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Webinar*

May 20, 2020

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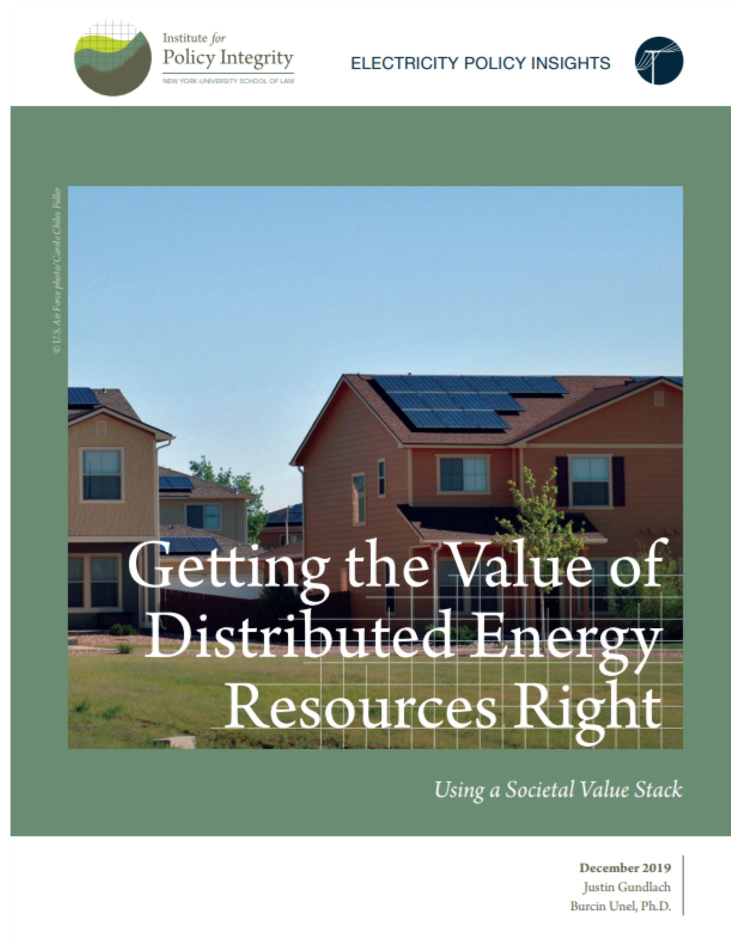

* *This version includes slides added in response to a question posed during the webinar*

Overview

I. Background

II. Value of DERs

III. Reasons to move beyond net metering

Table of Contents

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Background: DERs' Value Is Necessarily Relative

- In general, on a per-unit basis, DERs generate electricity less cost-effectively than centralized resources.
- Exceptional instances where DERs are more cost-effective owe to locational & temporal factors.
- Ignoring those factors ensures DERs' over- or undervaluation.

44 *Harvard Environmental Law Review* [Vol. 41

MANAGING THE FUTURE OF THE ELECTRICITY GRID: DISTRIBUTED GENERATION AND NET METERING

Richard L. Revesz and Burcin Unel***

ABSTRACT

As distributed energy generation is becoming increasingly common, the debate on how a utility's customers should be compensated for the energy they sell back to the grid is intensifying. And net metering, the practice of compensating for such energy at the retail rate for electricity, is becoming the subject of intense political disagreement. Utilities argue that net metering fails to compensate them for grid construction and distribution costs and that it gives rise to regressive cost shifting among customers. Conversely, solar energy proponents argue that the compensation should be higher than the retail rate to account for other benefits that distributed generation systems provide, such as greenhouse gas emission reductions, improved air quality, and reduced utility spending on new capacity installations. This ongoing debate is leading to significant changes to net metering policies in many states.

