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The Impacts of Net Metering on Utility Profits and Rates: Case Studies of Two Prototypical Utilities

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***Abstract* — Heated debates about the impact of net metering on utility shareholders and ratepayers have surfaced in some of the larger state solar markets and will only become more pronounced and widespread as solar costs decline and deployment accelerates. In order to inform these discussions, we performed a scoping analysis to quantify the magnitude of the financial impacts of distributed PV on utility shareholders and ratepayers, and that assesses the potential efficacy of various options for mitigating those impacts. We quantify the impacts of customer-sited PV for two prototypical investor-owned utilities: a vertically integrated utility located in the southwest and a wires-only utility and default service supplier located in the northeast. For each utility, we model the impacts of customer-sited PV over a 20-year period, estimating changes to utility costs, revenues, average rates, and utility shareholder earnings and return-on-equity.**

***Index Terms* — net metering, profits, rates, utilities**

I. Introduction

Deployment of customer-sited photovoltaics (PV) in the United States has expanded rapidly in recent years, driven in part by public policies premised on a range of societal benefits that PV may provide. With the success of these efforts, heated debates have surfaced in a number of U.S. states about the impacts of customer-sited PV on utility shareholders and ratepayers, and such debates will likely become only more pronounced and widespread as solar costs continue to decline and deployment accelerates. To inform these discussions, we performed a scoping analysis to quantify the financial impacts of customer-sited PV on utility shareholders and ratepayers and to assess the potential efficacy of various options for mitigating those impacts.

The analysis relied on a pro-forma utility financial model that Lawrence Berkeley National Laboratory previously developed for the purpose of analyzing utility shareholder and ratepayer impacts of utility-sponsored energy efficiency programs. Using this model for the present study, we quantified the impacts of net-metered PV for two prototypical investor-owned utilities: a vertically integrated utility located in the southwest (SW) and a wires-only utility and default service supplier located in the northeast (NE). For each utility, we modeled the impacts of PV over a 20-year period, estimating changes to utility costs, revenues, average rates, and utility shareholder earnings and return-on-equity (ROE).

II. Base Case Results

The utility shareholder and ratepayer impacts of customer-sited PV were first assessed under a set of base-case assumptions related to each utility's regulatory and operating environment, in order to establish a reference point against which sensitivities and potential mitigation strategies could be measured. The base-case analyses were performed with total penetration of customer-sited PV rising over time to stipulated levels ranging from 2.5% to 10% of total retail sales. Each of these PV penetration cases were compared to a scenario with no customer-sited PV over the entire analysis period. Key findings from the base-case analysis are as follows.

Utility Costs and Revenues. Customer-sited PV reduces both utility revenues and costs (i.e., revenue requirements). In the case of the SW Utility, impacts on revenues and costs are roughly equal under the 2.5% PV penetration scenario. At higher PV penetration levels, however, revenue reductions exceed cost reductions, in part because of a declining marginal value of PV. In the case of the NE Utility, revenue reductions exceed cost reductions across all future PV penetration levels considered, and the divergence is considerably wider than for the SW Utility. This occurs because the NE Utility has higher assumed growth in certain fixed costs that customer-sited PV does not reduce.

Achieved ROE. Impacts on achieved shareholder ROE varied by utility and PV penetration level (see Figure 1). Under the scenario with PV penetration rising to 2.5% of retail sales, average achieved shareholder ROE was reduced by 2 basis points (a 0.3% decline in shareholder returns) for the SW utility and by 32 basis points (5%) for the NE Utility. Under the more aggressive 10% PV penetration scenario, average ROE fell by 23 basis points (3%) for the SW Utility and by 125 basis points (18%) for the NE Utility. These ROE reductions occur because of the proportionally larger effect of customer-sited PV on utility revenues than on utility costs, under our base-case assumptions. ROE impacts were larger for the wires-only NE utility, because of both its higher assumed growth in fixed costs and its proportionally smaller ratebase (as it does not own generation and transmission).

