Net Metering (NEM) Fact Sheet

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November 9, 2021

Highlights

California adopted net metering (NEM) in 1996 to support the nascent solar industry. As the industry developed and costs came down, net metering rates have been adjusted to reflect current costs and benefits. This is done by CPUC about every five years, and most recently in 2016. CPUC has relied on scientists, engineers and economists in academia, national labs and NGOs to gain a full picture of the true costs and benefits. They have also heard from stakeholders.

The California grid has been increasingly dominated by solar power during midday -- from utility-scale to small rooftop systems. This has dramatically lowered California's GHG emissions from the electricity sector, while also increasing the complexity and cost of operating California's grid. CPUC's NEM hearings are a purely administrative process in reassessing and re-allocating costs.

People who have an interest in perpetuating the status quo have mounted a robust disinformation campaign that appears to come from multiple sources. This disinformation typically includes the following claims:

1. *Solar owners do not use the grid as much as non-solar users and should contribute less to the grid*. In fact solar owners are heavy users of the grid, both pushing and pulling power at different times of day.
2. *Efforts to change the reimbursement rates to time of use that accurately reflect the true value of electricity and costs to the grid are done to "kill the solar industry"*. In fact, this did not happen in California with the cost adjustments of 2011 and 2016, nor has it happened in other states.
3. *NEM adjustment is anti-solar*. This is a false choice. NEM adjustments are part of a healthy feedback system, based on real economics and science.

Since 1996, CPUC has been effectively managing cost distributions using NEM reimbursement rates, which includes dramatic changes and resultant costs for the grid. LWVC has been watching this process and does not see a need to take action at this time.

Background & Summary[1]

Net metering occurs when Photovoltaic (PV) aka solar panel owners feed excess electricity into the grid and their meter runs backwards. This helps offset their electricity use during hours when they produce less electricity than they use.

California adopted Net Energy Metering (NEM), aka net-metering, in 1996, when PV was much more expensive. Net-metering supplemented the federal tax credit, and helped encourage solar adoption. It was spectacularly successful; the Department of Energy's National Renewable Energy Laboratory (NREL) estimates that, "between 1980 and 2010, the cost of solar panels decreased from $10/W to around $2/W" and continued to drop to $0.2/W in 2020[2].

Of course, solar installation costs include much more than the panels alone. The median total price of a typical US 6.5 W home solar installation has fallen from $57,070 in 1990 to $24,440 in 2019[3]. (New Californian systems tend to average 7 W.) While the cost of installing a PV system has fallen by ~60%, the retail electricity rate in California has gone up by ~70%[4], providing a windfall to PV owners.

When California set up NEM, the electricity mix and demand curve were very different. Diablo Canyon and San Onofre nuclear power plants generated about 20% of the electricity used within the state, and on a 24/7 basis. There was more snowmelt, which provided reliable hydroelectricity during the afternoon/evening peak. Solar wasn't a large part of the mix yet, and the highest electricity rates were during daytime. CPUC set a NEM compensation rate equal to the average cost of electricity between 7 am and 5 pm.

In 2021, there is so much solar power, both utility-scale and distributed roof-top, that the utilities need to curtail (shut down) renewable power supplies.