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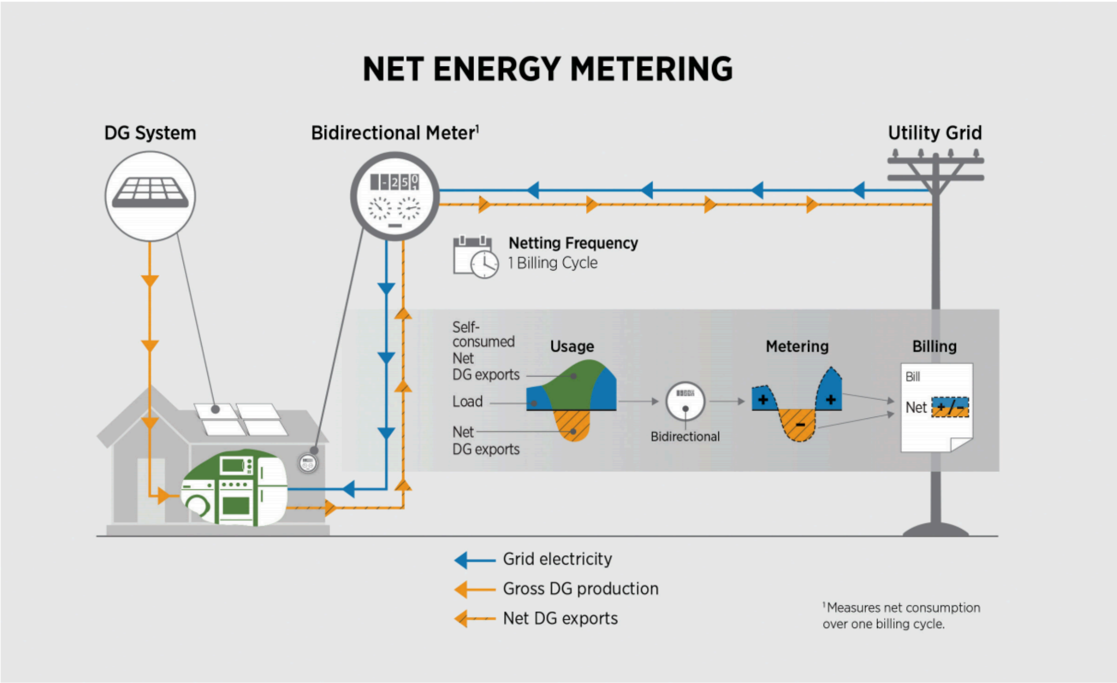
Background: Net Metering

Figure 2. National Renewable Energy Laboratory's schematic of NEM, showing physical and financial interaction between DER owner and utility.[22]



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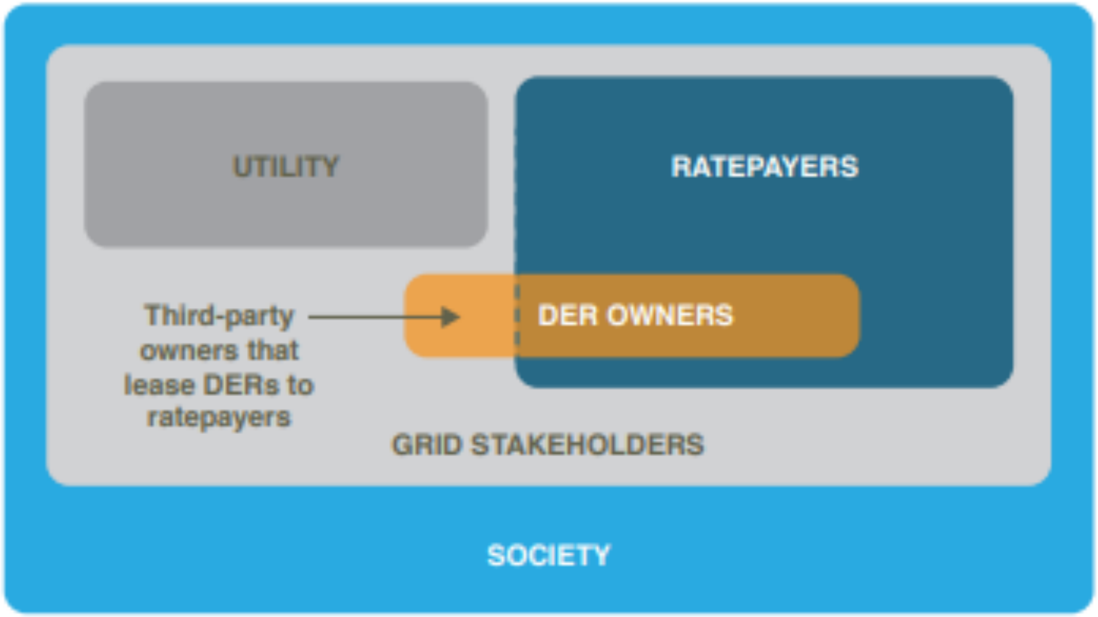
Value of DERs: Perspective

Figure 3. Overlapping perspectives on electricity-related benefits and costs.



https://nationalefficiencyscreening.org/the-national-standard-practice-manual-for-ders/

Value of DERs: Functions

Table 2. Potential functions of DERs.

