Benefits and costs of a utility-ownership business model for residential rooftop solar photovoltaics

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https://emp.lbl.gov/publications/benefits-and-costs-utility-ownership

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Motivation and Context

- Increasing interest in utility ownership of distributed energy resources (DERs)
  - Part of broader discussions about evolution in utility business models
  - Roughly a dozen US utilities have implemented pilots focused on rooftop PV
- Specific motivations noted in the literature:
  - Utility earnings opportunities by rate-basing rooftop PV assets
  - Facilitating higher value forms of deployment; greater utility visibility and control
  - Cost savings (e.g., via bulk procurement, reduced interconnection costs)
  - Targeting underserved markets (e.g., low/moderate-income)
  - Potential for mitigating concerns around cost-shifting between solar and non-solar customers
- Prospects for large-scale implementation are uncertain
  - Broad policy questions and issues (e.g., related to appropriate utility roles in this market)
  - Basic questions related to the financial impacts on utility shareholders and customers

Examples of Utility-Owned Rooftop Solar Programs

Arizona Public Service Solar Partners Program: Pilot program capped at 10 MW, focusing on single-family homes with west-facing roofs on specific feeders; 4-8 kW-sized systems connected to the utility-side of the meter; customers receive $30/month for use of their rooftops; utility has central control over smart inverters to test their ability to provide grid services; subsequent APS Solar Communities Partners program is similar but targets LMI customers

Tucson Electric Power Residential Solar Program: Customers receive a fixed monthly utility bill for 25 years (i.e., hedge against future rate increases) in exchange for allowing the utility to site a system on their property

Dominion Energy Solar Partnership Program: Demonstration program capped at 30 MW, focusing on commercial and industrial customers; 500-2,000 kW-sized systems are connected to the utility-side of the meter and customers receive a negotiated lease payment for use of their roof-space or grounds

Los Angeles Department of Water and Power Solar Rooftops Program: Focuses on single-family homes, initially prioritizing zip codes with the fewest solar installations; 2-4 kW-sized systems connected to the utility-side of the meter and customers receive $30/month for use of their rooftops; program cap of 1 MW total

We Energies Solar Now Program: Pilot program capped at 35 MW, focusing on commercial and industrial customers; 10 MW set aside for government and non-profit; systems up to 2.25 MW in size connected to the utility-side of the meter; customers receive monthly lease payments for use of their property, based on the PV system's capacity value, as estimated from the Midcontinent Independent System Operator's Cost of New Entry

Others: Ameren, CPS Energy, Duke Energy, Entergy Louisiana, Entergy Mississippi, Wisconsin Power and Light

Analysis Overview

Objective

- Estimate impacts of utility-owned residential rooftop PV on (A) *utility shareholder earnings* and (B) *non-solar customer bills*
- Compare to outcomes under non-utility ownership

Methods

- Estimate earnings and bill impacts using Berkeley Lab's FINDER model
- Assume utility characteristics representative of a Southeastern IOU
- Focus on a particular variant of utility-owned rooftop PV: system connected to utility side of meter; host customer receives monthly payment for use of rooftop

Some Key Limits to the Analysis Scope

This analysis does…	*This analysis does NOT…*
▫ Compare outcomes between utility-owned & non-utility-owned rooftop PV	▫ Compare outcomes between utility-owned rooftop PV and other utility investments (e.g., in large-scale PV)
▫ Compare outcomes in terms of impacts on utility shareholder earnings and non-participant bills	▫ Compare outcomes in terms of other factors that may also be important to determining whether utility-ownership of rooftop PV is in the public interest
▫ Consider an illustrative utility and program design, with sensitivities	▫ Evaluate a broad range of utilities or program designs (though we discuss qualitatively how results might differ)

Analysis Structure

Base-Case Scenarios

1. **No PV**
2. **Non-Utility Owned PV**
   - Host-owned or third-party owned (HO/TPO)
   - Net-metered
   - Ramps up to 8% of residential sales over 10 yrs
3. **Utility-Owned PV**
   - Same amount of PV, but utility-owned

* Outcomes measured by comparing Case 2 and 3 to Case 1

Sensitivity Cases

1. Program size
2. Panel orientation
3. PV CapEx
4. Investment tax credit (ITC)
5. Authorized return on equity (ROE)
6. Customer “rooftop lease” payment