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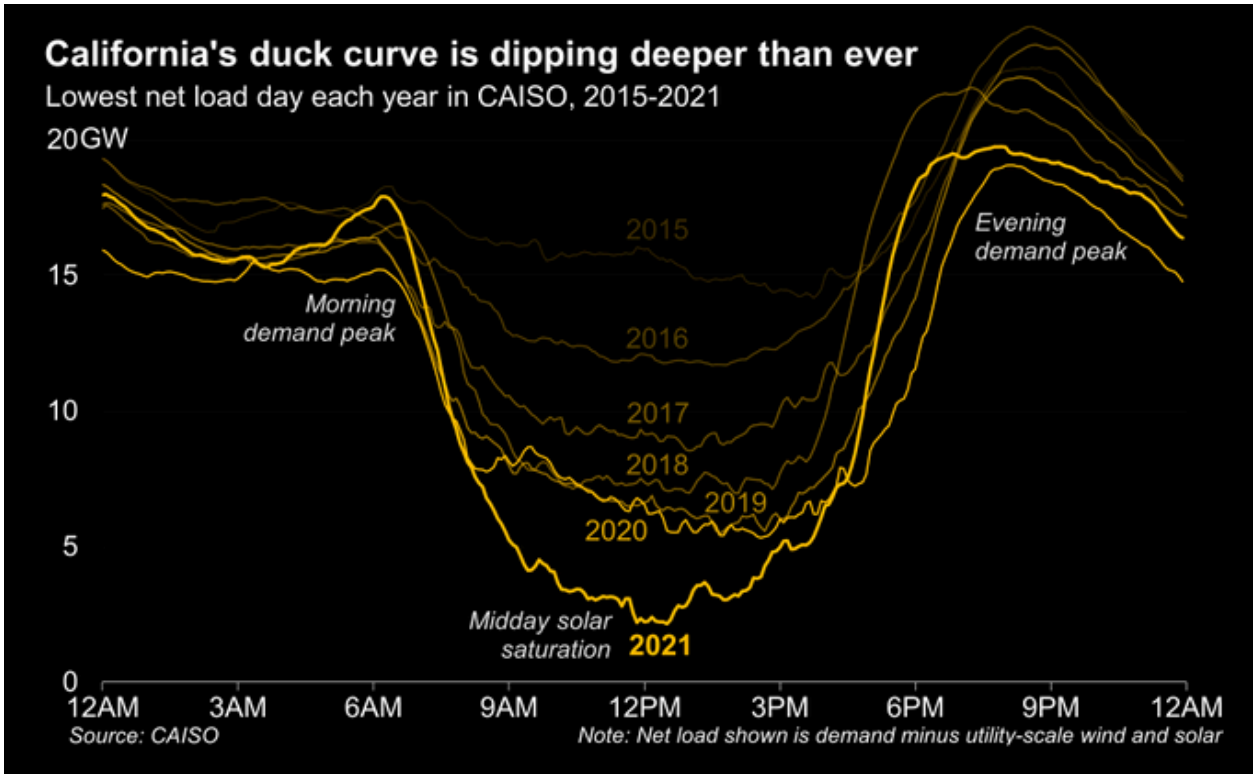
[1] This would be very easy if I could just refer people to https://energyathaas.wordpress.com/2021/06/01/rooftop-solar-inequity/, and https://haas.berkeley.edu/wp-content/uploads/WP314.pdf, but LWV never relies on just one source (or research group)

[2] https://news.energysage.com/how-have-solar-equipment-costs-declined-over-time/

[3] https://www.thesolarnerd.com/blog/will-solar-get-cheaper/

[4] https://www.eia.gov/electricity/state/



[5]

