



An Analysis of the California Public Utilities Commission's Net Energy Metering Tariff and the Implications for Residential Solar PV Power in California

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Abstract

With the rise of rooftop solar infrastructure in the United States, the relationships among regulators, utilities companies and consumers are rapidly changing. Public utilities commissions across the country are dealing with new tensions between the solar industry and traditional utilities, as many utilities companies are demanding that subsidization of solar technology be reduced. One type of subsidization is net metering, where solar customers can sell energy to the grid and buy energy back when necessary at certain rates. In California, net energy metering policy came up for review in 2015 and a hard battle was fought between multiple utilities companies and solar proponents for the policy's future. This paper reviews and analyzes the various arguments of involved parties before explaining the final decision of the California Public Utilities Commission (CPUC). Other considerations for solar customers and NEM policies in other states are also explained in order to provide context for the policy changes in California. The final CPUC decision was ultimately a win for the solar industry, but the new policy's effects and the long-term direction of utilities regulations in California have yet to be seen.

Glossary of Terms

Coincident demand: Energy demanded by a given customer or group of customers during a particular time period (usually measured peak), meaning non-coincident demand is demand from several different times.

Demand charge: A charge for the maximum rate at which energy is used during peak hours of a billing period.¹

Departing load charges (DLCs): Non-bypassable charges that are applied to electricity produced and consumed on-site.²

Distributed generation: Power generation at or near the point of consumption.

Distribution costs: Costs used to cover maintenance and implementation of power lines, poles and transformers owned by utility companies or independent entities that distribute energy over shorter distances.³

Electric utility: An electric power company that owns and operates equipment and facilities for the generation, transmission and distribution of electric energy, which it sells to consumers.

Fixed charge: A steady charge paid by solar customers on a monthly basis.

General Rate Case (GRC): The major regulatory proceeding for California utilities, which provides the CPUC an opportunity to perform an exhaustive examination of a utility's operations and costs.⁴

Grid access charge (GAC): A monthly charge for net metering customers to cover the costs associated with use of the grid.

Installed capacity fee: A fee to maintain the total capacity of electrical generation devices in a power system.⁵

Interconnection fee: A charge associated with a connection to the grid, enabling consumers to draw on reserves in times of need.⁶

Investor-owned utility: A utility owned by private investors, as opposed to one owned by a municipal or public agency or its members.

1 "Glossary of Energy-Related Terms." Energy.gov. Accessed February 22, 2016. <http://energy.gov/eere/energybasics/articles/glossary-energy-related-terms>.

2 *Onsite Generation in CA: Potential Ratepayer Savings and Key Barriers*. June 11, 2014. Accessed February 22, 2016. http://www.energy.ca.gov/chp/documents/2014-07-14_workshop/comments/A_Simpson_Onsite_Generation_in_CA-Potential_Ratepayer_Savings_and_Key_Barriers_June_2014_Final_2014-06-11_TN-73642.pdf.

3 "What Factors Impact Electricity Transmission and Distribution Costs?" Constellation: An Exelon Company. Accessed February 22, 2016. <http://blogs.constellation.com/energy4business/what-factors-impact-electricity-transmission-and-distribution-costs>.

4 "General Rate Case (GRC)." California Public Utilities Commission. Accessed February 23, 2016. <http://www.cpuc.ca.gov/cfaqs/generalratecasegrc.htm>.

5 "Glossary of Energy-Related Terms." Energy.gov. Accessed February 22, 2016. <http://energy.gov/eere/energybasics/articles/glossary-energy-related-terms>.

6 Ibid.

Kilowatt (kW): Unit of power used to express the capacity of residential solar photovoltaic systems and to measure a customer's electricity demand at a given time; 1 kW = 1,000 watts.⁷

Kilowatt-hour (kWh): Unit of energy equal to 1,000 watt-hours; commonly used to measure a customer's electricity consumption during a billing period.⁸

Megawatt (MW): Unit of power used to express capacity of large-scale solar arrays and other types of power plants; 1 MW = 1,000,000 watts.⁹

Nameplate capacity: Maximum rated output of electric power production equipment, commonly expressed in megawatts (MW).

Net energy metering (NEM): A California billing arrangement that provides credit to customers with solar PV systems for the full retail value of the electricity their system generates and exports to the grid. Excess electricity generated by consumers' systems is sent back into the electric utility grid. The power provider purchases the net energy production.¹⁰

Net present value: Difference between the present value of cash inflows and the present value of cash outflows, accounting for the time value of money.

Non-bypassable charges (NBCs): Charges that are applied to ratepayer bills and assessed based on the amount of electricity consumed from the grid. Customers who install on-site generation that is not eligible for net energy metering are required to pay NBCs for electricity produced and consumed on-site.¹¹

Power Purchase Agreement (PPA): A contract between two parties in which one party agrees to purchase the energy production of an electricity generator for a specified price over a given period of time.¹²

Ratepayer Impact Measure (RIM) test: Measures what happens to customer bills or rates due to changes in utility revenues and operating costs caused by a conservation program.¹³

7 *50 States of Solar*. September 2015. Accessed February 22, 2016. https://nccleantech.ncsu.edu/wp-content/uploads/50-States-of-Solar-Q3-FINAL_25.pdf

8 Ibid.

9 Ibid.

10 "Net Energy Metering in California." Go Solar California. Accessed February 24, 2016. http://www.gosolarcalifornia.ca.gov/solar_basics/net_metering.php.

11 *Onsite Generation in CA: Potential Ratepayer Savings and Key Barriers*. June 11, 2014. Accessed February 22, 2016. http://www.energy.ca.gov/chp/documents/2014-07-14_workshop/comments/A_Simpson_Onsite_Generation_in_CA-Potential_Ratepayer_Savings_and_Key_Barriers_June_2014_Final_2014-06-11_TN-73642.pdf.

12 *50 States of Solar*. September 2015. Accessed February 22, 2016. https://nccleantech.ncsu.edu/wp-content/uploads/50-States-of-Solar-Q3-FINAL_25.pdf

13 "Ratepayer Impact Measure (RIM) Test (California Metrics)." BEopt. Accessed February 28, 2016. https://beopt.nrel.gov/sites/beopt.nrel.gov/files/help/Ratepayer_Impact_Measure_Test.htm.