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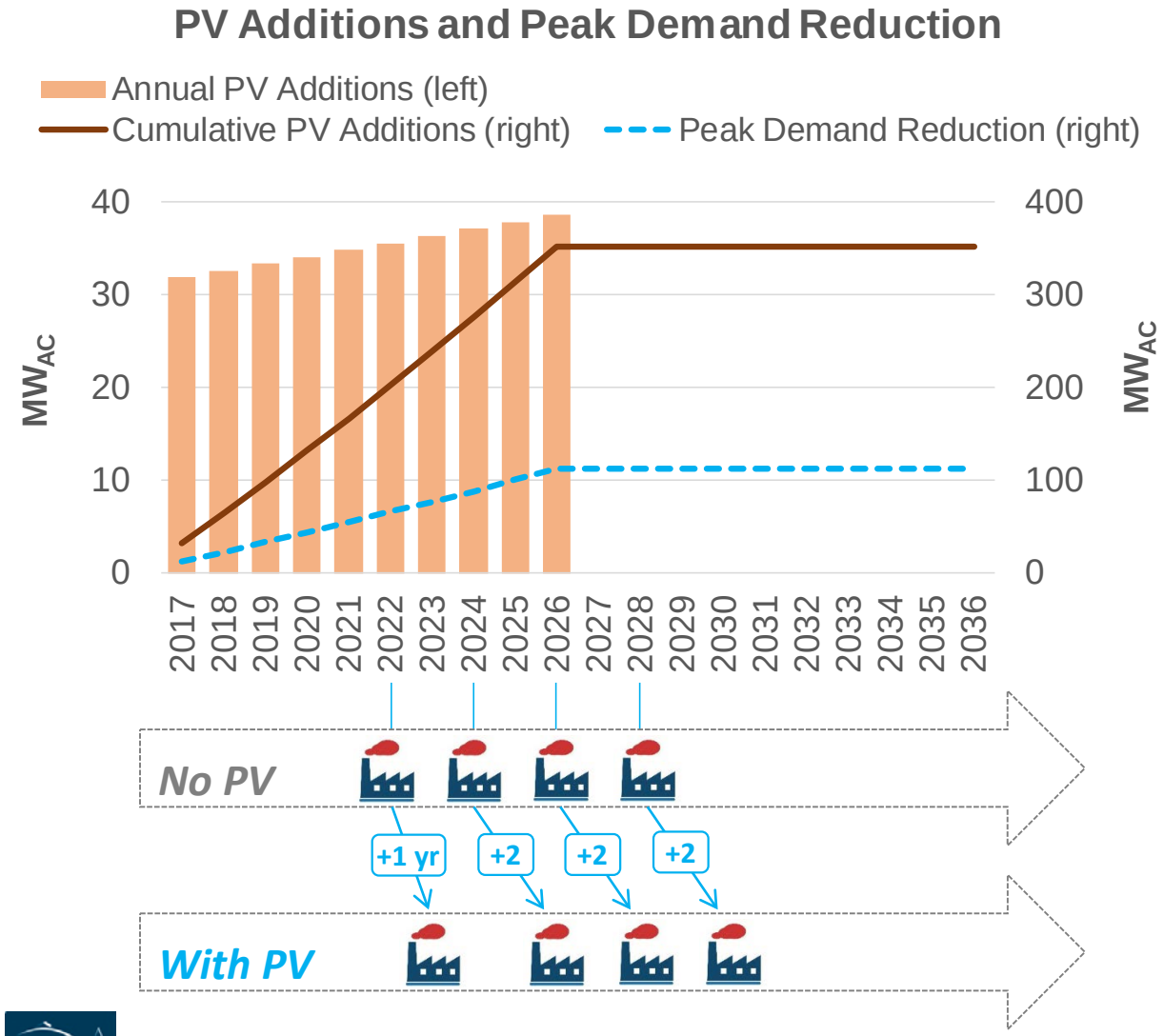
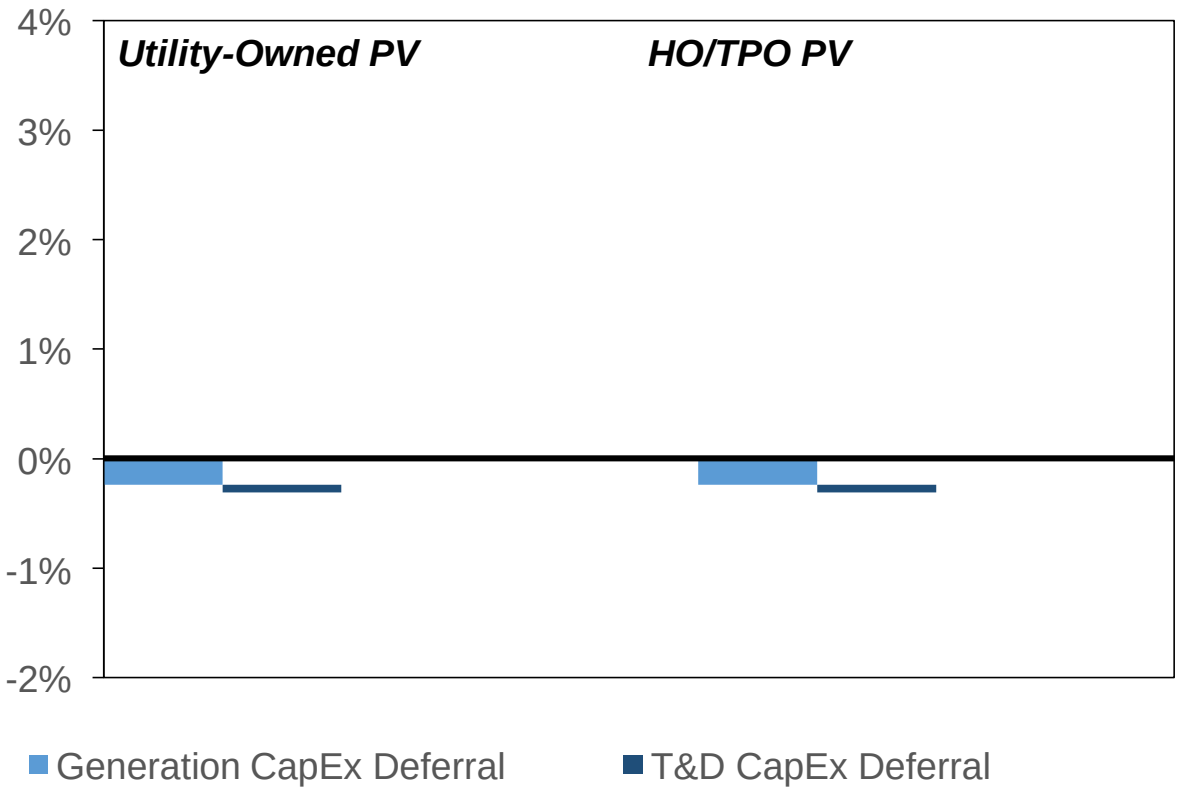
Net Peak Demand Reductions and Associated CapEx Deferrals



- To reach 8% of residential sales, roughly 35 MW of PV added each year for 10 years
- Cumulatively **350 MW** of PV added
  - Equates to 10% of utility peak in Year-10
- Reduces utility peak by **110 MW**
  - Utility peak initially occurs 3-4 pm; shifts to 4-5 pm as more PV is deployed
- Net peak demand reductions result in CapEx deferrals
  - 3 CCGTs and 1 CT each deferred by 1-2 yrs
  - Some T&D-related CapEx deferrals

Base-Case Earnings Impacts

Change in Utility Earnings Relative to No-PV (20-yr NPV)



- Generation and T&D CapEx deferrals reduce utility earnings relative to no-PV—same effects for both HO/TPO and utility-owned PV

