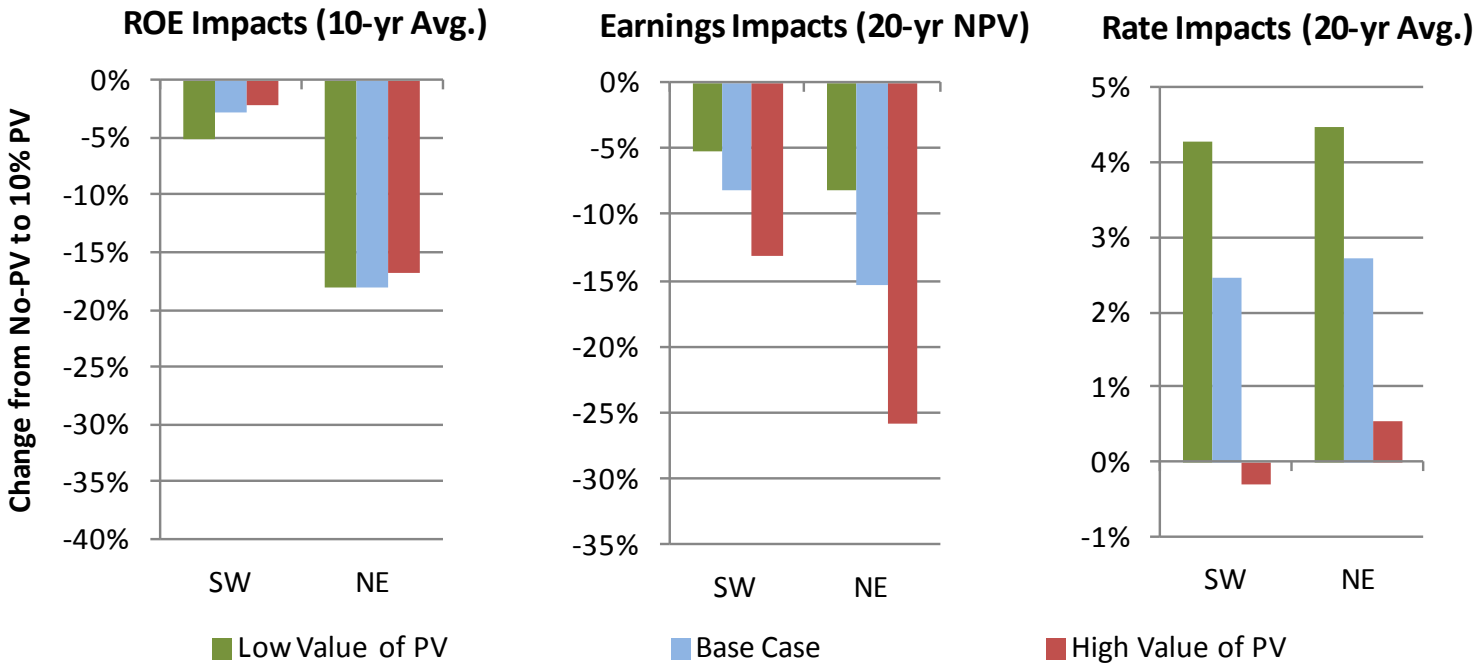
Sensitivity analysis summary



**All sensitivity cases focus on impacts under 10% PV trajectory for illustrative purposes*

- Impacts are directionally consistent, but their magnitude varies widely
- Shareholder impacts (ROE and earnings) are particularly sensitive to utility operating and regulatory environment, especially for NE Utility
- Greatest sources of sensitivity vary by metric and utility: e.g., for NE utility, choice of test year and load growth causes large swings in shareholder impacts, but value of PV is key for ratepayer impacts

Sensitivity analysis example: Value of PV



- Value of PV sensitivities consider alternate assumptions about the capacity value of PV and whether impacts on T&D costs are positive or negative
- Impacts can be quite sensitive to these assumptions, but implications are divergent for shareholders vs. ratepayers: High Value of PV results in *lower* ratepayer impacts but *higher* shareholder impacts

Selected additional sensitivity results

- **Load growth:** Shareholder and ratepayer impacts tend to be more significant with lower underlying load growth, partly because of reduced opportunities for deferral of capital expenditures
- **Rate structure:** Shareholder impacts tend to be more severe when retail rates rely predominantly on volumetric energy charges, because of greater revenue erosion
- **Ratemaking process:** Shareholder impacts are more severe when longer lags exist within the ratemaking process (e.g., longer periods between rate cases or use of historic test years)
- **Utility cost growth:** Shareholder and ratepayer impacts also depend on magnitude and growth of various utility cost elements, though the degree and direction of those sensitivities depend on the type of cost and how it is recovered (i.e., via fuel adjustment clause or via rates set in rate case)

Refer to report for details on the full set of sensitivity cases

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Mitigation analysis overview