Function	Type of DER					
	Solar PV*	Solar PV + Storage	Standalone Storage	CHP	Demand Response	Energy Efficiency
Generation	Yes, limited	Yes, limited	No	Yes	No	No
Generation capacity	Yes, limited	Yes, limited	No	Yes	Yes	Yes, limited
Voltage control	No	Yes	Yes	Yes	No	No**
Frequency regulation	No	Yes	Yes	Yes	Yes, limited	No
Spinning reserves	No	Yes	Yes	Yes	Yes, limited	No
Nonspinning reserves	No	Yes	Yes	Yes	No	No***
Flexibility to support renewables integration	No	Yes	Yes	Yes	Yes	No
Line loss reduction	Yes	Yes	Yes, limited	Yes	Yes	No**
Black start capability	No	No	Yes	Yes	No	No

** Newer inverters enable solar PV modules to perform a wider range of functions than those deployed even a few years ago. As new modules' prevalence grows, some of the "No" entries in this column—such as "Flexibility to support renewables integration"—will switch to "Yes."*
*** Conservation voltage reduction (CVR) is an exceptional form of energy efficiency that can provide voltage control and reduce line losses.*
**** A small subset of energy efficiency resources can bid to provide services in wholesale capacity markets.*

Value of DERs: Benefits and Costs

Table 4. Potential Benefits of DERs.

Perspective	Category	Benefit
Electricity system stakeholders (i.e., utilities and their customers, including DER owners)	Bulk power system	Avoided energy costs
		Avoided generation capacity costs
		Avoided reserves and ancillary services costs
		Avoided transmission capital costs and line loss
		Avoided financial risk of primary energy source price volatility
		Avoided environmental compliance costs
	Distribution system	Avoided distribution capital costs and line losses
Society	Public health and safety	Improved resilience to disruptive hazards and stressors
		Public health benefits of avoided local pollution
	Environmental	Environmental benefits of avoided local pollution
		Avoided greenhouse gas emissions

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Value of DERs: Benefits and Costs

Table 5. Costs of DERs.

Perspective	Category	Costs
Utilities + ratepayers who do not own DERs	Program costs	Measure costs (to utility)
		Financial incentives
		Program and administrative costs
		Evaluation, measurement, and verification
	Integration	Interconnection costs (in excess of utility's own costs of interconnection)
	Capital costs (if any)	Distribution grid segment upgrades prompted by DER additions*
DER owners	Costs of DER adoption and operation	Measure costs (to participants)
		Interconnection fees
		Annual operations and maintenance costs
		Resource consumption by participant
		Transaction costs to participant

** At least some of this category of costs is often paid by DER developers*

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Value of DERs: Benefits and Costs

Figure 6. Real-time energy prices (LMP) across New York Independent System Operator (NYISO) Zones A through K at 1pm on July 20, 2019.[52]