Problem

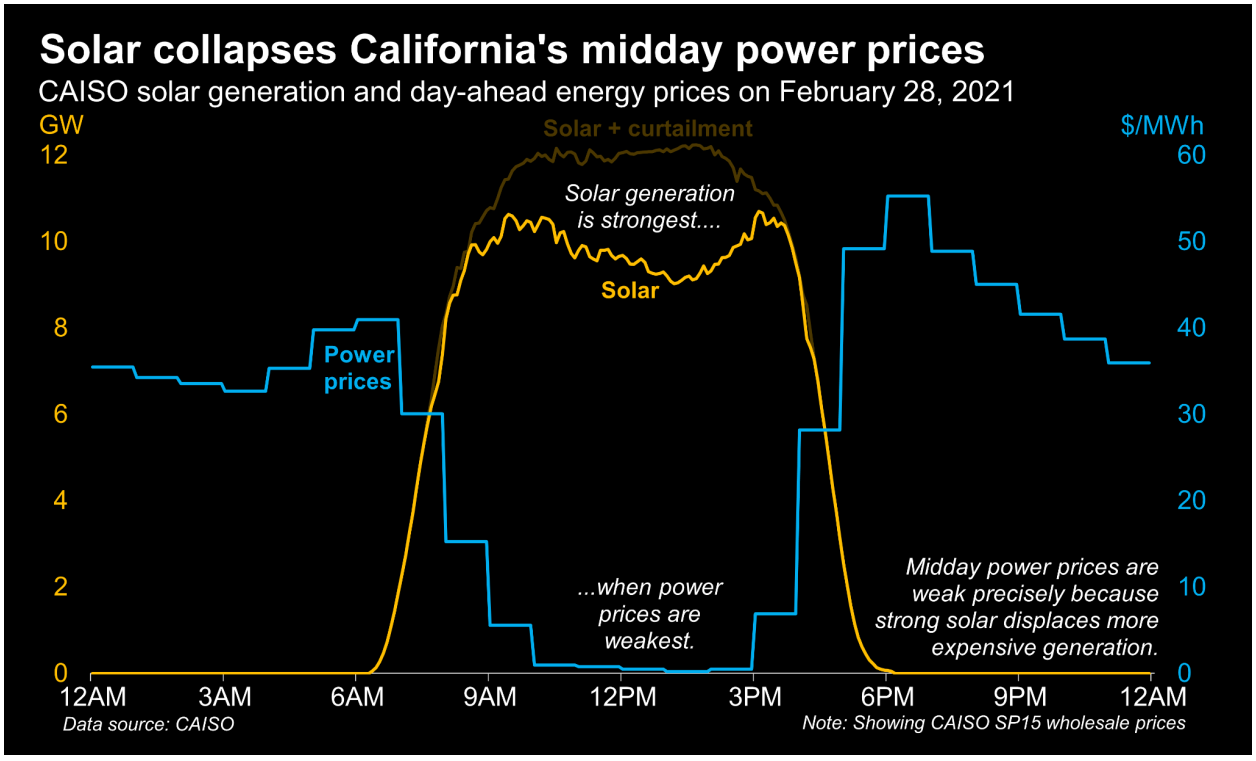
The central conundrum is that electricity costs vary widely between 7 am and 5 pm. Electricity prices are highest in the evening and (to a lesser extent) morning peaks. But rooftop solar feeds into the grid mainly at midday, when electricity has near zero value.

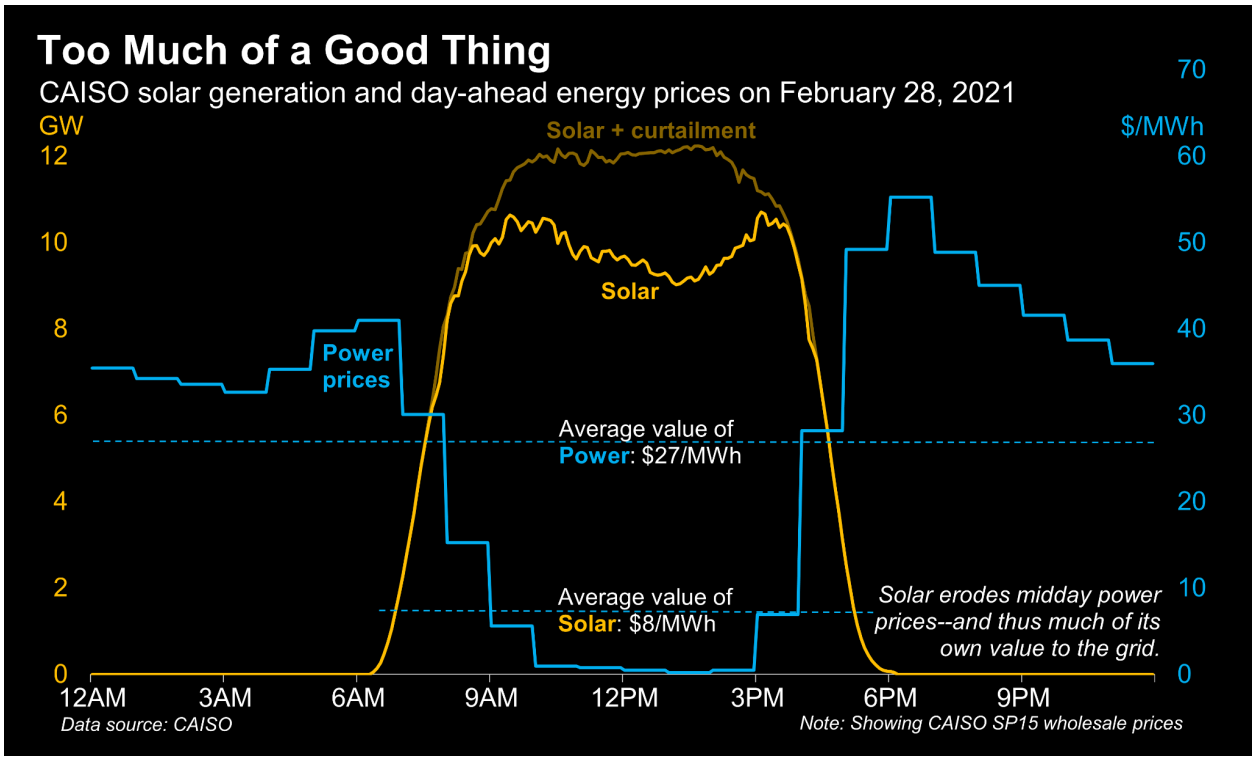
Solar production varies by solar radiation density at the panel site and solar incidence angle relative to the panel. See The Department of Energy's National Renewable Energy Laboratory's (DOE NREL) PV Watts calculator[6] to learn more about expected production capacity at various sites.