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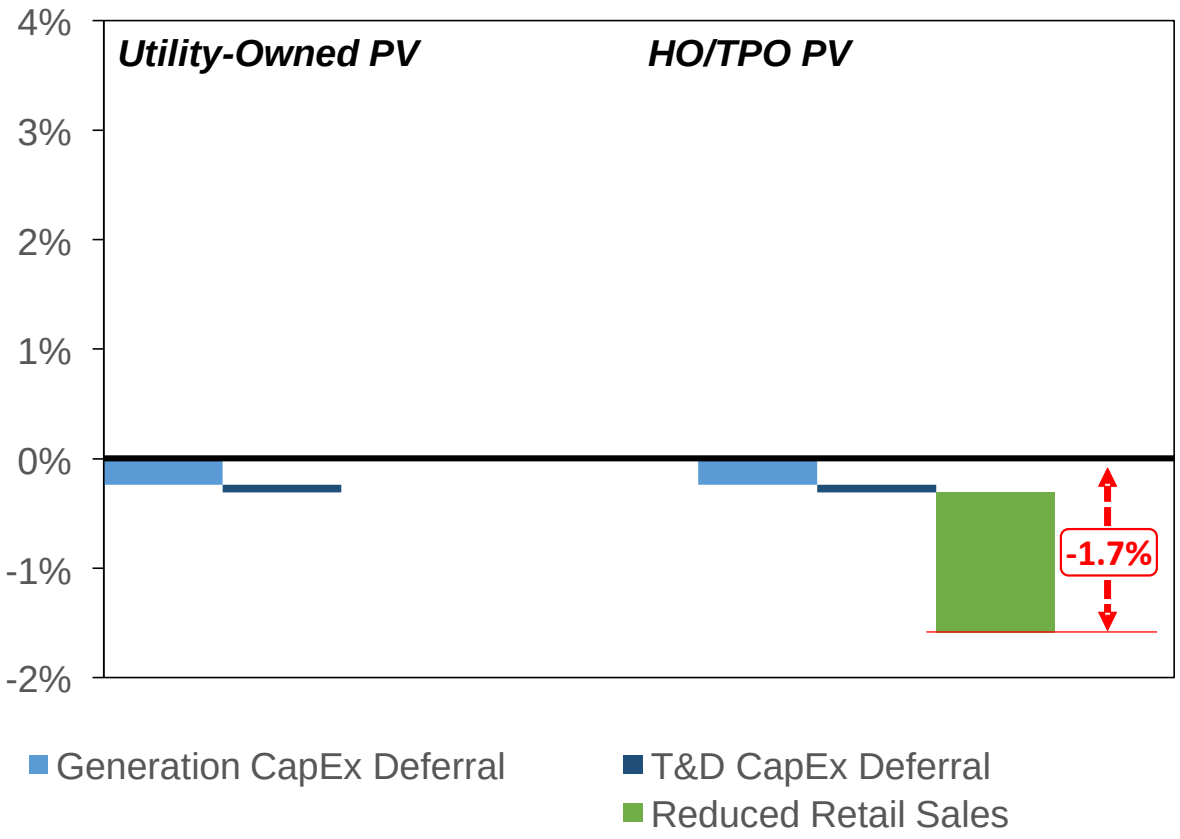

- Generation and T&D CapEx deferrals reduce utility earnings relative to no-PV—same effects for both HO/TPO and utility-owned PV
- HO/TPO PV: net metering reduces retail sales and revenues, leading to further earnings erosion

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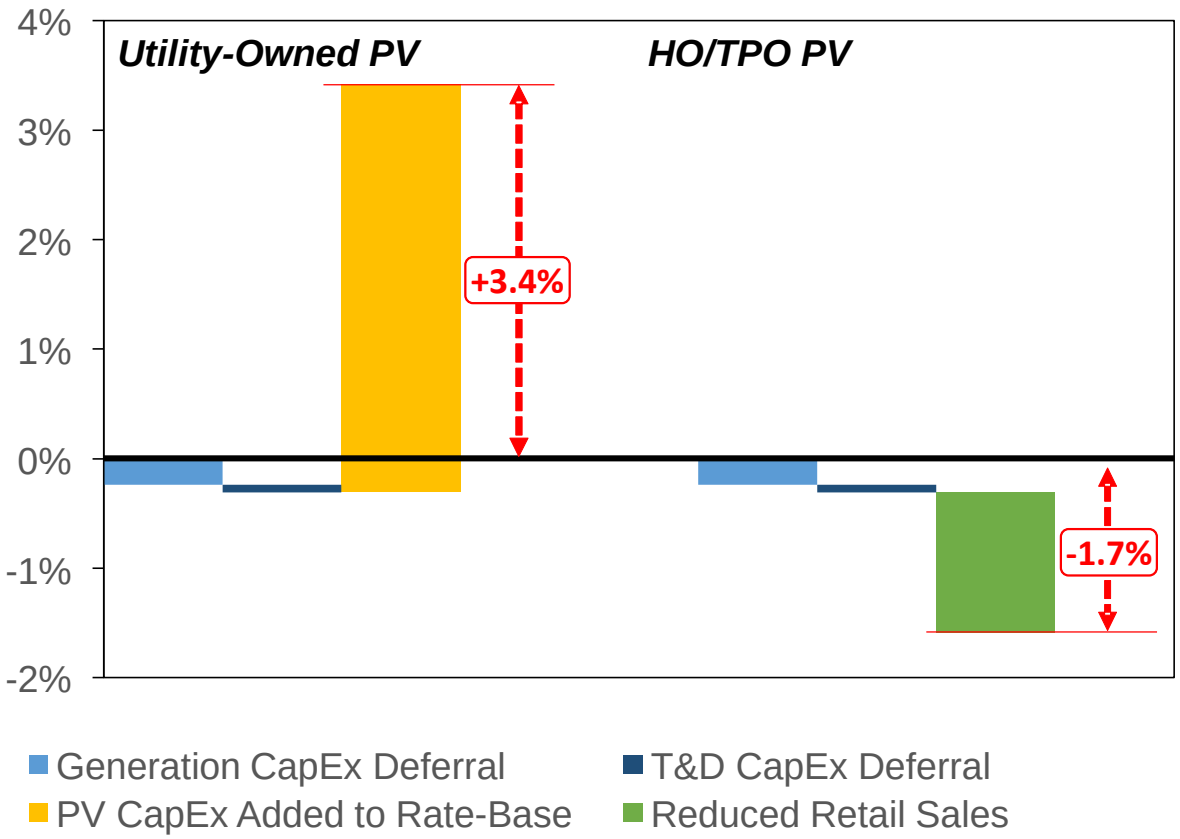
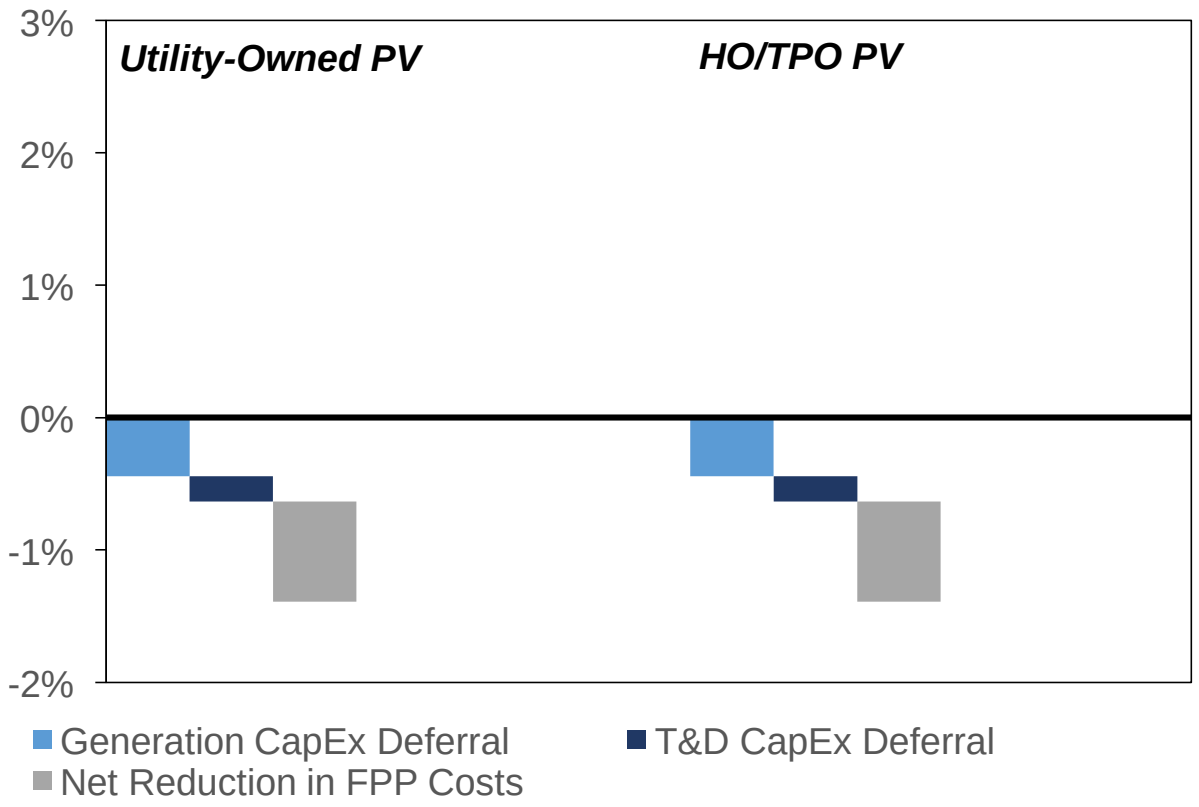