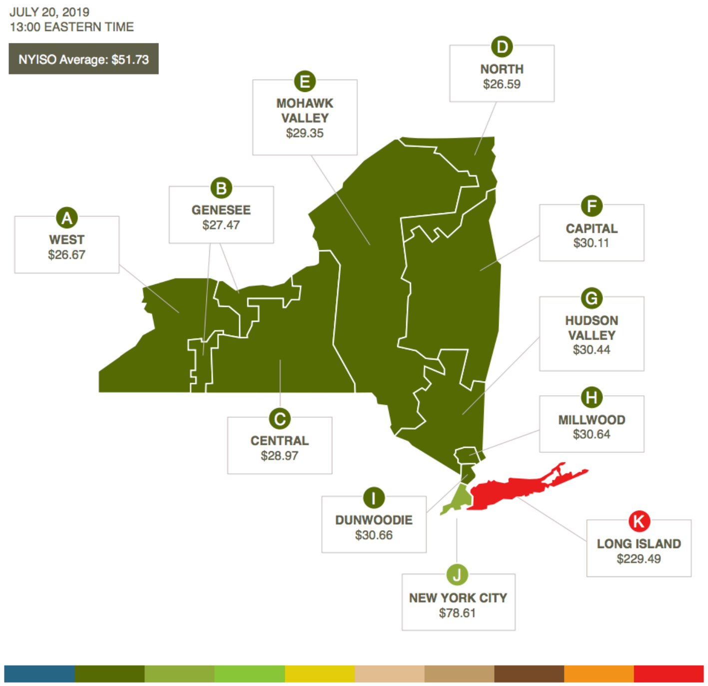
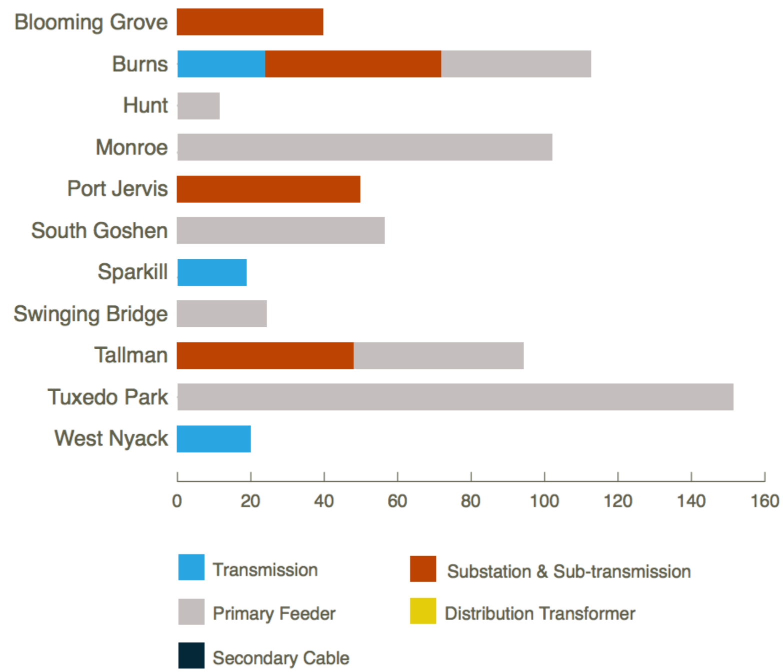


Figure 7. Marginal costs of planned capacity additions ($/kW) in sample of feeder areas in Orange & Rockland's service territory.[63]



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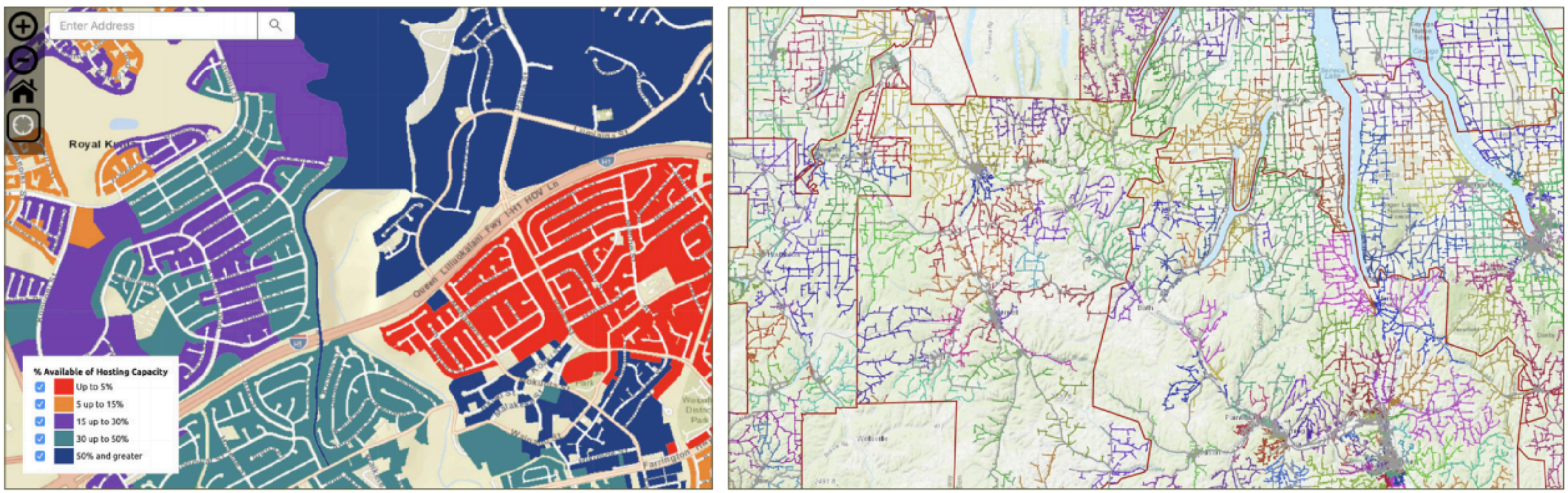
Value of DERs: Benefits and Costs