Because roof-top solar installations are mounted at a fixed angle limited by roof pitch and orientation, they do not maximize production. Their output in the early morning and late afternoon hours is poor. Most home installations feed into the grid at the midday peak, when their power has little to no economic value and ***draw*** power off the grid at other hours, including the duck curve peaks where power prices are highest. Yet, they get compensated under the current NEM scheme as if power added to the grid at noon is equivalent to that added between 7-9 AM and 3-5 PM.

[5] This, and the next 2 graphs, are courtesy of Brian Bartholomew, formerly an energy analyst for NRDC

[6] https://pvwatts.nrel.gov/


Solar collapses California's midday power prices
CAISO solar generation and day-ahead energy prices on February 28, 2021
GW
$/MWh
Solar + curtailment
Solar generation is strongest....
Solar
Power prices
...when power prices are weakest.
Midday power prices are weak precisely because strong solar displaces more expensive generation.
12AM
3AM
6AM
9AM
12PM
3PM
6PM
9PM
12AM
Data source: CAISO
Note: Showing CAISO SP15 wholesale prices


Too Much of a Good Thing
CAISO solar generation and day-ahead energy prices on February 28, 2021
GW
$/MWh
Solar + curtailment
Solar
Power prices
Average value of Power: $27/MWh
Average value of Solar: $8/MWh
Solar erodes midday power prices--and thus much of its own value to the grid.
12AM
3AM
6AM
9AM
12PM
3PM
6PM
9PM
Data source: CAISO
Note: Showing CAISO SP15 wholesale prices

The data from February 28, 2021 is an extreme example, but this cost-shift from solar rooftop owners to other users is real has been estimated by multiple government agencies and academics to be $3 Billion/year in California and climbing[7].

This is particularly pressing in San Diego County, where 16% of residential customers have rooftop solar[8]. During sunny but not hot days, San Diego experiences both negative electricity and negative transmission costs. That is, there is so much solar power flooding the grid, the transmission network operator has to pay people to take power off the grid to prevent destroying equipment.

SDG&E customers pay twice as much per kWh as the national average while PG&E customers[9] pay 1.8x and SCE customers pay 1.45x.[10] Low income users receive a subsidy of 30-35%, which is not enough to cover the cost shift. Ironically, as the cost shift increases, retail electricity rates rise, further increasing the cost shift.

The following "Energy Waterfall" graph from Haas shows that SDG&E spends over 10x supporting distributed PV than for supporting low income customers through CARE.