Achieved Earnings. The impact of customer-sited PV on shareholder earnings for the SW Utility was somewhat more pronounced than the ROE impacts, because of lost earnings opportunities associated with deferred capital expenditures that would otherwise generate earnings for shareholders. Under the 2.5% PV penetration scenario, average earnings for the SW Utility were reduced by 4% (compared to a 0.3% reduction in ROE). Because of the lumpy nature of capital investments and the way in which they change the timing of general rate cases (GRCs) and setting of new rates, those earnings impacts do not necessarily scale with the penetration of customer-sited PV; under the 10% PV penetration scenario, earnings for the SW Utility were reduced by 8%. Because the NE Utility does not own generation or transmission, the lost earnings opportunities from customer-sited PV are less severe, and thus impacts on earnings are similar to impacts on ROE, ranging from a 4% reduction under the low-end PV penetration scenario to a 15% reduction in earnings at the high-end PV penetration scenario.

Average Rates. The ratepayer impacts of customer-sited PV were relatively modest compared to the impacts on shareholders. In the 2.5% PV penetration scenario, customer-sited PV led to a 0.1% increase in average rates for the SW Utility and a 0.2% increase for the NE Utility. Under the more aggressive 10% PV penetration scenario, average rates rose by 2.5% and 2.7% for the SW and NE Utilities, respectively. These rate impacts reflect the net impact of customer-sited PV on utility costs and sales, where reduced costs are spread over a smaller sales base. Note, though, that these impacts represent the increases in average rates across all customers, including those with and without PV, and thus do not measure cost-shifting, per se.

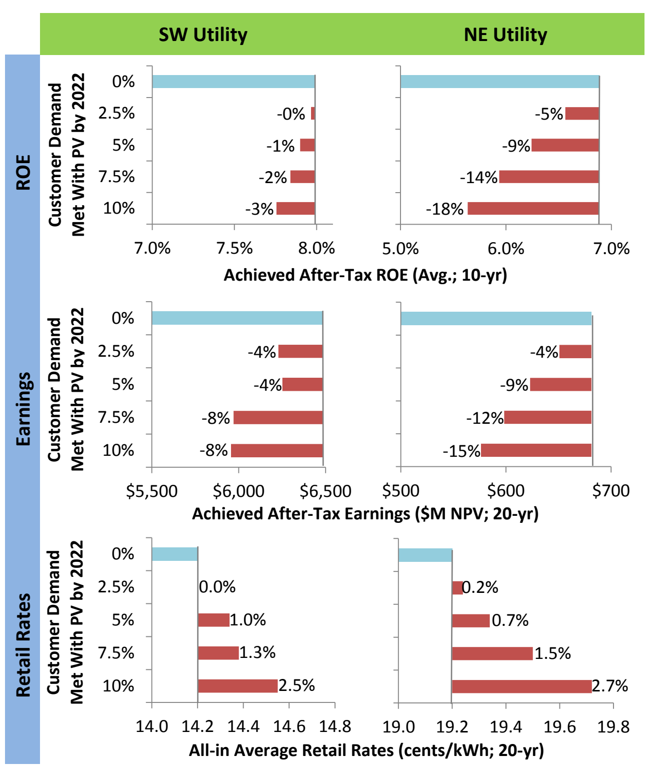

Fig. 1. Impacts of Customer-Sited PV on Utility Shareholder ROE and Earnings under Base Case Assumptions

III. Sensitivity Analyses

One key objective of this scoping study was to illustrate the extent to which the potential impacts of customer-sited PV on utility shareholders and ratepayers depend on underlying conditions of the utility. To explore these inter-relationships, we compared the impacts from PV under a wide array of sensitivity cases, each involving alternate assumptions about key aspects of the utilities' operating or regulatory environments (see Table 1). The sensitivity cases all focus specifically on impacts from customer-sited PV at a penetration level of 10% of total retail sales; this is the highest penetration level examined within this study and is used for the sensitivity cases in order to clearly reveal the relationships between the impacts of PV and the sensitivity variables.