Figure 5. Oahu hosting capacity and locational value map (left); Hornell, NY hosting capacity map (right).



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Value of DERs: Actually Calculating their Value

(1) Identifying the resource(s) whose operation will be modified or displaced by operation of the DER;

(2) Characterizing the timing and degree of that modification or displacement by comparing DER operation/output to that of the displaced resource(s);

(3) Estimating the costs avoided as a result of this displacement (including the costs of infrastructure development and pollution);

(4) Comparing those avoided costs to the costs of installing and operating the DER; and

(5) Determining the appropriate frequency of and process for updates.

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Value of DERs: Actually Calculating their Value

Table 7. Value stack components, their underlying dynamic metric(s), and their temporal and locational parameters.

<table>
<tr><th>Component</th><th>Metric and/or Units</th><th>Interval</th><th>Geography</th></tr>
<tr><td>Wholesale energy (including generation, congestion, and line losses)</td><td>LMP [$/MWh]</td><td>Hour</td><td rowspan="3">Wholesale market node (or zone)</td></tr>
<tr><td>Wholesale capacity</td><td>Installed capacity or “ICAP”[107]</td><td>Varies by jurisdiction</td></tr>
<tr><td>Transmission</td><td>Varies by jurisdiction;[108] LMP & ICAP capture some but not all capital and O&M costs of transmission</td><td>Six months</td></tr>
<tr><td>Distribution system capacity and line losses</td><td>Utilities’ marginal costs of service</td><td>Decade</td><td>As local as possible: primary feeder, lateral feeder, transformer</td></tr>
<tr><td>Greenhouse gases</td><td>[CO_2e / MWh]</td><td>Hour</td><td>Wholesale market zone</td></tr>
<tr><td>Ambient air pollutants</td><td>[PM, SOx, NOx / MWh]</td><td>Hour</td><td>As granular as is supported by available tools e.g., EASIUR, InMap</td></tr>
<tr><td>Resilience</td><td>Varies by jurisdiction</td><td>Varies by jurisdiction</td><td>Distribution utility service territory</td></tr>
</table>