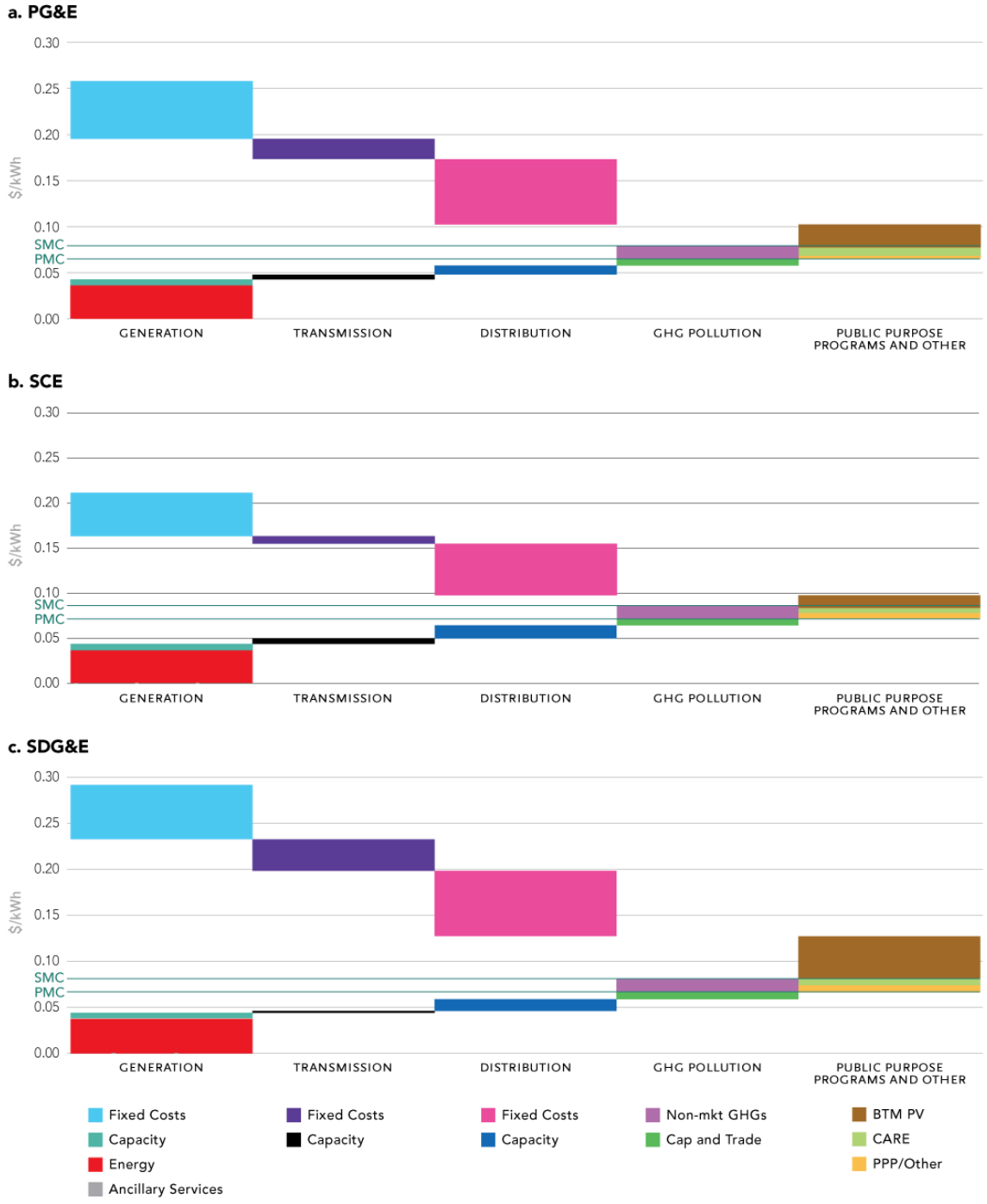
[7] https://energyathaas.wordpress.com/2021/06/01/rooftop-solar-inequity/

[8] https://www.sandiegouniontribune.com/business/story/2021-03-15/debate-begins-over-updating-californias-solar-rules

[9] Sprawl and fire mitigations are major drivers of PG&E's high rates.
https://calmatters.org/california-divide/debt/2021/03/california-high-electricity-prices/
https://www.resources.org/resources-radio/the-low-down-on-high-power-prices-with-meredith-fowlie/

[10] https://calmatters.org/california-divide/debt/2021/03/california-high-electricity-prices/

FIG 4a-c Residential Price Decomposition ($/kWh) for 2019



Notes: Primary marginal cost estimates are weighted by IOU load. Average 2019 residential prices (CARE and non-CARE) are constructed using advice letters and rate schedules PG&E sources: 5366-E-A/B; 5444-E; 5573-E; 5644-E. SCE sources: 67666-E: 67668-E. SDGE: 31811-E; 31501-E. Details on the methodology behind author calculations can be found in the Appendix.