TABLE 1
SENSITIVITY CASES

	Sensitivities
Utility Operating Environment	Value of PV: Higher/lower PV capacity credit and ability of PV to offset non-generation capital expenditure
	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 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

Across the full set of sensitivity cases examined, the magnitude of shareholder impacts varies considerably, as shown in Figure 2. Specifically, achieved earnings were reduced by 5% to 13% for the SW utility and by 6% to 41% for the NE utility, with similar ranges in the impacts on achieved ROE, illustrating the degree to which these impacts potentially depend on utility-specific conditions. By comparison, ratepayer impacts were relatively stable across sensitivity cases, with increases in average rates ranging from 0% to 4% for the SW utility and from 1% to 4% for the NE utility.

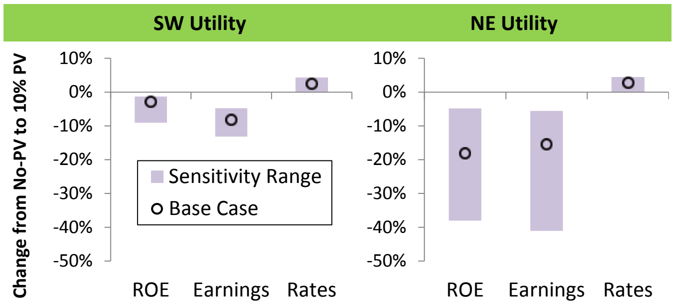

Fig. 2. Impacts of Customer-Sited PV across Sensitivity Cases

The impacts to both prototypical utilities are particularly sensitive to the capacity value and avoided T&D costs from customer-sited PV. Important to note, however, is the divergent set of implications for ratepayers vs. shareholders. The greater the capacity value and avoided T&D costs from PV, the greater the deferral of utility capital expenditures. This reduces the impacts of customer-sited PV on retail rates. Indeed, under one set of assumptions for the SW Utility, customer-sited PV results in a slight decrease in average rates. For utility shareholders, however, increased deferral of capital expenditures leads to greater erosion of earnings.

As to be expected, utility shareholder impacts from customer-sited PV tend to be more severe when retail rates rely predominantly on volumetric energy charges and also tend to be more severe when longer lags exist within the ratemaking process (e.g., longer periods between rate cases or use of historic test years). The heightened shareholder impacts in these cases occur because of greater revenue erosion associated with PV.

Shareholder impacts from customer-sited PV also depend, though often to a lesser extent, on the magnitude and growth rates of various utility cost elements; however, the degree and direction of those sensitivities depend on the type of cost and how it is recovered. For example, the erosion of shareholder profitability from customer-sited PV is unaffected by fuel costs (assuming they are a pass-through), but may be highly sensitive to capacity costs for utility-owned generation.

IV. Mitigation Analysis

Finally, we analyzed a number of (though by no means all) options for mitigating the possible impacts of customer-sited PV on utility shareholders and ratepayers. As in the sensitivity analysis, we again focused on the impacts under the 10% PV penetration scenario, in order to most clearly reveal the effects of the mitigation measures considered. These mitigation scenarios borrow, to some degree, from the kinds of measures that have been implemented or suggested in connection with energy efficiency programs. Most target shareholder impacts associated with either revenue erosion or lost earnings opportunities from customer-sited PV, and in some cases may exacerbate the ratepayer impacts from customer-sited PV. Key themes and findings from the quantitative analysis of mitigation options include the following.

Decoupling and lost-revenue adjustment mechanisms may moderate revenue erosion from customer-sited PV, and thereby mitigate its impacts on shareholder ROE and earnings (see Figure 3); however, the size (and even direction) of impact varies greatly depending upon the design of these mechanisms and characteristics of the utility. This can be seen by comparing the results for revenue per customer (RPC) with and without a "k-factor" (which adjusts revenue growth during periods between rate cases to account for cost inflation). For the prototypical NE Utility in our analysis, RPC decoupling without a k-factor actually exacerbates revenue erosion, while for the SW Utility, it would over-compensate for the impacts of distributed PV on utility ROE.

Depending on the utility's underlying rate of cost growth, revenue erosion from customer-sited PV can also be mitigated by transitioning to more-frequent rate cases, use of current or future test years, and reduced regulatory lag, all of which serve to tighten the temporal alignment between the incidence of costs and collection of revenues. However, to the extent that these various mitigation measures serve to restore shareholder ROE and earnings, they may entail some corresponding increase in average retail rates, exemplifying the kind of tradeoffs inherent in many potential mitigation measures.