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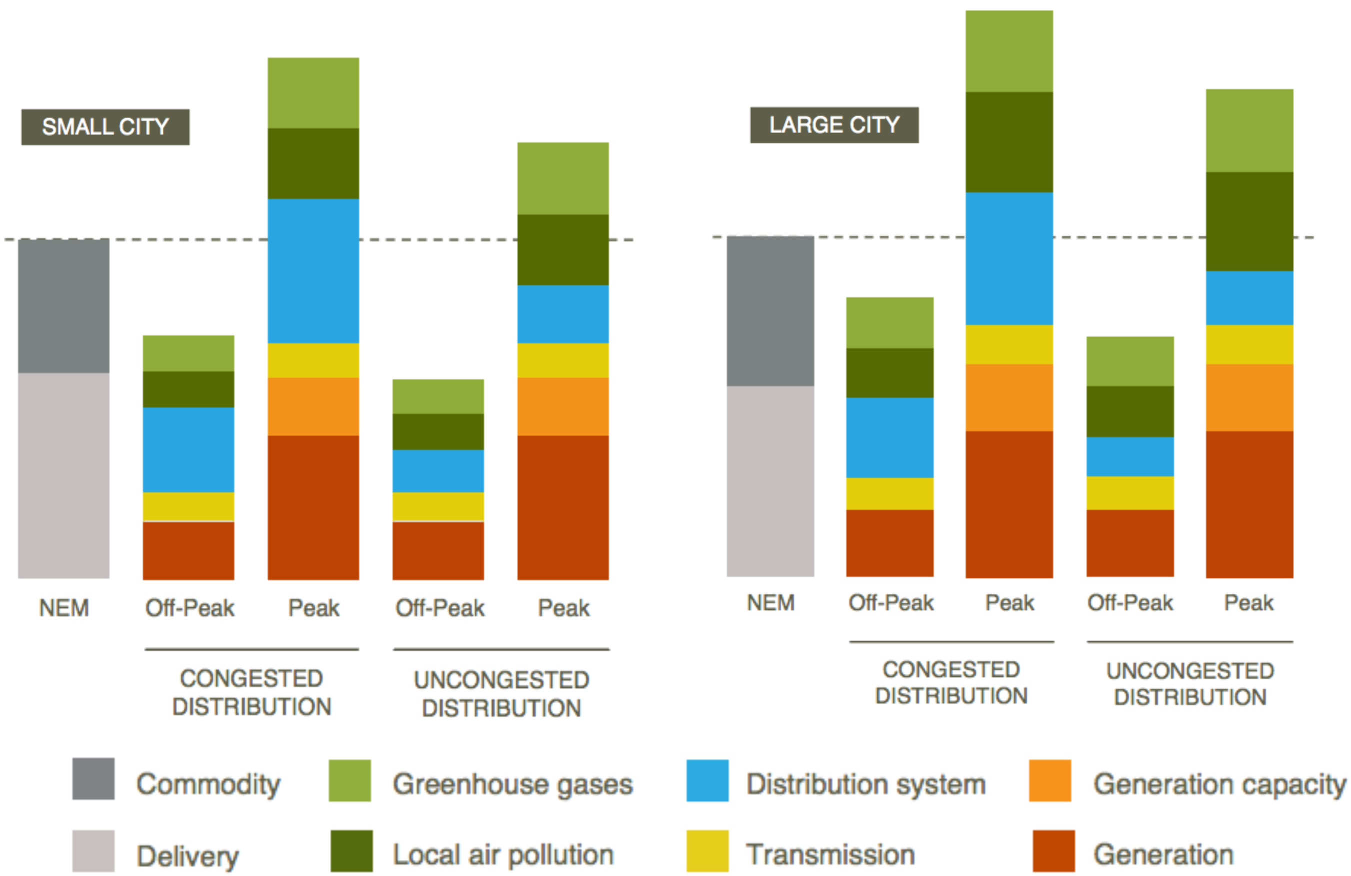
Reasons to Move Beyond Net Metering



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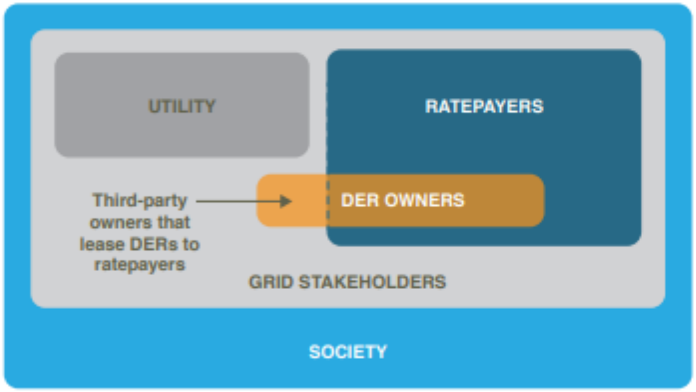
"Fairness"

- **Cost shift**: DER owners pay less, so non-DER owners pay more
- **Distribution system cost recovery**: utilities adjust fixed and variable elements of rates as DER owners--
  (i) avoid consuming grid-based electricity but
  (ii) retain reliable access to the grid and maybe even hit the same demand peaks

Figure 3. Overlapping perspectives on electricity-related benefits and costs.