Proposed Solutions

NEM has been such a runaway success in promoting solar adoption in California, but all programs need to be periodically reexamined and adjusted. NEM has already been adjusted at least once. The California Public Utilities Commission (CPUC) has met most recently on June 15, 2021[11] to study the problem and develop a "successor" NEM 3.0 program.

All of the proposed reforms would protect benefits to existing rooftop solar owners for long periods that should cover their promised payback periods. The reforms would only reduce benefits for future owners to reflect the current much lower installation costs.

All proposals would change the time of use value of net-metering to reflect the true amount of avoided costs and greenhouse gas emissions. All proposals would also increase the base charge (with lower charges for low income users) to more evenly spread the costs of maintaining the grid for all users.

Some of the proposals would pay lower income (CARE) electricity users a higher rate for their solar power fed into the grid. This is only fair because tax deductions for installation are worth more to higher earners in higher tax brackets. Other proposals suggest more deeply subsidizing installation while reducing prices paid for electricity fed into the grid .

NREL shows that, under normal circumstances, residential rooftop solar displaces utility-scale sources costing ⅓ as much. For disaster resilience, micro-grids make sense. But, larger installations-like those found on civic and commercial buildings, and over parking lots-deliver neighborhood-scale benefits at much lower costs[12].

Distributed solar energy has benefits to society[13], as purveyors of solar systems frequently point out[14]. But most of the avoided cost benefits come from battery solar systems, which account for only a small proportion of installed systems. Solar systems pay off most for homeowners when they have a guaranteed buyer for their excess electricity; battery systems reduce their return on investment[15]. That disparity comes from subsidies from other electricity users. (Berkeley and Stanford agree on something!)

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[11] See report and proposals https://m.box.com/shared_item/https%3A%2F%2Fwilldan.app.box.com%2Fs%2F3jpscul3lbtof5erje7f4bkqkk96uahp/view/822926041281

[12] https://www.nrel.gov/solar/solar-installed-system-cost.html

[13] https://energyathaas.wordpress.com/2021/07/26/will-investing-big-in-distributed-solar-save-us-billions/, https://energyathaas.wordpress.com/2021/02/08/distribution-costs-and-distributed-generation/