- Generation and T&D CapEx deferrals reduce utility earnings relative to no-PV—same effects for both HO/TPO and utility-owned PV
- HO/TPO PV: net metering reduces retail sales and revenues, leading to further earnings erosion
- Utility-Owned PV: no revenue erosion; rate-basing PV CapEx more-than-offsets earnings loss from other capacity deferrals

→ ***Utility ownership leads to a net gain in shareholder earnings, compared to the net loss under HO/TPO PV***

Base-Case Non-Participant Bill Impacts

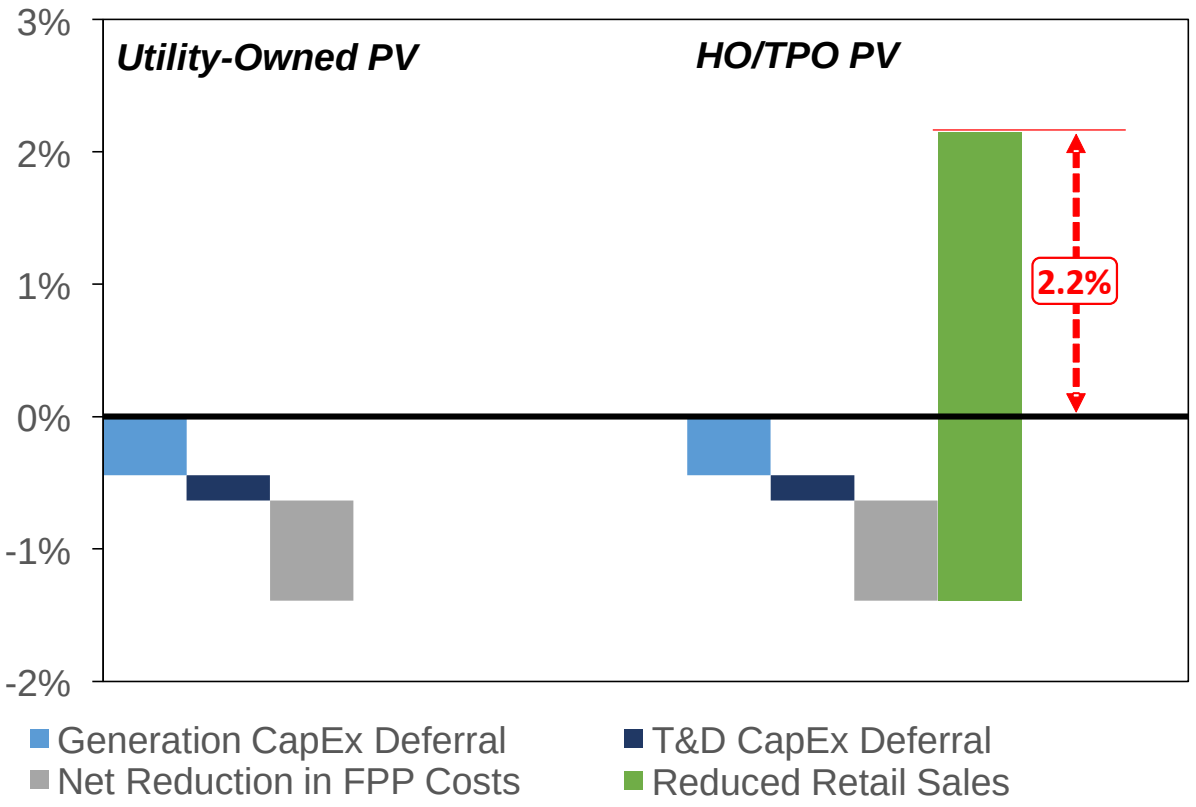
Change in Average Bills Relative to No-PV (20-yr NPV)



- CapEx deferrals and reduced fuel & power purchase (FPP) costs reduce non-participant bills (the same in both cases)

Base-Case Non-Participant Bill Impacts

Change in Average Bills Relative to No-PV (20-yr NPV)



- CapEx deferrals and reduced fuel & power purchase (FPP) costs reduce non-participant bills (the same in both cases)
- HO/TPO PV: Reduced retail sales via net metering puts upward pressure on rates, more than offsetting cost savings