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CLE code:

Thanks for your attention

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Quantitative Examples: Post-webinar Addition

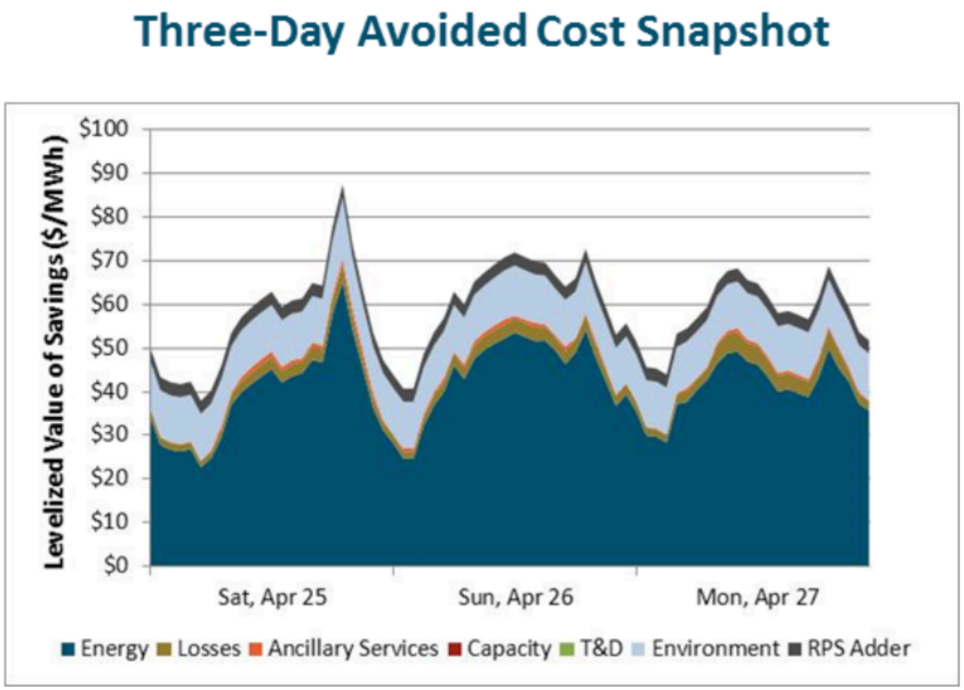
One webinar participant asked us to describe or make available a quantitative example of value stacking that illustrates how integration of the various benefits (mostly in the form of avoided costs) listed on slide 6 / Table 4 of our report might be executed.

The three slides that follow draw on examples from California, Minnesota, and New York. While none of those jurisdictions has adopted exactly the approach Policy Integrity argues for in this presentation, each jurisdiction arrives at a valuation of DERs using a form of "stacking," and so illustrates—quantitatively—how value stacking might be done.

Quantitative Example: California's Avoided Cost Calculator

"The E3 Avoided Cost Model forecasts long-term marginal costs to evaluate the cost-effectiveness of distributed energy resources (DERs) such as energy efficiency, distributed generation, storage, and demand response. It provides robust area- and time-specific cost estimates suitable for regulatory proceedings using public data and transparent forecasting methods."

The 3-day snapshot at right shows changes over 72 hours in the avoidable costs of the following 8 factors for a given service area: energy, generation capacity, transmission capacity, distribution capacity, T&D losses, ancillary services, RPS procurement, environmental (criteria pollutants, GHGs, water).



Source: https://www.ethree.com/tools/acm-avoided-cost-model/ (click "All Tools" box to access presentations containing data sources and worked examples)

Quantitative Example: New York's VDER Value Stack

The top table lists elements of the VDER Value Stack, which has changed several times since 2015. The bottom table is excerpted from an Orange & Rockland statement of payments made to VDER program participants; it indicates amounts paid for each element of the value stack, most of which are tallied in kWh (though one is in kW and another in kW-year).

Component	Projects Eligible	Metric
Energy (LBMP)	All	Day-ahead hourly wholesale energy rate from NYISO
Capacity (ICAP)	All	Paid as Alternative 1, 2, or 3
Environmental (E)	All	Fixed per-kWh rate for environmental benefits
Demand Reduction Value (DRV)	All	Paid per kWh during peak window
Locational System Relief Value (LSRV)	Only in designated utility load pockets	Paid per kW during 10 call events/year
Market Transition Credit / Community Credit	Only community solar	Paid for every kWh