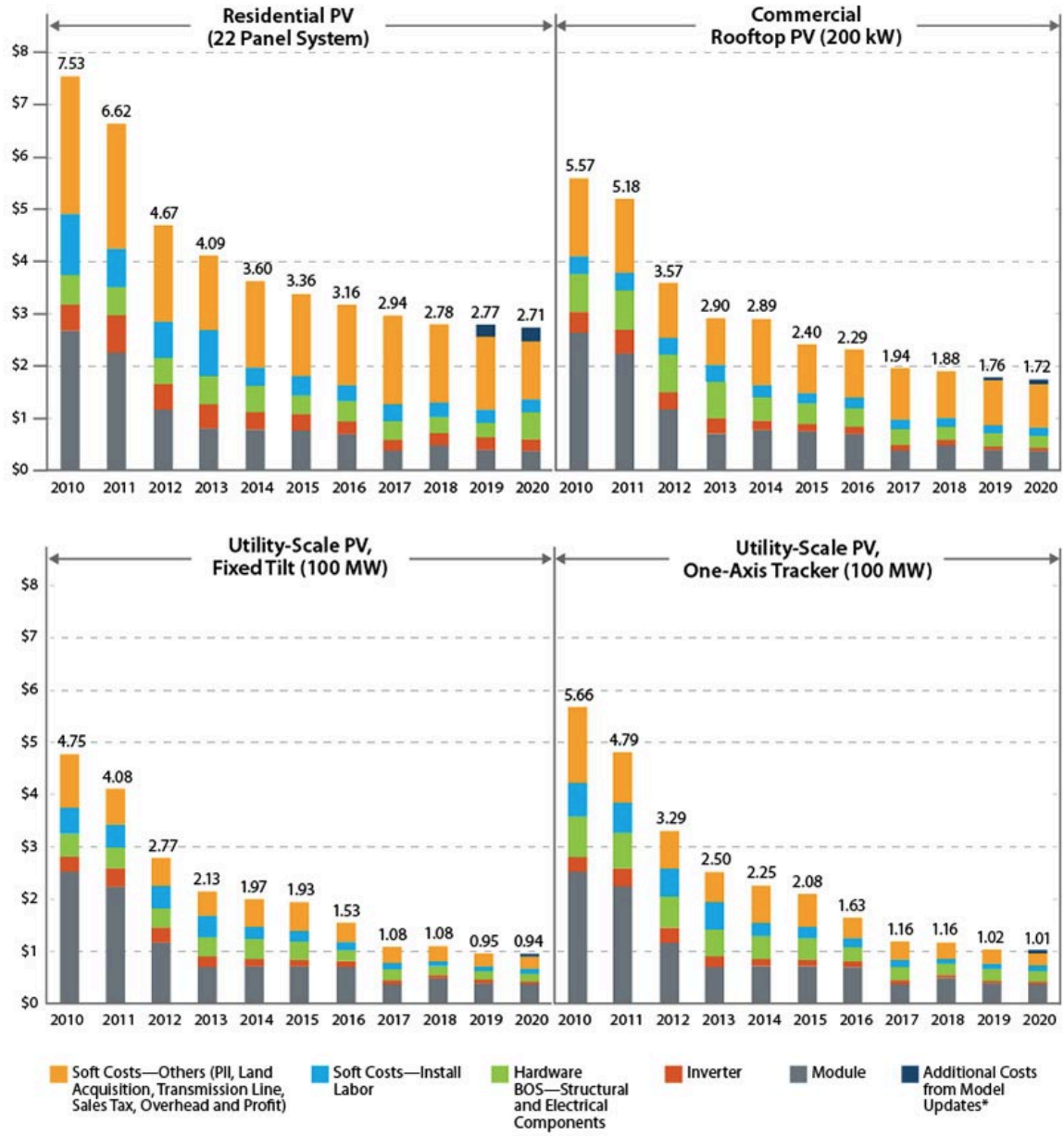
[14] https://www.seia.org/initiatives/net-metering

[15] https://news.stanford.edu/2019/04/09/good-news-rooftop-solar-not-home-batteries/

Distributed generation is a smart resilience move as long-distance transmission lines become increasingly vulnerable to wildfires (public safety power shutoffs) and strong storms. Owners of distributed solar who promise to reliably share with vulnerable neighbors (e.g. medically fragile or local infrastructure) during emergencies should be compensated. But they are not doing so currently.

Solar Installed System Cost Analysis

NREL analyzes the total costs associated with installing photovoltaic (PV) systems for residential rooftop, commercial rooftop, and utility-scale ground-mount systems. This work has grown to include cost models for solar-plus-storage systems.



Utility-scale solar has been installed in sensitive public lands, which is contrary to LWV land-use policies. However, there are more than enough degraded lands, particularly agricultural land that should be retired, to meet the solar needs of California and the southwestern US. European countries have demonstrated that solar farms can coexist with agriculture, particularly land managed for bees. We should replicate that here.

Professor Dustin Mulvaney has done extensive research on siting of solar facilities. The rural electrification act used public lands to string transmission. Solar is most valuable when close to transmission. To put solar on less sensitive degraded lands, we need to build transmission. Currently, FERC does not have Federal ability to use eminent domain to build electricity transmission the way we have to build oil and gas pipelines. This is something LWV should look into, perhaps develop a decision support tool for.

Long-distance transmission lines help us borrow and loan renewable power from other states without the need for very expensive and toxic batteries. California benefits from solar farms in Nevada to reduce our dependence on gas-powered plants for the early morning peak. Similarly, utility-scale SoCal solar farms with sun-trackers can send solar power to Arizona in the late afternoon. LADWP signed a deal to purchase power from a wind farm in eastern New Mexico. New Mexico experiences a fairly predictable evening Low-Level Jet (part of the Great Plains Low-Level Jet[16]), which will bring reliable power during the evening demand peak.