Base-Case Non-Participant Bill Impacts

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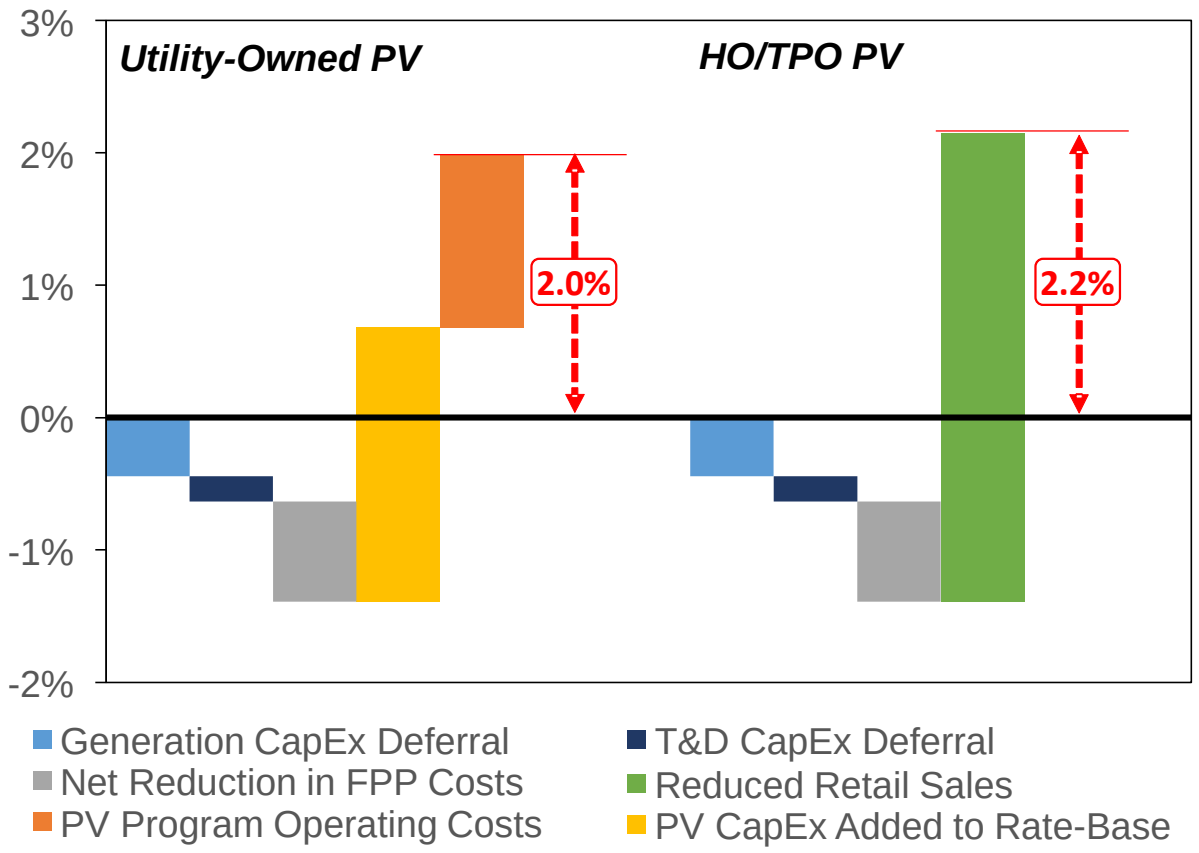

- CapEx deferrals and reduced fuel & power purchase (FPP) costs reduce non-participant bills (the same in both cases)
- HO/TPO PV: Reduced retail sales via net metering puts upward pressure on rates, more than offsetting avoided costs
- Utility-Owned PV: Revenue requirements associated with rate-basing rooftop PV plus program operating costs more than offset avoided costs

→ ***On net, non-participant bill impacts are roughly equivalent between the two ownership structures***