Renewable Energy Credit (REC): A tradable commodity that represents the renewable attributes of energy produced from renewable energy facilities. Often used as a method of tracking progress toward renewable energy portfolio standards and serving as a market-based incentive.¹⁴

Solar photovoltaic (PV) systems: A power system designed to supply usable solar power by means of photovoltaics, which is a means of converting solar energy into direct current electricity.

Time-of-use (TOU) rates: Rates dependent on the estimated cost of electricity during the time of energy consumption, considering both the time of day and the seasonality of usage.¹⁵

Total Resource Cost (TRC) Analysis: Measures the net cost of an energy conservation program, including both utility and participant costs and reflecting the impacts of a program on both participating and non-participating customers.¹⁶

Transmission costs: Costs associated with transmission or the bulk transfer of electrical energy over long distances at high voltages via interconnected lines that form a network.¹⁷

True up statement: An annual representation of an accumulated 12 billing months of credits and/or charges on a customer's NEM statement.¹⁸

Two-tier pricing: Pricing varies based on usage – customers who use more energy pay higher rates than customers using less energy.

Utility avoided cost: Marginal cost for a public utility to produce one more unit of energy. In California, these costs are determined by the CPUC in hearings to simulate a market price for energy to encourage efficiency.

14 Hasic, Mirsad. "Renewable Energy Credits Explained." Triple Pundit. October 26, 2011. Accessed July 25, 2016. <http://www.triplepundit.com/2011/10/renewable-energy-credits-explained/>.

15 "Glossary of Energy-Related Terms." Energy.gov. Accessed February 22, 2016. <http://energy.gov/eere/energybasics/articles/glossary-energy-related-terms>.

16 "Total Resource Cost (TRC) Test (California Metrics)." BEopt. Accessed February 28, 2016. https://beopt.nrel.gov/sites/beopt.nrel.gov/files/help/Total_Resource_Cost_Test.htm.

17 "What Factors Impact Electricity Transmission and Distribution Costs?" Constellation: An Exelon Company. Accessed February 22, 2016. <http://blogs.constellation.com/energy4business/what-factors-impact-electricity-transmission-and-distribution-costs>.

18 "How to Read Your Bill." PG&E. Accessed February 16, 2016. <https://www.pge.com/en/myhome/saveenergymoney/solar/readbill.page>.

I. Introduction

Net energy metering allows commercial and residential solar customers to receive compensation for excess energy that they generate and feed back to the electric grid. Although the general practice of net energy metering is widespread throughout the United States, net energy metering programs and policies vary widely by state and utility company.¹⁹ California's net energy metering policy, known as the state's net energy metering (NEM) tariff, is considered to be one of the most solar-friendly policies in the nation, allowing net energy metering customers to receive credits for the full retail value of their excess solar energy production.²⁰ The credits for excess solar energy production help to offset the costs of the energy that solar customers receive from the grid. California's NEM tariff was established after Gov. Arnold Schwarzenegger signed Assembly Bill 920 (AB 920) into law on Oct. 11, 2009. AB 920 required "California utilities to compensate Net Energy Metering customers for electricity produced in excess of on-site load over a 12-month period."²¹ In addition to important tax credits like the federal Solar Investment Tax Credit (ITC), California's NEM tariff has contributed to the growth of residential solar in the state as it helps to offset the costs of investing in solar production.

In 2015 alone, California installed 3,266 MW of solar electric capacity to bring its total solar capacity to 11,987 MW.²² California has 44 percent market share of the US solar industry, with more than 2,754 solar companies at work employing around 76,000 people.²³ The numbers are expected to grow, as California plans to install 22,645 MW of solar electric capacity over the next five years – this amount is over three times the amount of solar installed over the past five years.²⁴ These numbers alone demonstrate the important economic and environmental role of the solar industry, not just in California but nationwide.

However, as California's solar industry has grown, many utility companies have argued that California's NEM tariff may render them unprofitable, calling for amendments to the NEM tariff. This is due to the fact that net metering means some residential customers may not be contributing toward the fixed costs of utilities, shifting these costs onto a smaller group of ratepayers.²⁵ This cost burden is a concern of utility companies, in addition to their argument that distributed solar panels make grid management more difficult and costly. It should be noted that utilities' opposition to net metering is not new—there is documented opposition going back to the 1990s—but the tension grew in recent years

19 "Issues & Policies: Net Metering." Solar Energy Industries Association. <http://www.seia.org/policy/distributed-solar/net-metering>.

20 Montgomery, James. "Rank 'Em: The Most Solar-Friendly States in the US." Renewable Energy World. Last modified July 30, 2013. <http://www.renewableenergyworld.com/articles/2013/07/rank-em-the-most-solar-friendly-states-in-the-u-s.html>.

21 "Net Energy Metering." California Public Utilities Commission. Last modified 2016. <http://www.cpuc.ca.gov/General.aspx?id=3800>.

22 "Solar Industry Data," Solar Energy Industries Association, 2016, accessed July 17, 2016, <http://www.seia.org/research-resources/solar-industry-data>.

23 "California Solar," Solar Energy Industries Association, 2016, accessed July 17, 2016, <http://www.seia.org/state-solar-policy/california>.

24 Ibid.

25 Roberts, David. "Utilities Vs. Rooftop Solar: What the Fight Is About," Grist, May 15, 2013, accessed July 17, 2016, <http://grist.org/climate-energy/utilities-vs-rooftop-solar-what-the-fight-is-about/>.

due to rapid solar growth.²⁶ Solar proponents counter the complaints regarding grid management. According to the solar industry, real-time distributed grid management and decreasing expensive peak load demand would decrease the need to build additional capacity as energy demand grows.²⁷ As such, smart grid management and NEM are the answers to utility company woes.