			Capacity Component					
	Energy ($/kWh)	Alternative 1 $/kWh	Alternative 2 $/kWh	Alternative 3 $/kW	E ($/kWh)	DRV ($/kWh)	LSRV (kW-year)	Market Transition Credit ($/kWh)
Phase One	NYISO Zone G	$ 0.01023	$ 0.22312	$ 5.52	$ 0.02741	$ 64.78	n/a	$ 0.0911 - $ 0.0235
Phase Two	NYISO Zone G	$ 0.01277	$ 0.29298	$ 5.52	$ 0.02741	$ 0.22180	$ 39.61	n/a

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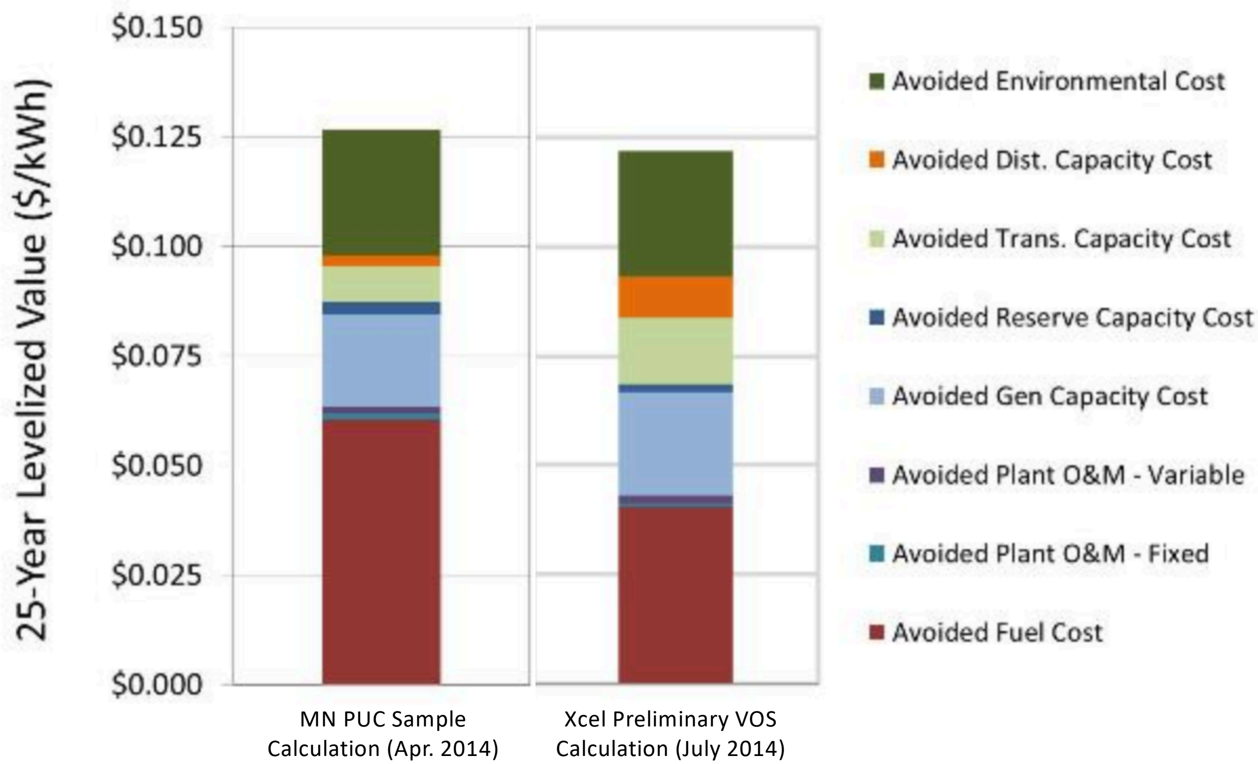
Sources: VDER overview, https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Contractors/Value-of-Distributed-Energy-Resources
Orange & Rockland data: https://www.nyserda.ny.gov/-/media/NYSun/files/VDER-Statement-Log.xlsx

Quantitative Example: Minnesota's Value of Solar

The Value of Solar calculation used by the Minnesota PUC applies to community scale projects. The VOS value ($/kWh), which applies to excess generation injected by the project into the grid, is updated annually. The semi-static nature of the VOS calculation distinguishes it from Policy Integrity's preferred value stacking approach, which calls for updating each element of the stack in whatever interval reflects a material change.



Source: https://www.nrel.gov/state-local-tribal/blog/posts/vos-series-minnesota.html