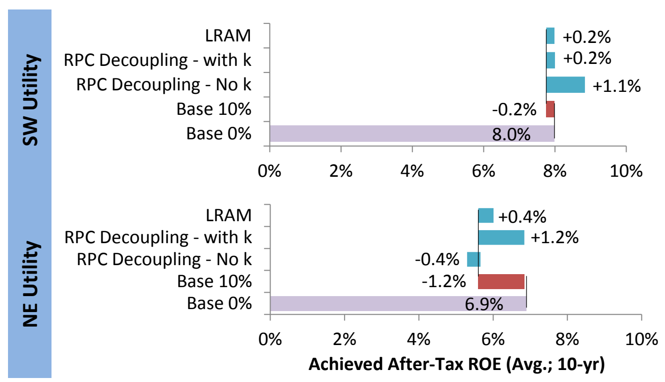

Fig. 3. Mitigation of PV Impacts through Decoupling and LRAM

Increased fixed customer charges or demand charges may also moderate revenue erosion, and the associated impacts on shareholder ROE and earnings, from customer-sited PV. Importantly though, the effectiveness of those measures depends critically on the underlying growth in the number of customers or customer demand. For the purpose of our mitigation analysis, we specified two scenarios involving alternative rate designs – a high demand charge case and a high fixed customer charge case – applied to all customers. Both entail shifting all non-fuel costs that were recovered through volumetric charges in the base case to either demand charges (in the high demand charge case) or fixed customer charges (in the high fixed customer charge case). The resulting share of revenue collected through volumetric, demand, and fixed charges is shown in Table 2.

TABLE 2
DISTRIBUTION OF UTILITY REVENUE COLLECTION ACROSS BILLING COMPONENTS IN RATE DESIGN MITIGATION CASES

	Base Case	High Demand Charges	High Customer Charges
SW Utility			
Volumetric Charges	77%	24%	24%
Demand Charges	11%	63%	11%
Customer Charges	12%	12%	65%
NE Utility			
Volumetric Charges	84%	64%	64%
Demand Charges	8%	28%	8%
Customer Charges	8%	8%	28%

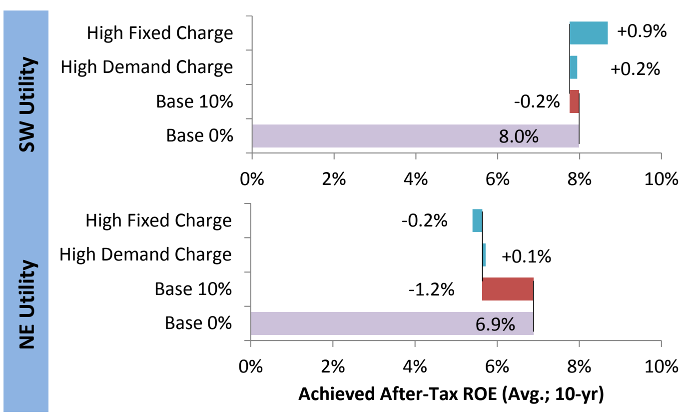

Fig. 4. Mitigation of PV Impacts through Increased Customer Charges or Demand Charges

As shown in Figure 4, the extent to which these alternate rate designs mitigate the utility shareholder impacts of PV varies considerably, both between the fixed customer charge and demand charge scenarios, and between the two prototypical utilities. Somewhat counterintuitively, the high fixed customer charge scenario actually exacerbates erosion of shareholder ROE for the NE Utility. This occurs because of the low rate of growth in the number of utility customers relative to growth in sales (even considering the dampening effect on sales from increased PV adoption). Moreover, such shifts in rate design are not without other consequences, including that they dampen incentives for customers to invest in energy efficiency and PV.

Shareholder incentive mechanisms, similar to those often implemented in conjunction with utility-administered energy efficiency programs, as well as utility ownership or financing of customer-sited PV, both offer the potential for substantial shareholder earning opportunities, though the associated policy and regulatory issues may be significant.