Analysis Structure

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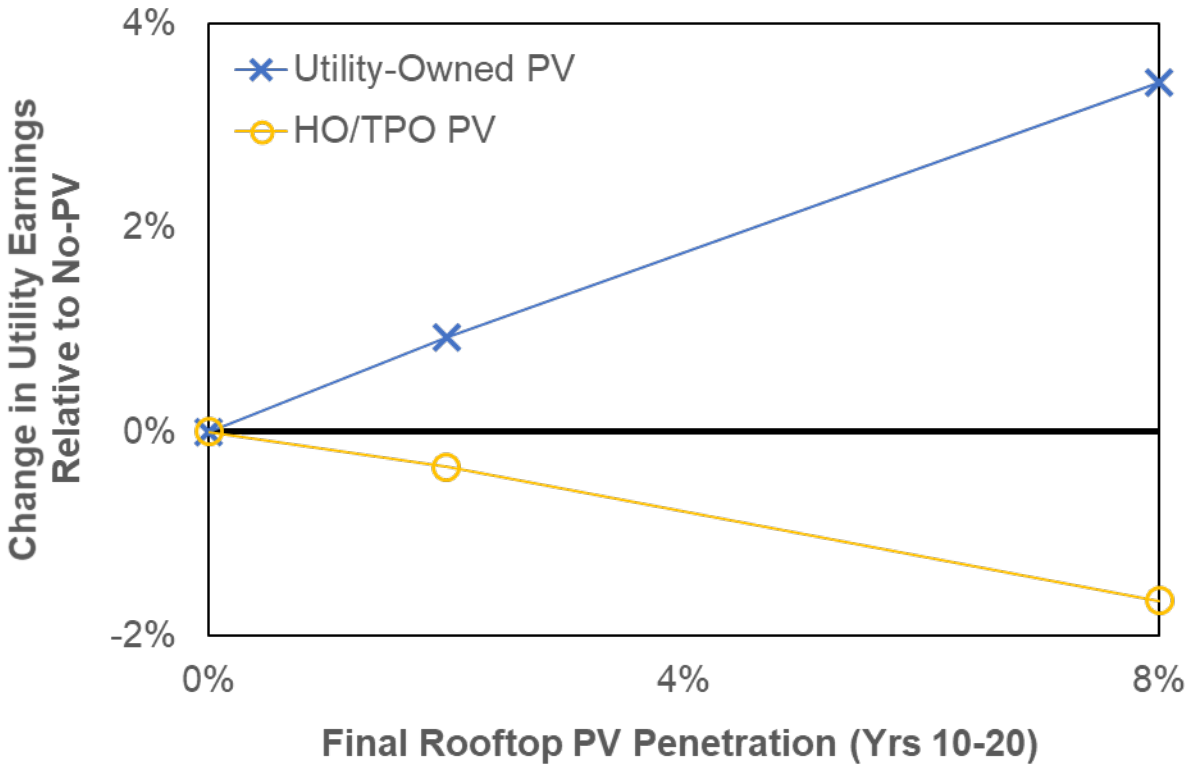
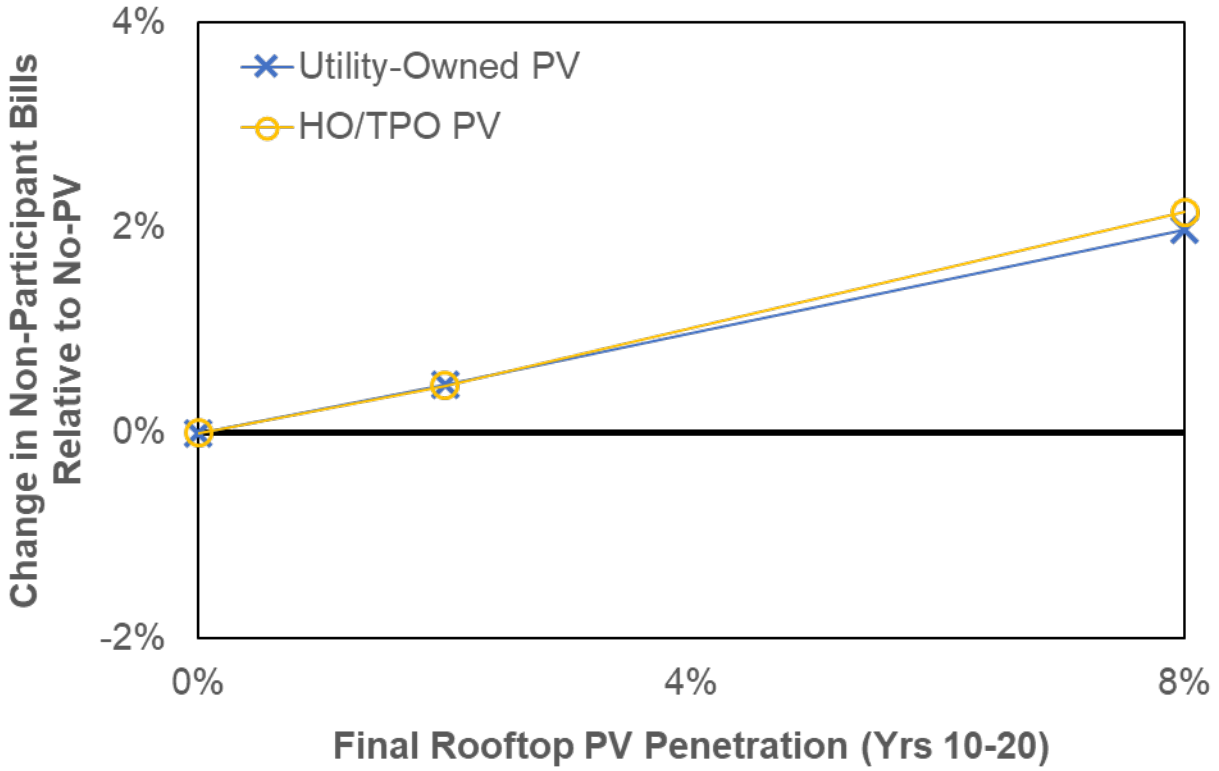
Sensitivity Case: Lower Deployment Levels (2% of sales)

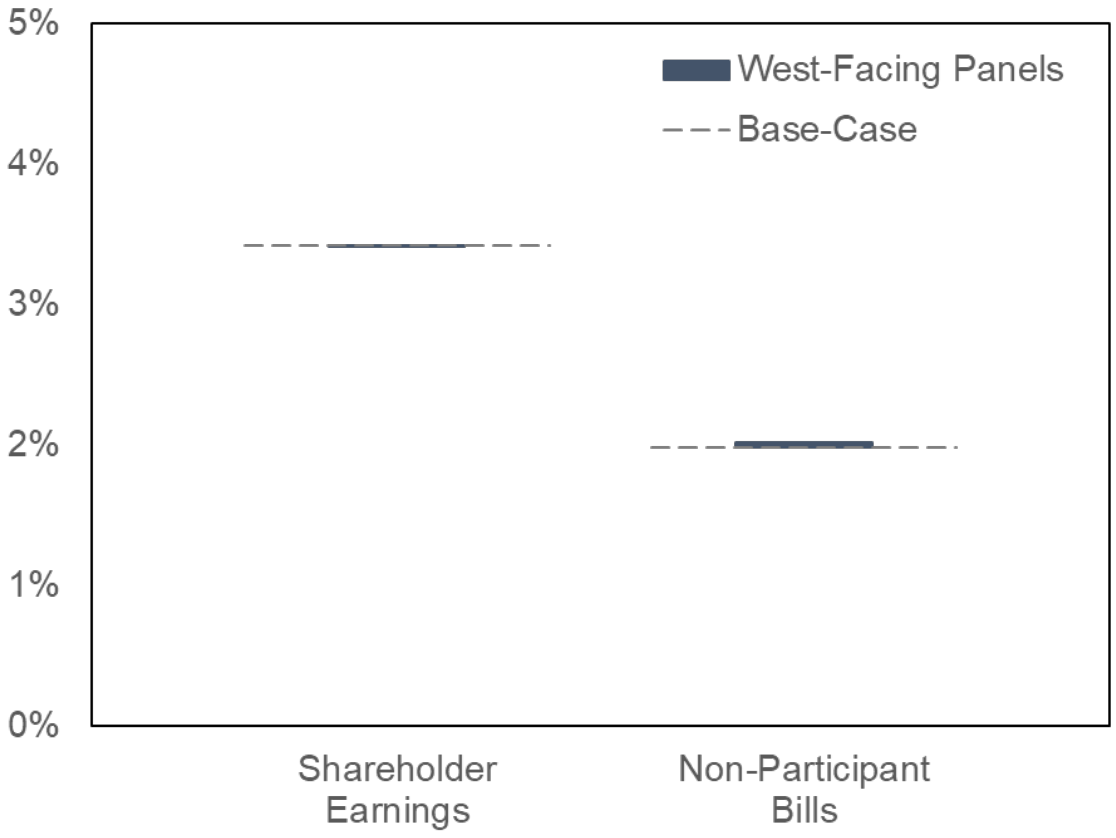
Although some of the underlying dynamics are "lumpy" in nature (e.g., CapEx deferrals), the net impacts on shareholder earnings and non-participating bills scale roughly in a linear fashion, up to the base-case deployment levels (8% of sales)