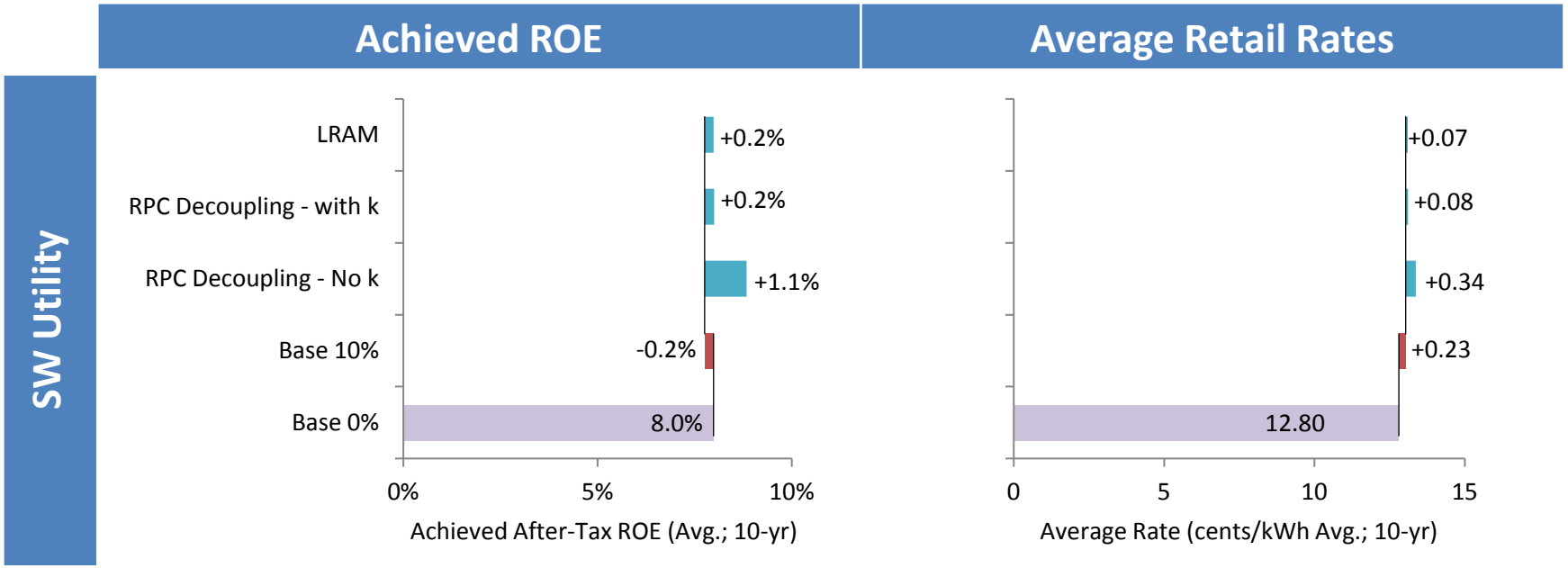
Objective: Explore the efficacy and potential tradeoffs associated with regulatory and ratemaking measures for mitigating the impacts of PV

Mitigation Measure	Revenue Erosion	Lost Earnings Opportunities	Increased Rates
Revenue-per-Customer (RPC) Decoupling	●		○
Lost Revenue Adjustment Mechanism (LRAM)	●		○
Shareholder Incentive		●	○
Shorter Rate Case Filing Frequency	●		○
No Regulatory Lag	●		○
Current & Future Test Years	●		○
Increased Demand Charge & Fixed Charge	●		○
Utility Ownership of Customer-Sited PV		●	○
Customer-Sited PV Counted toward RPS			●

● Primary intended target of mitigation measure
○ May exacerbate impacts of customer-sited PV

- Mitigation scenarios borrow from measures implemented with energy efficiency programs, though are not an exhaustive set of options
- Mitigation analysis focuses on impacts under 10% PV trajectory, for illustrative purposes

Mitigation example: decoupling and LRAM



- RPC decoupling and LRAM mitigate revenue erosion impacts from customer-sited PV, thereby improving ROE, but degree of mitigation varies by utility and depends on design (e.g., k-factor)
- Mitigation of shareholder impacts in these cases necessarily entails an increase in average retail rates, illustrating one form of tradeoff

Selected additional mitigation results

- **More-frequent rate cases, use of current or future test years, or reduced regulatory lag:** May mitigate revenue erosion and associated shareholder impacts, but in doing so lead to increased average rates
- **Increased fixed customer charges or demand charges:** May moderate revenue erosion and associated shareholder impacts, but effectiveness depends on underlying growth in number of customers or customer demand (and can actually exacerbate revenue erosion)
- **Shareholder incentive mechanisms:** May offset earnings erosion associated with deferred capital expenditures, with degree of mitigation tailored via incentive design
- **Utility ownership or financing of customer-sited PV:** Offers the potential for substantial shareholder earning opportunities, especially for wires-only NE Utility with otherwise limited investment opportunities
- **Application of net-metered PV towards RPS obligations:** May mitigate rate impacts, but associated policy issues and tradeoffs are significant

Refer to report for details on the full set of mitigation cases

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Conclusions

- Even at penetration levels significantly higher than today, the impacts of customer-sited PV on average retail rates may be relatively modest (though we stress that our analysis does not isolate cost-shifting per se)
- In comparison, impacts on utility shareholders are potentially much more pronounced, though they depend highly upon the specifics of the particular utility
- Various “incremental” changes to utility business or regulatory models (as opposed to wholesale paradigm shifts) can mitigate the impacts of customer-sited PV on utility ratepayers and shareholders
- However, those measures generally entail important tradeoffs, either between ratepayers and shareholders or among competing regulatory and policy objectives

Potential areas for future research

As a scoping study, one final objective was to highlight additional questions and issues worthy of further analysis, including to:

- Benchmark the impacts of customer-sited PV against other factors affecting utility profitability and customer rates
- Examine the combined impacts from customer-sited PV, aggressive energy efficiency, and other demand-side measures
- Examine differential impacts among customer groups, including cost-shifting from PV to non-PV customers
- Examine a broader range of mitigation options and combinations thereof
- Continue improving methods for estimating the avoided costs from customer-sited PV
- Identify strategies for maximizing the avoided costs of customer-sited PV

For more information

Download the full report and companion briefing:

http://emp.lbl.gov/publications

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