In response, California Gov. Jerry Brown signed Assembly Bill No. 327 (AB 327) on Oct. 7, 2013. AB 327 required the California Public Utilities Commission to develop a new net energy tariff by the end of 2015.²⁸ Once utility companies reach a 5 percent cap on rooftop solar systems, they must implement the new NEM policy. Additionally, AB 327 argued that the CPUC's successor tariff needed to sustain the attractiveness of residential rooftop solar growth in California, while treating all electricity customers fairly, regardless of whether they own solar or not.²⁹ In order to weigh the opinions of California utility companies that were in favor of amending the net energy metering policy, the CPUC accepted proposals for the successor net energy metering tariff from utility companies along with non-utility actors.

After reviewing the proposals put forth by Southern California Edison (SCE), Pacific Gas & Electric (PG&E), and San Diego Gas & Electric (SDGE), and non-utility organizations such as the Natural Resource Defense Council (NRDC), the California Public Utilities Commission issued its own proposal for the NEM's successor tariff in December 2015. Following a period for comments from the public and the private sector, the California Public Utilities Commission voted 3-2 in favor of enacting its own proposal on Jan. 28, 2016.³⁰

This report explores the implications of the successor net energy-metering tariff, also known as NEM 2.0 for California's residential solar customers. To understand the new NEM policy, the report provides context by briefly explaining the original tariff and its comparison to other relevant residential solar PV policies in the United States. In addition to analyzing the amendments to California's net energy metering policy, the report also assesses the various proposals submitted to the CPUC prior to the passing of the successor tariff. This report was written by research analysts at the Roberts Environmental Center, an undergraduate research institute based at Claremont McKenna College in Claremont, California.

26 Trabish, Herman. "Sunrun Ceo: Why Utilities Are Attacking Net Metering," Green Tech Media, June 12, 2013, accessed July 17, 2016, <http://www.greentechmedia.com/articles/read/Sunrun-CEO-Why-Utilities-Are-Attacking-Net-Metering>.

27 Hanley, Steve. "Solarcity Shows How Utilities Can Benefit from Solar." Clean Technica. August 31, 2015. Accessed July 25, 2016. <http://cleantechnica.com/2015/08/31/solarcity-shows-how-utilities-can-benefit-from-solar/>.

28 St. John, Jeff, "AB 327: From California Solar Killer to Net Metering Savior?" Greentech Media. Last modified September 3, 2013. <http://www.greentechmedia.com/articles/read/ab-327-from-california-solar-killer-to-net-metering-savior>.

29 Trabish, Herman K. "Inside the decision: California regulators preserve retail rate net metering until 2019." Utility Dive. Last modified February 1, 2016. <http://www.utilitydive.com/news/inside-the-decision-california-regulators-preserve-retail-rate-net-meterin/413019/>.

30 St. John, Jeff, "Breaking: California's NEM 2.0 Decision Keeps Retail Rate for Rooftop Solar, Adds Time-of-Use." Greentech Media. Last modified January 28, 2016. <http://www.greentechmedia.com/articles/read/Californias-Net-Metering-2.0-Decision-Rooftop-Solar-to-Keep-Retail-Payme>.

II. 2009 NEM Tariff

Passed in 2009, AB 920 requires utility companies to pay customers who generate electricity through the utilization of solar and/or wind energy systems for unconsumed energy they supply to the grid.³¹ Compensation to solar customers is made possible through a crediting system or direct payment, measured on the net-surplus energy produced within a 12-month period.³² In order to receive market value compensation, customers generating solar must enter into an agreement plan with their utility company.³³ Companies select the method by which customer-generators may credit their excess energy.³⁴ In addition, the Public Utilities Code Section 2827 is incorporated into this assembly bill. Section 2827 aims to encourage growth of the solar industry, energy efficiency and the use of renewable resources through net energy metering and surplus energy compensation.

Under AB 920, net energy must be used with a bidirectional energy meter and operate under time of use (TOU) schedules.³⁵ Surplus energy is measured in kilowatt hours and rated accordingly.³⁶ AB 920 differentiates between a net supplier and net consumer; utility companies determine if customers are net suppliers or net consumers at the end of the 12-month period.³⁷ Net suppliers generate electricity that exceeds their 12-months consumption and are compensated at the rate the utility company charges based on the pricing tier for which they qualify, while net consumers pay for the excess energy they drew from the grid.³⁸ All NEM customers will receive general information with their monthly bill.³⁹ Eligible customers who do not sign into an agreement will not receive compensation.⁴⁰ Utility companies were responsible for notifying customers of NEM compensation by Jan. 31, 2010.⁴¹

The legislation was implemented to “encourage substantial private investment in renewable energy resources, stimulate in-state economic growth, reduce demand for electricity during peak consumption periods, help stabilize California’s energy supply infrastructure, enhance the continued diversification of California’s energy resource mix, reduce interconnection and administrative costs for electricity suppliers and encourage conservation and efficiency.”⁴² While these goals were largely met and California was hailed as a solar model, the utility companies had complaints. Arguments that a disproportionate cost burden fell on non-solar customers and that grids required additional maintenance due to the distributed solar generation, among others, lead to a re-evaluation of the policy and the creation of NEM 2.0.

31 California (State). Legislature. Assembly. *An act to amend Section 2827 of the Public Utilities Code, relating to energy*. AB 920 (October 11, 2009). California State Assembly. Web. 17, June 2016.

32 Ibid.

33 Ibid.

34 Ibid.

35 Ibid.

36 Ibid.

37 Ibid.

38 Ibid.

39 Ibid.

40 Ibid.

41 Ibid.

42 Ibid.

III. Contextual Analysis of NEM in Nevada, Arizona and Hawaii

A brief exploration of net energy metering policies in other states provides important context for the state and near-term future of solar power in California. However, these policies are not unique to California—43 states have adopted net metering policies. Looking at other states demonstrates that various utility companies have similar concerns about the implications of net energy metering, however, each state is responding to companies' demands in distinct manners.