The benefits of distributed generation are real, but they are relatively expensive and limited in duration. Unless we install huge amounts of highly toxic batteries in residential neighborhoods, rooftop generation will not power California through multi-day storms or natural disasters. Within urbanized areas, large commercial buildings and parking lots are cost-efficient ways to build micro-grids. Local distributed generation and long-distance utility-scale renewables are complementary; they should not be viewed as in competition with one another. We need to do both.

NRDC has studied and written extensively about this, most recently A Four Point Guide to California's Net Metering Update. Debunking Myths Surrounding California's Net Metering Reform.

CPUC NEM Revisiting Rulemaking Page with links to proposed decision, December 13, 2021.
CPUC NEM Fact Sheet

Addenda

The solar industry has become dependent on very abusive labor and ecological practices ranging from Uyghur forced labor in China[17] to child labor in Congo, strip mining in the tropics or ocean

[16] http://www.theweatherprediction.com/severe/llj/

[17] https://www.bbc.com/news/world-asia-china-57124636

dredging for the rare earth minerals used in batteries. We need to be careful not to replicate the injustices of the fossil fuel industry in the renewable energy industry.

Some of the arguments made by proponents of the inequitable status quo are physically nonsensical. Saving wear and tear on transmission lines is not a physical reality. Under normal operating conditions, the metal wires in transmission lines do not wear. The plastic coatings on transmission lines wear with UV sun exposure, and that would happen regardless of whether they are carrying power. Most importantly, transmission losses are inversely proportional to voltage and (less strongly) proportional to distance. Multi-state transmission lines (at up to 500,000 volts) usually lose less power than neighborhood-scale transmission lines (at 13,800 to 240 volts).

It's not a fruitful use of time to debunk all the wild claims.

These decisions do NOT apply to municipal power companies or CCAs. They apply only to IOUs, Investor Owned Utilities: PG&E, SCE, SDG&E.

CPUC has jurisdiction over only a tiny portion of municipal water and power companies (only over the water part for safety).

Solar Rights Alliance is very coy about where they receive their funding, but an energy journalist reported how it was founded at an industry back room.
https://cleantechnica.com/2018/10/11/the-solar-rights-alliance-connects-solar-owners-in-support-of-solar-rights/

The CPUC looks after CA ratepayers, not utilities or solar industry. They disallowed this utility request, but allowed a 9% increase in 2021 to harden the grid against fires.
https://www.utilitydive.com/news/ferc-southern-california-edison-PGE-profit-power-line-transmission-roe-puc/611386/
https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-issues-decision-in-sce-2021-rate-case
SCE had another 3% increase in Jan 2022.

NEM 3.0 Proposed Decision (PD)
Net Energy Metering Revisit - Rulemaking (R.) 20-08-020
Fact Sheet
Proposed Decision December 13, 2021

Guiding Principles (not up for debate)

These guiding principles, adopted in D.21-02-007, will assist the Commission in the development and evaluation of proposals for a successor to the current NEM tariff.

(a) A successor to the net energy metering tariff should comply with the statutory requirements of Public Utilities Code Section 2827.1;

(b) A successor to the net energy metering tariff should ensure equity among customers;

(c) A successor to the net energy metering tariff should enhance consumer protection measures for customer-generators providing net energy metering services;

(d) A successor to the net energy metering tariff should fairly consider all technologies that meet the definition of renewable electrical generation facility in Public Utilities Code Section 2827.1;

(e) A successor to the net energy metering tariff should be coordinated with the Commission and California's energy policies, including but not limited to, California Senate Bill 100 (2018, DeLeon), the Integrated Resource Planning process, Title 24 Building Energy Efficiency Standards, and California Executive Order B-55-18;

(f) A successor to the net energy metering tariff should be transparent and understandable to all customers and should be uniform, to the extent possible, across all utilities;

(g) A successor to the net energy metering tariff should maximize the value of customer-sited renewable generation to all customers and to the electrical system; and

(h) A successor to the net energy metering tariff should consider competitive neutrality amongst Load Serving Entities.

Findings of Fact, Section 10, begins on page 159

After examining all the evidence presented, these are the findings upon which the decision is based. These may be debatable, if there is new evidence that supports a different choice. But, it's not fruitful to argue based on already-presented evidence.

Conclusions of Law, begins on page 179

See Leg Analysis Form