Sensitivity: West-Facing Panels

Utility-Owned PV: Changes Relative to No-PV



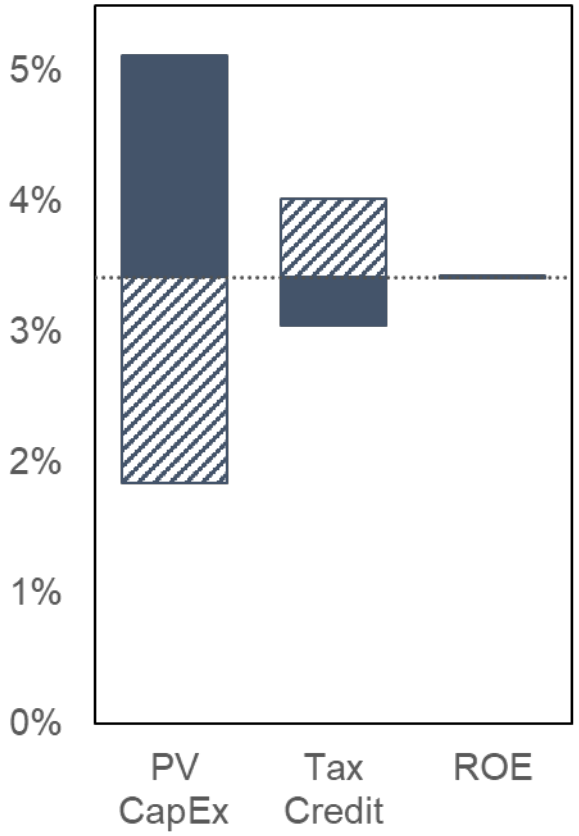
- Assume Utility-Owned PV is all west-facing (as opposed to mostly south-facing in our base-case)
- Results in slightly greater T&D deferrals, but no incremental generation deferral
- But also reduces rooftop PV generation and associated avoided FPP costs

→ ***Net effects are <u>negligible</u>: a slight decrease in shareholder earnings and increase in non-participant bills, compared to the base-case impacts***

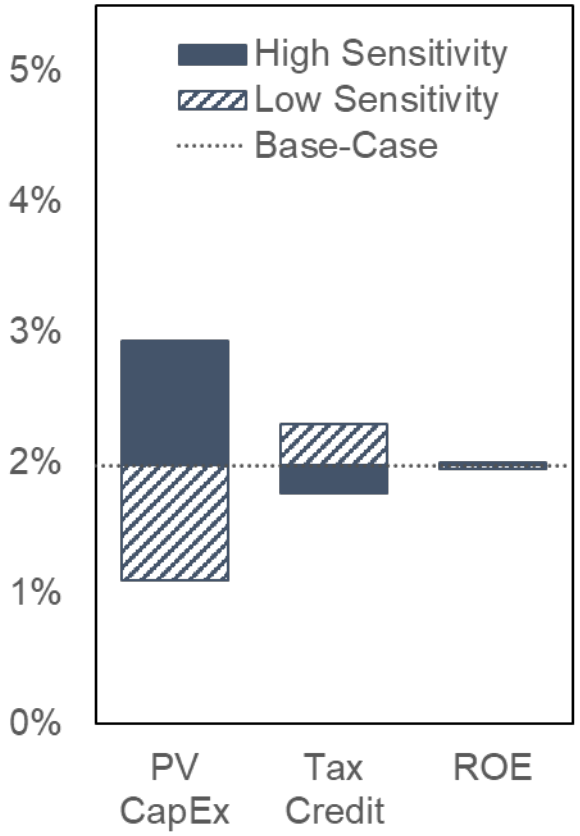
Sensitivities: PV CapEx, ITC, and Authorized ROE

Utility-Owned PV: Changes Relative to No-PV

Shareholder Earnings



Non-Participant Bills

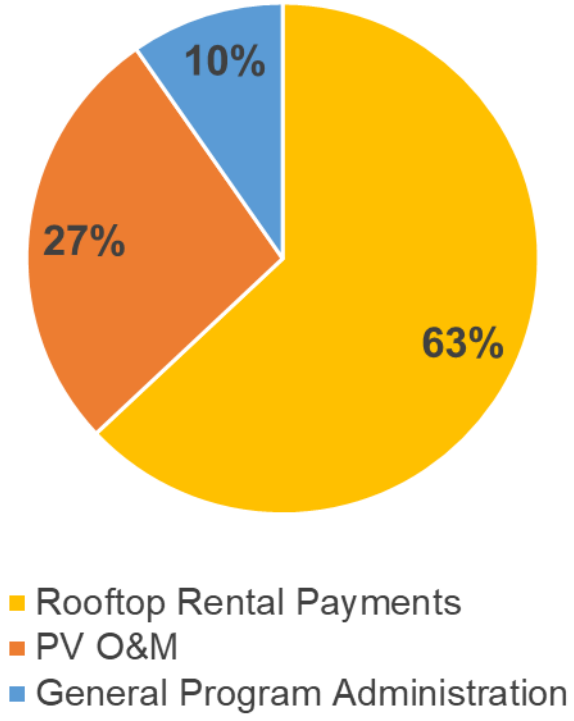


- Three sensitivity cases, all related to the effects of rate-basing rooftop PV:
  - **PV CapEx:** $1.5/W - $3.5/W in Yr.1
  - **ITC:** 10% vs. 30%
  - **Authorized ROE:** +/- 50 basis points
- Results most sensitive to PV CapEx
  - At the lower end, non-participant bill impacts still rise by 1% relative to no-PV, compared to the 2% rise under HO/TPO PV

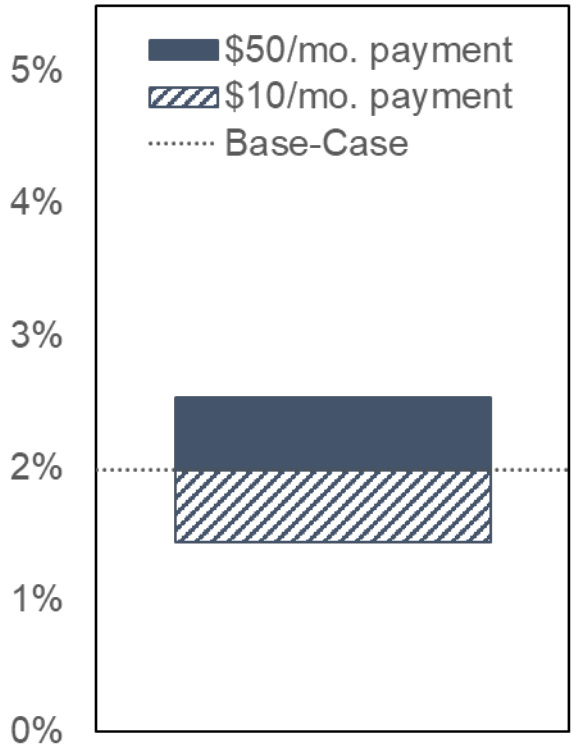
→ ***Suggests that low-cost procurement may be essential to realizing ratepayer benefits***