Net Energy Metering in Nevada

Nevada recently implemented new net energy metering pricing structures. In June 2015, Nevada's Senate passed Senate Bill 374, which imposed a 235-megawatt cap on the state's net energy metering program.⁴³ Any solar customers opting into the net energy metering program after the aggregate limit was reached were eligible for new net energy metering rates, which spurred movement among the energy utilities to develop a new pricing structure for applicants after the cap. One month following the passing of SB374, Nevada Energy, the public utility that provides electric services in Nevada, completed a cost-of-service study for net-metered customers.⁴⁴ Its analysis concluded that net-metered customers do not pay fully for the costs that Nevada Energy incurs to serve them. Subsequently, Nevada Energy filed new net energy metering tariffs in July and proposed that rates take effect immediately for solar applicants applying after the 235-MW cap.⁴⁵ Though the cap was reached in August 2015, the Nevada Public Utilities Commission ordered that applicants whose systems were installed after the cap be served under the existing rates until a new pricing structure was approved.⁴⁶ The Nevada Public Utilities Commission established new rates in December 2015, including a basic service charge, a demand charge and reduced energy charges for each unit of energy delivered by NV Energy. These new rates tripled the fixed basic service charges paid by solar customers, while reducing the credit received for net excess generation.⁴⁷ These net-metering cuts led to an exodus of solar from Nevada, as multiple, major solar companies pulled out of the state because, they argue, all the financial savings from going solar have been destroyed.⁴⁸ As a result, in the first quarter of 2016, residential solar installation permits dropped by 92 percent.⁴⁹

43 "SB374." Nevada Legislature. June 5, 2015. Accessed February 15, 2016. <https://www.leg.state.nv.us/Session/78th2015/Reports/history.cfm?ID=821>

44 *50 States of Solar*. September 2015. Accessed February 22, 2016. https://nccleantech.ncsu.edu/wp-content/uploads/50-States-of-Solar-Q3-FINAL_25.pdf

45 "Original Filing." Public Utilities Commission of Nevada. August 31, 2015. Accessed February 1, 2016. http://pucweb1.state.nv.us/PDF/AxImages/DOCKETS_2015_THRU_PRESENT/2015-7/4402.pdf

46 "Net Metering." NV Energy. Accessed February 15, 2016. <https://www.nvenergy.com/renewablesenvironment/renewablegenerations/NetMetering.cfm>

47 Pyper, Julia. "Does Nevada's Controversial Net Metering Decision Set a Precedent for the Nation?," Green Tech Media, February 4, 2016, accessed July 17, 2016, <http://www.greentechmedia.com/articles/read/nevada-net-metering-decision>.

48 St. John, Jeff. "Nevada's Solar Job Exodus Continues, Driven by Retroactive Net Metering Cuts." Green Tech Media. January 8, 2016. Accessed July 17, 2016. <http://www.greentechmedia.com/articles/read/nevadas-solar-exodus-continues-driven-by-retroactive-net-metering-cuts>.

49 Muro, Mark, and Devashree Saha. "Rooftop Solar: Net Metering Is a Net Benefit." Brookings Institution. May 23, 2016. Accessed July 18, 2016. <http://www.brookings.edu/research/papers/2016/05/23-rooftop-solar-net-metering-muro-saha>.

This net energy metering decision has set a potentially concerning precedent for other states with a big focus on solar and has hurt the solar industry as a whole.

Net Energy Metering in Arizona

Arizona has experienced intense struggles over net energy metering between utilities and the solar industry. Solar announced a ballot initiative to constitutionally protect retail rate NEM until 2020 and, in response, the Arizona Public Service Company, the largest energy provider for the state, applied for approval of rate changes.⁵⁰ These changes included an increase in monthly solar charges by over \$2 per kW per month of nameplate installed photovoltaic capacity.⁵¹ However, the Arizona Corporation Commission struck down the proposal.⁵² Another energy utility in Arizona, Tucson Electric Power Company, also filed a rate case with the Commission to increase the firm's revenue. The Tucson Electric Power Company proposed rate changes that better reflect the service costs it is incurring, particularly in times of peak energy demand.⁵³ The Tucson Electric Power Company's proposed rates included a basic service fee, lower usage-based rates and an added demand charge. If the Commission had approved the Tucson Electric Power Company's proposal, the new rates would have gone into effect beginning in January 2017, increasing solar customers' average monthly bill by approximately \$12. The new rates would have applied only to customers that qualified for the net energy metering program after June 1, 2015.⁵⁴

Contentious ballot measures were on the horizon from the utility companies and the solar industry, moving Gov. Doug Ducey to seek a compromise between utility companies' desire to preserve their business model and proponents of solar.⁵⁵ In May 2016, competing ballot measures to change net metering were withdrawn to allow for the adoption of a compromise reimbursement system.⁵⁶ Lawmakers brought the two sides into negotiations. An agreement has yet to be reached, but it will likely not have the major impacts that either of the ballot measures would have had.

50 Trabish, Herman. "Inside the Deal That Averted a Net Metering Ballot Showdown in Arizona." Utility Dive. May 3, 2016. Accessed July 17, 2016. <http://www.utilitydive.com/news/inside-the-deal-that-averted-a-net-metering-ballot-showdown-in-arizona/418392/>.

51 "In the matter of the application of Arizona Public Service Company for approval of net metering cost shift solution." The Arizona Corporation Commission. October 27, 2015. Accessed February 14, 2016. <http://images.edocket.azcc.gov/docketpdf/0000166471.pdf>

52 "Newsroom." TEP. November 5, 2015. Accessed February 20, 2016. <https://www.tep.com/news/newsroom/release/?idRec=433>

53 "Arizona Utility TEP wants to add solar fee, reduce net metering credit." Utility Dive. November 6, 2015. Accessed February 15, 2016. <http://www.utilitydive.com/news/arizona-utility-tep-wants-to-add-solar-fee-reduce-net-metering-credit/408791/>

54 *50 States of Solar*. September 2015. Accessed February 22, 2016. https://nccleantech.ncsu.edu/wp-content/uploads/50-States-of-Solar-Q3-FINAL_25.pdf

55 Martin, Richard. "Battles Over Net Metering Cloud the Future of Rooftop Solar." MIT Technology Review. January 5, 2016. Accessed July 17, 2016. <https://www.technologyreview.com/s/545146/battles-over-net-metering-cloud-the-future-of-rooftop-solar/>.

