Customer-Sited Solar Generation

Net Cost or Net Benefit?

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- Attorney and Board Member: Renewable Energy Industries Association;
- General Manager of Solar Installation Companies in the New Mexico Market;
- Genuinely nice fella under most circumstances

Arizona Study of Distributed Generation Costs and Benefits

- Crossborder Energy (Thomas Beach and Patrick McGuire)
- Focused on the effect of demand-side (customer-sited) solar would have on ratepayers
- Analyzed solar over the useful life of solar equipment (20-30 years)
- Conclusion: "…the benefits of DG on the APS system exceed the cost, such that new DG resources will not impose a burden on APS ratepayers."
- **$0.22 to $0.24 benefit compared to $0.14 to $0.16 costs**

Table 1: *Benefits and Costs of Solar DG on the APS System*

Benefits	*20-year levelized cents per kWh (2014 $)*
Energy	6.4 to 7.5
Generation capacity	6.7 to 7.6
Ancillary services & Capacity reserves	1.5
Transm ission	2.1 to 2.3
Distributi on	0.2
Envir onmental	0.1
Avoi ded Renewables	4.5
Total Benefits	**21.5 to 23.7**
Costs	*20-year levelized cents per kWh (2014 $)*
Lost retail rate revenues	13.7
DG incentives	0 to 1.6
Integration costs	0.2
Total Costs	**13.9 to 15.5**

Evaluating the Benefits and Costs of Net Energy Metering in California

- Crossborder Energy (Thomas Beach and Patrick McGuire)
- Explored claims by California's investor-owned utilities that the net metering policies caused substantial cost-shifts between solar customers and those without solar (particularly in residential markets)
- Finding: Net metering actually created a small net benefit to ratepayers on average, across various IOU markets
- Ranged from cost to ratepayers of $0.013 (just over a cent) in PG&E territory to benefit of $0.028 in SDG&E.

Net Metering in Mississippi

- Commissioned by the Public Service Commission
- Authors Elizabeth Stanton, et. al. - Synapse Energy Economics
- Finding: Net metering provides net benefits (benefit-cost ratio above 1:0) under almost all of the scenarios and sensitivities analyzed.

ES Table 1. Summation of TRC Test benefit/cost ratios under various sensitivities

	Low	Mid	High
Fuel Price Scenario	1.17	1.19	1.21
Capacity Value Sensitivities	1.11	1.19	1.26
Avoided T&D Sensitivities	1.01	1.19	1.32
CO_2 Price Sensitivities	1.16	1.19	1.24
Combined Scenarios	0.89	1.19	1.47

Evaluation of Net Metering in Vermont

- Mandated study by the legislature, directed to *"include an analysis of whether and to what extent customers using net metering systems under [state statute] are subsidized by other retail electric customers who do not employ net metering."*
- Included utility lost revenue as a "cost" in the analysis
- Findings: **Net metered systems do not impost a significant net cost to ratepayers who are not net metering participants.**
- Answer seems to turn on the degree to which future greenhouse gas compliance costs are included.

Figure 5. *Annual costs and benefits associated with a 4 kW fixed solar PV residential system installed in 2013.*