To be sure, utility ownership or financing of customer-sited PV may raise a variety of significant policy and regulatory questions, not the least of which being whether a regulated utility should be allowed to provide a service similar to that provided by unregulated, competitive companies (including, in some cases, unregulated affiliates of the utility). In the case of a regulated utility, ratepayers would generally bear some portion of the risk of such investments. Furthermore, some states no longer allow regulated utilities to own generation (as in our NE Utility), in which case utility ownership of customer-sited generation may be prohibited or would require special authorization.

Putting aside those important policy questions, we assume for the purpose of our analysis that the regulated utility is allowed to own customer-sited PV and earn its authorized rate of return on those assets. We consider two scenarios: one bookend scenario in which the utilities own 100% of customer-sited PV capacity in their service territories, and another in which they own 10% of PV capacity. As shown in Figure 5, allowing the utility to own distributed PV assets can offset some of the earnings erosion that would otherwise occur as a result of distributed PV. The significance of the potential earnings boost is most pronounced for wires-only utilities with otherwise limited investment opportunities: in the case of the NE Utility in our analysis, nearly all of the earnings erosion that would otherwise occur as a result of customer-sited PV is offset in a scenario where the utility owns just one-tenth of the customer-sited PV deployed in its service territory offsets. For both utilities, ownership of 100% of the distributed PV would more-than-offset the earnings erosion that otherwise occurs.

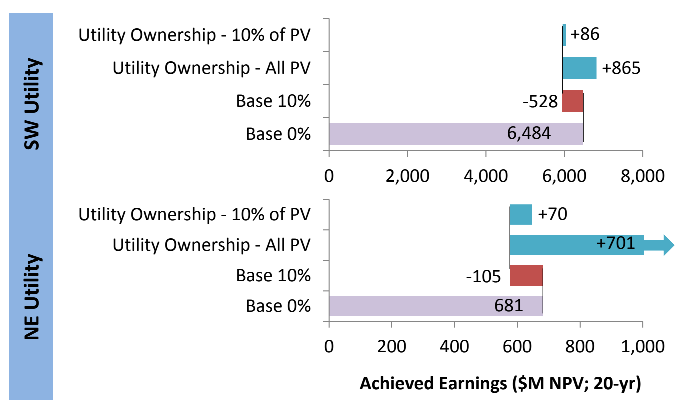

Fig. 5. Mitigation of PV Impacts through Utility Ownership of Customer-Sited PV

IV. Conclusions and Areas for Further Research

In summary, the findings from this scoping study point towards several high-level policy implications. First, even at 10% PV penetration levels, which are substantially higher than exist today, the impact of customer-sited PV on average retail rates may be relatively modest (at least from the perspective of all ratepayers, in aggregate). At a minimum, the magnitude of the rate impacts estimated within our analysis suggest that, in many cases, utilities and regulators may have sufficient time to address concerns about the rate impacts of PV in a measured and deliberate manner. Second and by comparison, the impacts of customer-sited PV on utility shareholder profitability are potentially much more pronounced, though they are highly dependent upon the specifics of the utility operating and regulatory environment, and therefore warrant utility-specific analysis. Finally, we find that the shareholder (and, to a lesser extent, ratepayer) impacts of customer-sited PV may be mitigated through various "incremental" changes to utility business or regulatory models, though the potential efficacy of those measures varies considerably depending upon both their design and upon the specific utility circumstances. Importantly, however, these mitigation strategies entail tradeoffs – either between ratepayers and shareholders or among competing policy objectives – which may ultimately necessitate resolution within the context of broader policy- and rate-making processes, rather than on a stand-alone basis.

As a scoping study, one final objective of this work is to highlight additional questions and issues worthy of further analysis, many of which will be addressed through follow-on work to this study and further refinements to LBNL's utility financial model. Although by no means an exhaustive list, these areas for future research include examining: the relative impacts of customer-sited PV compared to other factors that may impact utility profitability and customer rates; the combined impacts of customer-sited PV, aggressive energy efficiency, and other demand-side measures; the rate impacts of customer-sited PV and various mitigation measures specifically on customers without PV and differences among customer classes; a broader range of mitigation options; potential strategies for maximizing the avoided costs of customer-sited PV; and continued efforts to improve the methods and data required to develop reliable and actionable estimates of the avoided costs of customer-sited PV.

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