56 Climate Nexus. "The Net Metering Fight." 2016. Accessed July 17, 2016. <http://climatenexus.org/net-metering-fight-understanding-latest-issue-nation%E2%80%99s-rapidly-changing-electricity-market>.

Net Energy Metering in Hawaii

In October 2015, the Hawaii Public Utilities Commission filed a ruling to close the net metering program to new participants.⁵⁷ The Hawaii PUC stated this was due to a need to protect the stability of the grid against the high diffusion of distributed solar. Net metered systems in Hawaii increased by over 60 times the original cap in 1996 for NEM customers, meaning program capacity now runs from 30 to 53 percent of system peak load.⁵⁸ Nothing will change for existing net-metered customers or for customers who have already been approved. But these measures are supposed to advance integration of renewables while addressing technical and operational challenges experienced by Hawaiian electric companies.⁵⁹ To replace the retail rate net metering program, the Commission introduced two new options for solar consumers—a grid-supply tariff and a self-supply tariff. The grid-supply option is similar to net metering in that it allows solar customers to export excess energy to the grid, but differs from net metering in that it credits the energy exported back to the grid at a fixed rate, which is generally lower than the retail rate.⁶⁰ The other new choice for solar consumers is the self-supply tariff, which is intended for those who seek to install PV systems that do not export power to the utility grid, meaning all energy generated by their system will need to be used or stored for later use by the consumer.⁶¹ As energy will not be sent back to the grid, customers opting into the self-supply option will not receive any credits. Despite the replacement of retail rate net metering with the grid-supply and self-supply tariffs, the Commission's decision has led to a contraction in the Hawaiian solar industry and job loss throughout the state.⁶² However, Hawaii's policy changes will likely not be copied by other states. As an island chain, Hawaii has higher electricity rates than most of the U.S. That, coupled with high solar irradiation, makes solar penetration particularly high and reduces the need to heavily subsidize solar customers.⁶³ Hawaii will continue its push for renewable energies but through mechanisms besides NEM, while other states need NEM to subsidize solar.

57 "In the Matter of Public Utilities Commission Instituting a Proceeding to Investigate Distributed Energy Resource Policies." Public Utilities Commission of the State of Hawaii, docket number 2014-0192. October 12, 2015. Accessed April 1, 2016. <http://dms.puc.hawaii.gov/dms/DocumentViewer?pid=A1001001A15J13B15422F90464>

58 Trabish, Herman. "Hawaii Court Upholds Puc Order Ending Retail Rate Net Metering." Utility Dive. January 4, 2016. Accessed July 17, 2016. <http://www.utilitydive.com/news/hawaii-court-upholds-puc-order-ending-retail-rate-net-metering/411414/>.

59 Pyper, Julia. "Hawaii Regulators Shut Down Heco's Net Metering Program." Green Tech Media. October 14, 2015. Accessed July 17, 2016. <http://www.greentechmedia.com/articles/read/hawaii-regulators-shutdown-hecocos-net-metering-program>.

60 Ibid.

61 "Customer Grid Supply and Self Supply Programs." Hawaiian Electric. Accessed April 2, 2016. <https://www.hawaiianelectric.com/clean-energy-hawaii/producing-clean-energy/customer-grid-supply-and-self-supply-programs>

62 "Hawaii solar sector braces for job losses after net metering decision." UtilityDrive. March 29, 2016. Accessed April 1, 2016. <http://www.utilitydive.com/news/hawaii-solar-sector-braces-for-job-losses-after-net-metering-decision/416417/>

63 Kress, R. "Why Hawaii's End of Net Metering Won't Dim Solar." Energy Central. October 16, 2015. Accessed July 17, 2016. <http://community.energycentral.com/why-hawaiis-end-net-metering-wont-dim-solar>.

IV. Proposals for NEM 2.0 in California

Within the national context of utility companies in several states arguing for changes in net energy metering and other pro-solar policies, the CPUC called for proposals for consideration in the process to update California's energy metering policy. The following sections describe the various proposals submitted to the CPUC for consideration, focusing mainly on utility companies but also including a proposal submitted by the Natural Resources Defense Council, an environmental advocacy organization, to provide greater context. Although none of them were officially adopted, they reflect the different perspectives and approaches leading up to the CPUC's final decision. In order to measure sustainability and cost, involved parties relied mostly on two tests: the Participant Cost Test (PCT) and the Ratepayer Impact Measurement (RIM). The PCT demonstrates the costs and benefits for customers participating in the program, while the RIM demonstrates where the burden of the new tariff lies - either on NEM customers or on non-participants. On the PCT, a score of one means that the benefits equal the costs (above one means the benefits outweigh costs), while RIM test result of less than one indicates that prices will increase for all customers (both participants and non-participants).

Southern California Edison Proposal

Background

Southern California Edison (SCE) is the largest subsidiary of Edison International. It is the primary electric utility company for 14 million residents covering approximately 50,000 square miles of Southern California. Specifically, the company provides electricity for all or a portion of the following counties: Mono, Tulare, Inyo, San Bernardino, Riverside, Kern, Ventura, Orange and Los Angeles. Currently, 3 percent of SCE customers generate solar energy, including more than 125,000 rooftop solar customers.⁶⁴ Nearly 24 percent of the energy delivered by SCE in 2014 was from renewable resources.⁶⁵ Partially due to AB32, SCE's goal is to raise this to 33 percent by the end of the decade.⁶⁶

Customers are increasingly installing renewable distributed generation (DG) systems, such as rooftop solar PV systems, and opting into net metering through the NEM tariff. While this tariff and decreasing solar PV system costs have led to a strong solar industry in California, SCE believes that this tariff must be revised, as the original purpose of the tariff was to incentivize customers to adopt a rooftop solar system despite its high cost. As solar adoption is rapidly expanding due to large decreases in cost for solar PV systems, several utility companies have concluded that these growth rates are unfair because the current NEM tariff pushes costs onto non-participating customers. Specifically, SCE found that the substantial reduction in utility bills for net-metered solar customers will push \$15.3 billion to \$16.7 billion of costs onto non-participating customers over the next decade.⁶⁷ Utility complaints also go further to the idea that solar generation makes grid stability and load management more challenging. However, as noted in other sections, there are many counterarguments to the utility concerns.