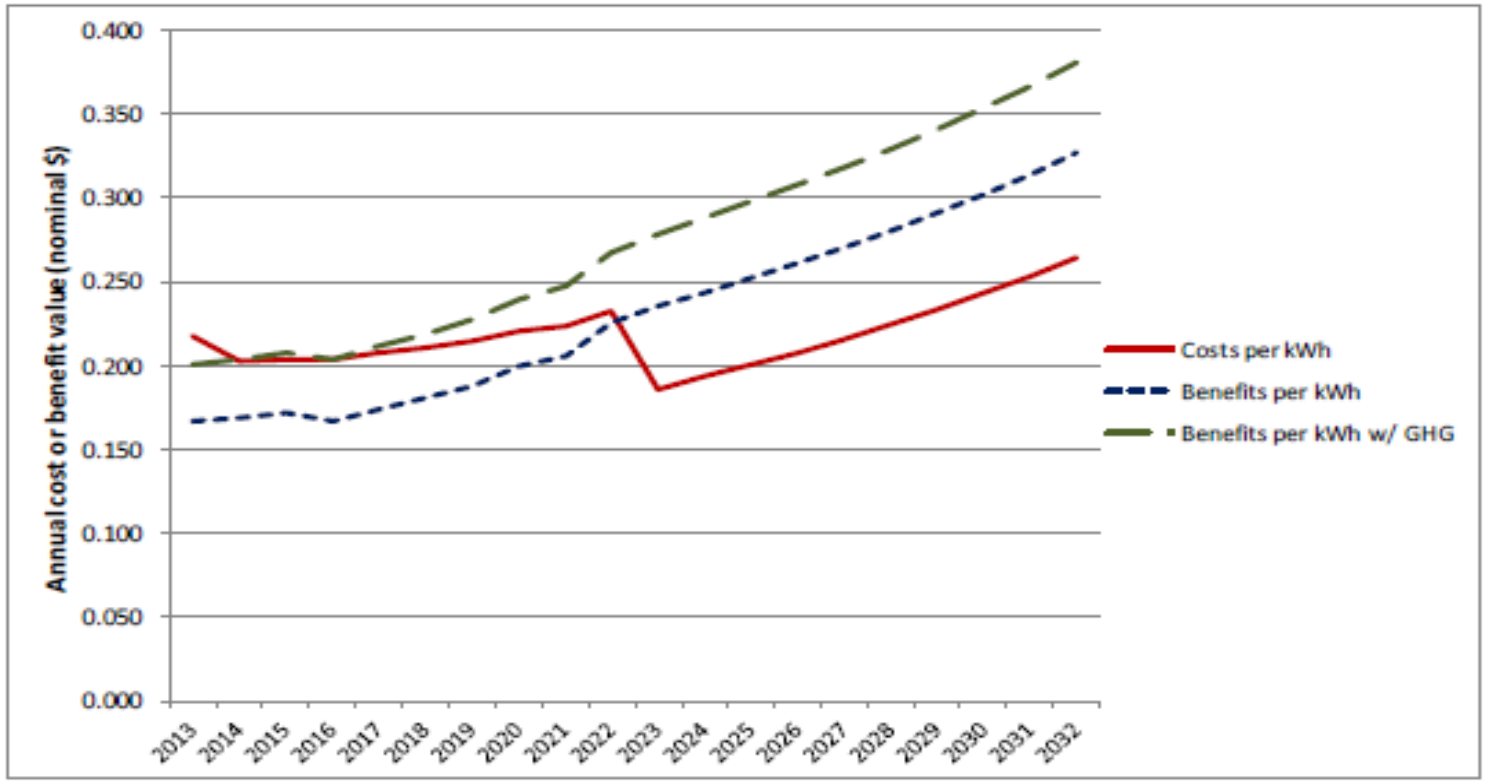

Table 4. *Levelized cost, benefit, and net benefit of a 4 kW fixed solar PV residential system installed in 2013 to other ratepayers individually ("ratepayer") or statewide.*

Units: $ per kWh generated		No GHG value included		GHG value included	
	Cost	Benefit	Net Benefit	Benefit	Net Benefit
Ratepayer	0.221	0.215	($0.006)	$0.257	$0.036
Statewide	0.222	0.222	$0.000	$0.264	$0.043

Maine Distributed Solar Valuation Study

- 2015 Study, prepared for Legislative Committee
- Study done by Clean Power Research, Pace Law School, and others
- Findings:
  - Found significant net benefit of Solar DG
  - First year “snapshot” benefit (net) of $0.182/kwH
  - Long-term, Levelized benefit (net) of $0.337/kwH
- Examined several categories of cost and benefit and compared

Figure ES- 2. CMP Distributed Value – 25 Year Levelized ($ per kWh)

25 Year Levelized		Gross Value A ($/kWh)	×	Load Match Factor B (%)	×	Loss Savings Factor (1+C) (%)	=	Distr. PV Value D ($/kWh)	
Energy Supply	Avoided Energy Cost	$0.076				6.2%		$0.081	Avoided Market Costs $0.138
	Avoided Gen. Capacity Cost	$0.068		54.4%		9.3%		$0.040	
	Avoided Res. Gen. Capacity Cost	$0.009		54.4%		9.3%		$0.005	
	Avoided NG Pipeline Cost								
	Solar Integration Cost	($0.005)				6.2%		($0.005)	
Transmission Delivery Service	Avoided Trans. Capacity Cost	$0.063		23.9%		9.3%		$0.016	
Distribution Delivery Service	Avoided Dist. Capacity Cost								
	Voltage Regulation								
Environmental	Net Social Cost of Carbon	$0.020				6.2%		$0.021	Societal Benefits $0.199
	Net Social Cost of SO_2	$0.058				6.2%		$0.062	
	Net Social Cost of NO_x	$0.012				6.2%		$0.013	
Other	Market Price Response	$0.062				6.2%		$0.066	
	Avoided Fuel Price Uncertainty	$0.035				6.2%		$0.037	
								$0.337	

Gross Values represent the value of perfectly dispatchable, centralized resources. These are adjusted using

- Load Match Factors to account for the non-dispatchability of solar; and
- Loss Savings Factors to account for the benefit of avoiding energy losses in the transmission and distribution systems.

Why the “Debate”?

Nature of typical solar benefits – conflict with utility revenue model:

- Avoided fuel – no problem there
- Avoided Generation Capacity (utility scale)
- Avoided Transmission Capacity Cost
- Use of variable rate-design to cover fixed costs
- Solutions to de-conflict solar DG with utility revenue model?