Sensitivity to “Rooftop Rental” Payment to Host Customer

Utility-Owned PV Program Operating Costs (Base-Case)



Change in Non-Participant Bills Relative to No-PV



- Monthly payments to site hosts are the largest component of program OpEx
- Base-case assumes $30/month; sensitivities consider $10-50/month
- All program OpEx treated as a straight pass-through; no impact on earnings
- Non-participant bill impacts range from a 1.4% to 2.5% increase from no-PV, depending on the rooftop rental rate

→ ***Minimizing rental rates is one lever for reducing program bill impacts, though may not be feasible under a large-scale implementation***

Other Factors That Could Materially Impact the Results

Alternate conditions…	which would lead to…	resulting in…
HO/TPO PV compensated at less than average retail rates (e.g., no NEM)	Less revenue erosion under HO/TPO, smaller changes in earnings and rates relative to no-PV	Lower value of utility ownership relative to HO/TPO, for both shareholders and ratepayers
Higher retail electricity rates	Greater revenue erosion under HO/TPO, larger changes in earnings and rates relative to no-PV	Greater value of utility ownership relative to HO/TPO, for both shareholders and ratepayers
Higher background levels of existing/planned solar generation	Greater potential for utility ownership to mitigate integration costs or defer higher CapEx resources	Greater value of utility ownership for ratepayers, relative both to HO/TPO and no-PV

Conclusions

- Ideally, one might identify a “win-win” for utility shareholders and ratepayers
- Base-case results represent more like a “win-wash” compared to outcomes under non-utility ownership, and a “win-lose” compared to no-PV
- The analysis points toward several options that might create a clearer “win” for ratepayers:
  - Procuring rooftop PV at especially low cost
  - Minimizing rooftop rental payments to participating customers
  - Leveraging utility ownership to facilitate higher value forms of deployment than considered in our analysis (e.g., geo-targeting, incorporating grid services, adding storage)
  - Evaluating ratepayer benefits in terms of equity outcomes (e.g., participation by LMI households), rather than simply average bill impacts

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For more information

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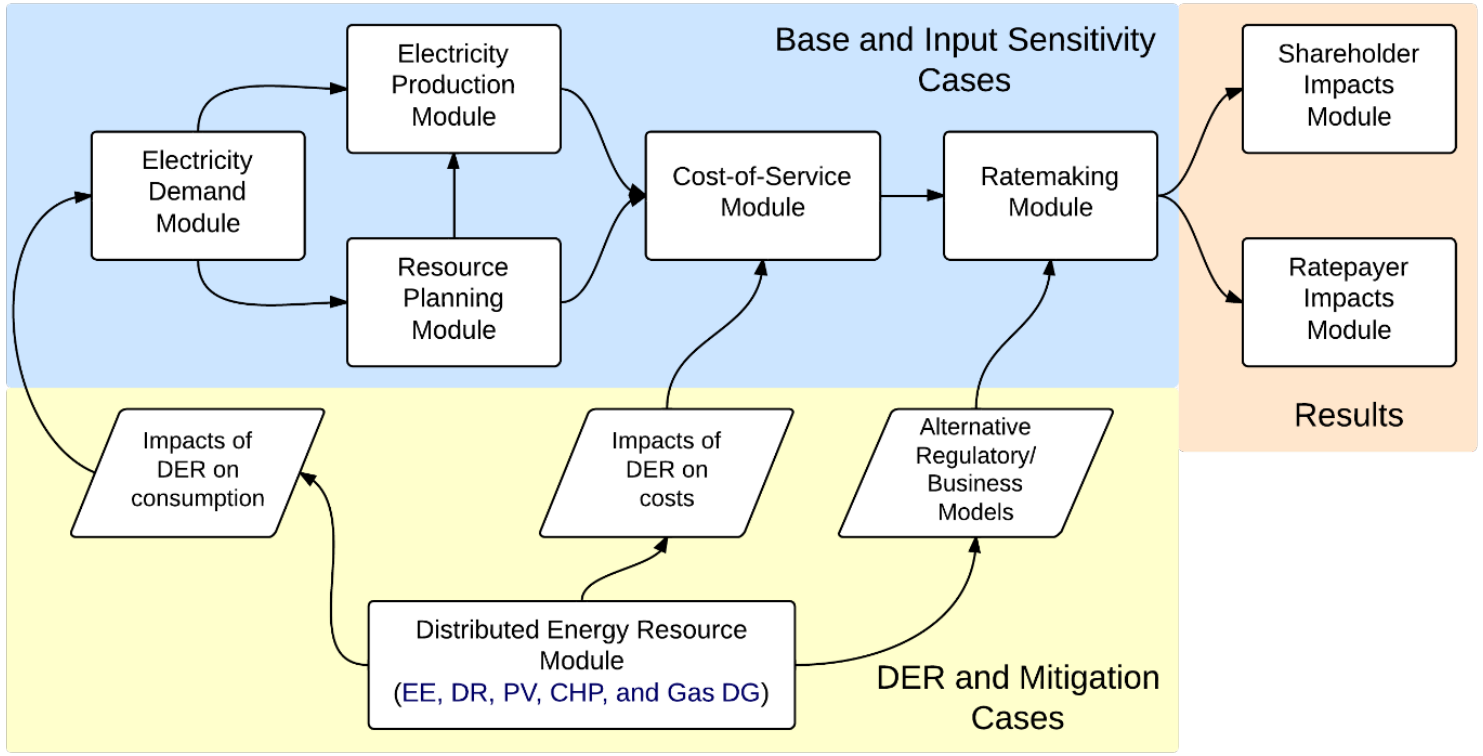
Berkeley Lab's FINancial Impacts of Distributed Energy Resources (FINDER) Model

- Pro-forma financial model of changes in utility costs and revenues with the addition of DERs
- Emphasis is on representation of ratemaking process and utility accounting mechanisms
  - High-level representation of utility cost drivers → not a detailed production cost or capacity expansion model
- Model outputs include shareholder metrics (achieved ROE and earnings) and ratepayer metrics (average retail rates and bills)
  - We focus on earnings and bill impacts



Appendix B contains additional details on FINDER's CapEx deferral logic. For a more complete description of the FINDER model structure and logic, see Satchwell et al. (2017) and Satchwell et al. (2014).