64 Brandt, Jaclyn. "SCE defending net metering proposal," August 20, 2015. Accessed February 15, 2016: <http://www.smartgridnews.com/story/sce-defending-net-metering-proposal/2015-08-20>

65 Ibid.

66 Ibid.

67 *Southern California Edison (U 339 E) Proposal for Successor Net Energy Metering Tariff*, 23, August 10, 2014, accessed February 19, 2016, http://www.edison.com/content/dam/eix/documents/our-perspective/R.14-07-002_NEM-Tariffs-Successor-SCE-Resp-to-ALJ-Ruling-Seeking-Party.pdf.

Assumptions and Metrics

According to SCE, its proposal for the new, successor NEM 2.0 tariff aimed to ensure sustainable growth of both residential and non-residential solar. Like all submitted revisions in response to AB 327, SCE's proposal aimed to reduce the cost shift from residential solar power generators to non-solar utility customers and the utility that is caused by the NEM program by ensuring benefits of the new standard tariff to all customers and creating sustainable growth of customer-sited renewable distributed generation. This is ultimately secured by maintaining a high participation rate among the utilities' customer base with a basic service charge, along with additional use charges. SCE, along with other utility companies, is hoping to avoid raising charges for non-solar customers while maintaining a stable electricity grid.

Proposal Overview

Reproduced below are the verbatim four main changes to the existing NEM in SCE's proposal,⁶⁸ which are then explained in more detail:

1. Eliminates netting and decouples the compensation for exported energy from the participating customers' OAT [otherwise applicable tariff] rate for energy purchases.
2. Allows renewable DG customer-generators to first serve their on-site load with generation produced by the renewable DG system.
3. Compensates customers for exports of excess electricity not consumed on-site.
4. Assesses a grid access charge to recover a portion of certain fixed costs that are not avoided by the customers' installation of renewable DG systems.

Elimination of Netting

Important changes would be made to the amount existing customers are currently paid for the excess solar power they produce. The SCE proposal requires no netting. Rather, energy imports and exports would be charged and credited at different rates. An otherwise acceptable tariff (OAT) rate would be applied for energy imports and energy exports would be reimbursed at an Export Compensation Rate (ECR) of \$0.08/kWh, as opposed to its current rate of \$0.15/kWh.⁶⁹ This rate was calculated with the help of the California Public Utilities Commission's "NEM Public Tool." Specifically, it would include the utility avoided cost estimate of \$0.07/kWh and a \$0.01/kWh premium for the renewable attributes of the exported generation.⁷⁰ The proposal also includes a provision for credits to carry over to future bills. Nevertheless, the consumer would earn less for giving excess electricity back to the grid. SCE recommended that this ECR rate be reassessed every three years.

Implementation of a Grid Access Charge

SCE proposed a \$3 grid access charge (GAC) per month for each installed solar kW to eligible residential customer-generators, based on the nameplate capacity—the maximum potential output—

68 Ibid.

69 Ibid.

70 Ibid.

of the distributed generation system involved.⁷¹ This would provide enough revenue to cover the utility's fixed costs of maintaining transmission and distribution grid infrastructure to participating customers, while also recovering other "non-bypassable charges"—charges that cannot be netted out by energy inputted on the grid—associated with the distributed generation system.⁷² Prior to this proposed change, these fixed costs were encompassed in a volumetric charge. To ensure that this charge would mitigate the cost shift efficiently, SCE proposed that the Commission reassess how the GAC is calculated every three years, specifically analyzing the fixed transmission and distribution costs associated with serving participating customers. On the other hand, non-residential customer-generators, i.e., industrial and utility-scale installations, would not be charged a GAC. Here, the fixed distribution and transmission costs would be compensated by demand, while customer charges and non-bypassable charges would be compensated through an updated departing load non-bypassable charge (DL-NBC) that would include a DWR Bond Charge and New System Generation Surcharge.

Assessment

SCE's proposal would reduce the current net present value cost shift between solar and non-solar customers by 78–83 percent.⁷³ Quantified, this would reduce the current decadal cost shift of \$15.3 billion to \$16.7 billion to \$2.8 billion to \$3.1 billion under SCE's Proposal.⁷⁴ SCE's proposal would increase non-participants' benefit/cost ratio from a ratio of 0.28–0.30 under NEM to 0.50–0.54 under its proposed new NEM.⁷⁵ Variability in charges that participants in the new NEM would see in their monthly bills may create consumer uncertainty that could dissuade adoption of solar technologies. Thus, more effort must be placed into educating consumers about the general structure of the tariff and the general utilities pricing scheme. The following tables show a comparison of these values to the original NEM contract in place in 2015.

71 Ibid.

72 Ibid.

73 Ibid.

74 Ibid.

75 Ibid.

RIM Test Results for SCE Residential Customers – Existing NEM Using SCE’s Case

	Two Tier	TOU (2-8 PM)	TOU (4-8 PM)
Non-Participant Benefit/Cost (All Generation)	0.29	0.28	0.30
Non-Participant Benefit/Cost (Export Only)	0.22	0.18	0.20
NPV (\$) Cost Shift (All Generation)	\$16.7 Billion	\$15.3 Billion	\$15.3 Billion
NPV (\$) Cost Shift (Exports Only)	\$15.1 Billion	\$14.6 Billion	\$14.9 Billion

RIM Test Results for SCE Residential Customers - SCE Proposal Using SCE’s Case

	Two Tier	TOU (2-8 PM)	TOU (4-8 PM)
Benefit / Cost for Non-Participants (All Generation)	0.54	0.50	0.53
Benefit/Cost for Non-Participants (Export Only)	0.87	0.87	0.87
NPV (\$) Cost Shift (All Generation)	\$2.8 Billion	\$3.3 Billion	\$3.1 Billion
NPV (\$) Cost Shift (Exports Only)	\$200 Million	\$200 Million	\$200 Million

Table 1. Comparison of SCE Proposal and NEM Tariff as of December 2015 from SCE Proposal.

Comparison with the CPUC

On December 15, 2015, the CPUC proposed its version of a revised NEM tariff that it later adopted. CPUC’s changes include three major elements, some of which overlap with those proposed by SCE. The first major change to the existing NEM tariff is the implementation of a one-time interconnection fee (\$75-\$150) paid by participating solar customers, which covers the cost to safely connect a NEM system to the grid.⁷⁶ In the existing NEM tariff, both participating and nonparticipating customers covered this cost. This amendment echoes SCE’s main goal to reduce costs for non-participating customers, as it too had proposed a \$75 new NEM customer interconnection fee.

The CPUC also proposed that new NEM customers must pay a non-bypassable charge on all energy consumed from the grid, irrespective of how much they are exporting back to the grid. In prior years, customers have been able to bypass this charge if they consume less electricity from the grid than their installation produced.⁷⁷ This charge is aimed at encouraging new customers to maximize their on-site power generation and use energy more efficiently rather than focus solely on their net grid energy consumption.

While the underlying goals of CPUC and SCE may be similar, there are several differences. SCE’s proposed fees were not adopted. The CPUC proposal specifically declined to impose grid access charges and installed capacity fees on NEM residential customers. As mentioned previously, SCE proposed a general access charge for all participating customers. Though the CPUC continues to analyze the need for these access charges and related fees, its decision maintained the existing retail rates.

76 St. John, Jeff. “California Net Metering 2.0 Keeps Retail Rates for Rooftop Solar.” Green Tech Media. December 15, 2015. Accessed July 17, 2016.<http://www.greentechmedia.com/articles/read/breaking-california-net-metering-2.0-keeps-retail-rates-for-rooftop-solar>.

77 Ibid.

The CPUC proposal also requires new NEM customers (those entering the NEM program after the new proposal was adopted) to utilize time of use (TOU) rates in 2018 and all residential customers to use TOU rates in 2019. TOU charges aim to reflect the cost of energy as a function of time of day and season. While the CPUC has ordered SCE and other utilities such as PG&E to shift towards TOU rates by 2020, SCE's proposal does not apply them to customers and instead uses two-tier price rates.

San Diego Gas & Electric Proposal

Background

San Diego Gas and Electric (SDG&E) serves 3.4 million people in San Diego and Southern Orange counties, reaching across 4,100 square miles.⁷⁸ The company provides service through 2.27 million meters—1.4 million electric and 870,000 gas.⁷⁹ As of April 1, 2016, SDG&E had installed 83,877 NEM systems with nameplate capacity reaching around 12 percent of SDG&E's peak load or 540 MW of rooftop solar at peak output.⁸⁰

SDG&E NEM 2.0 Tariff Options and Overview

SDG&E's proposed successor tariff had two options for customers—the Default Unbundled Rate Option and the Sun Credits Option. Customers would select an option based on what they plan to do with the energy they generate. The Default Unbundled Rate Option was for customers who use their generated energy to offset the energy delivered by the grid, but with the energy they generate receiving credit at a reduced rate. The Sun Credits Option was for customers who choose to sell all of the electricity they generate through NEM back to SDG&E.⁸¹

The key components of the Unbundled Default Rate option were:

1. System access fee.
2. Grid use charges.
3. Application of TOU rates.

The key components of the Sun Credits option were:

1. Export of all energy produced by customer's DG system.
2. Higher compensation rate for exported energy.
3. No TOU rates.

78 "Company Facts," San Diego Gas & Electric Company, accessed January 12, 2016, <http://www.sdge.com/aboutus>.

79 Ibid.

80 "Overview - NEM Cap," San Diego Gas & Electric Company, accessed March 10, 2016, <http://www.sdge.com/clean-energy/net-energy-metering/overview-nem-cap>.

81 *San Diego Gas & Electric Company (U 902 E) Proposal for Successor Net Energy Metering Tariff*, 23, August 3, 2015, accessed February 19, 2016, <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M153/K900/153900272.PDF>.

Default Unbundled Rate Option

Rather than charging an equal rate for a customer's delivered and exported energy, a customer's exported energy would be valued at a different rate than the retail rate. Specifically, the exported energy would "reflect the price of wholesale energy based on SDG&E's Default Load Aggregation Point (DLAP) price."⁸² In addition to changing the rate for exported energy, the Default Option would be unbundled and would include additional fees for the cost of energy. These fees would include a System Access Fee, a Grid Use Charge, and a separate rate for delivered energy.⁸³ The System Access Fee would ensure that each NEM customer pays for a "portion of the distribution costs that [are] directly related to the customer through a \$/month charge."⁸⁴ The Grid Use Charge would "recover that portion of the distribution costs related to a customer's demand or impact on the grid through a \$/non-coincident demand kW (\$/NCD-kW) charge."⁸⁵ Note that SDG&E did not specify these charges in their proposal—they had yet to be determined.

Sun Credits Option

The second option offered by SDG&E was for customers who sell all of their generated energy back to the grid. The rate at which customers would be compensated would be higher than the export rate for customers who choose the Default Unbundled Rate Option.⁸⁶ This is because the customer would not be using their generated energy to offset the cost of the energy that is delivered to them; thus, they would be paying all of the costs associated with the delivery of energy. The rate that SDG&E had proposed for the export of energy would be the "retail system average commodity rate."⁸⁷ The Sun Credits option would require customers to install a separate meter solely for the export of the energy that their distributed generation (DG) system produced.⁸⁸ Currently, compensation for surplus energy exportation is administered to customers on an annual basis; the new plan would compensate customers for their energy exports on a monthly basis. The reason for annual compensation prior to the introduction of the Sun Credits option hinges on the fact that many net metering customers produce infrequent amounts of excess energy, depending on seasonal discrepancies, and a monthly compensation would inaccurately reward them for their contribution to the grid. However, because the Sun Credits option separates the "net" amount of energy from the sheer amount of energy generated, compensation on a monthly basis is more justified, and does not have the former negative effects.

82 Ibid, A-40

83 Ibid, A-41-42

84 Ibid, A-41

85 Ibid.

86 Ibid, A-51

87 Ibid.

88 Ibid, A-3

Renewable DG Case	Compensation Structure (Full Scenario Name)	Avg Non-Participant Benefit /Cost Ratio	Ratepayer Impact/Bill Increase (% of Total RR)	Ratepayer Impact/Bill Increase (% of Res. RR)	Ratepayer Impact/Bill Increase (% of Non-Res. RR)
No Change					
Low	2-Tiered	0.26	9.80%	18.31%	2.69%
High	2-Tiered	0.46	7.11%	12.62%	2.83%
Low	TOU-Bookend-1	0.26	9.68%	17.99%	2.69%
High	TOU-Bookend-1	0.44	6.86%	11.97%	2.82%
Low	TOU-Bookend-2	0.27	10.13%	19.07%	2.69%
High	TOU-Bookend-2	0.47	7.25%	12.95%	2.84%
SDG&E Default Option					
Low	2-Tiered-Default	0.33	3.29%	5.54%	1.32%
High	2-Tiered-Default	0.47	2.43%	3.74%	1.37%
Low	TOU-Bookend-1-Default	0.33	3.25%	5.45%	1.32%
High	TOU-Bookend-1-Default	0.48	2.37%	3.60%	1.37%
Low	TOU-Bookend-2-Default	0.34	3.07%	5.08%	1.32%
High	TOU-Bookend-2-Default	0.49	2.29%	3.41%	1.37%
SDG&E Sun Credit Option					
Low	2-Tiered-Sun Credit	0.59	0.50%	1.05%	0.00%
High	2-Tiered-Sun Credit	0.97	0.15%	0.29%	0.03%
Low	TOU-Bookend-1-Sun Credit	0.59	0.50%	1.05%	0.00%
High	TOU-Bookend-1-Sun Credit	0.97	0.15%	0.29%	0.03%
Low	TOU-Bookend-2-Sun Credit	0.59	0.50%	1.05%	0.00%
High	TOU-Bookend-2-Sun Credit	0.97	0.15%	0.29%	0.03%

Table 2. RIM Test results as provided by SDG&E in their NEM 2.0 tariff proposal.⁸⁹

Differences between NEM 2.0⁹⁰ and SDG&E Proposals

There are three main tenets of the NEM 2.0: a one-time interconnection fee, non-bypassable volumetric charges for energy that is consumed from the grid and the utilization of TOU rates.

There are two similarities between SDG&E’s proposed Default Unbundled Rate Option and the CPUC’s final NEM 2.0 tariff decision. The first is the introduction of a flat fee—presented by SDG&E as a System Access Fee and by the CPUC as an interconnection fee. The other similarity is the introduction of Time of Use (TOU) rates. Beyond these similarities, the proposals vary widely. Each provides distinct, specific changes to address issues with the current NEM tariff, one of the main problems being a disproportionate contribution from NEM customers to government-mandated credit programs. SDG&E seeks to reduce this burden through its Access Fee, whereas the CPUC seeks to do so by the introduction of non-bypassable charges (in the form of a rate per kWh) for these programs.

The Sun Credits Option does not incorporate any of the ideas proposed by the CPUC. Due to the fact that this option separates a consumer’s generated energy from other aspects of their bill, the disproportionality of contribution by NEM customers to government-mandated programs is eliminated. Instead, these are factored into the consumer’s OAT bill. A customer’s OAT bill encompasses all other components of a customer’s energy use that do not pertain to their excess energy generation. This

⁸⁹ Ibid, A-63.

⁹⁰ DECISION ADOPTING SUCCESSOR TO NET ENERGY METERING TARIFF (Proposed by AL Judge Anne E. Simon), December 15, 2015, accessed February 19, 2016, <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M156/K443/156443378.PDF>.

separation of bills allows SDG&E to charge a customer for all energy consumed rather than net energy consumption, thereby promoting energy efficiency. Thus, the proposals are similar in that they both compensate consumers for their exported energy at the retail rate, rather than a reduced rate (such as the proposed rate in SDG&E's default option). Additionally, SDG&E does not incorporate TOU rates in this option, citing potential overcompensation for customers' generated energy if their current TOU rates were to be used.⁹¹

Pacific Gas & Electric Company Proposal

Background

Pacific Gas and Electric Company (PG&E) is a subsidiary of PG&E Corporation. The utility serves 16 million residents throughout California, predominantly in the northern and central regions of the state.⁹² Its coverage stretches from Santa Barbara County in Southern California to Humboldt County along the northern coast.⁹³ It also reaches throughout most of the Central Valley and into the eastern part of the state, from Kern County in the south to Shasta and Lassen counties in the north.⁹⁴ Approximately 3.5 percent of PG&E's customers are solar customers, making it the largest solar-providing utility company by number of users in the country.⁹⁵ Additionally, 30 percent of the energy it provides to customers is renewable, coming from solar, wind or other renewable energy sources.⁹⁶

PG&E Proposal

PG&E submitted its proposal in August 2015 with the following key assumptions and arguments. PG&E assumed that the percentage of its consumers using solar would grow about four times by 2025—from 3.5 percent to 15 percent.⁹⁷ PG&E used the PCT and RIM tests to demonstrate their proposal's effects. PG&E's observed PCT results were in the 1.91-2.02 range, meaning that benefits outweigh the costs for participants.⁹⁸ PG&E estimated that a score of 1.25 would ensure sustainable growth of residential solar.⁹⁹ These results indicate that PG&E expected the benefits of installing solar to far outweigh the costs, leading to the large projected growth rate over the next ten years.

On the RIM test, a score of one means that solar and non-solar customers pay the same rates, while a score below one means that non-participants shoulder more of the costs. PG&E's RIM results all

91 *Pacific Gas & Electric Company Proposal for Successor Net Energy Metering Tariff*, 23, August 3, 2015, accessed February 19, 2016, <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M153/K900/153900272.PDF>.

92 "Electric Service Areas Maps," map, November 17, 2014, Microsoft Word. http://www.pge.com/tariffs/tm2/pdf/ELEC_MAPS_Service_Area_Map.pdf

93 *Ibid.*

94 *Ibid.*

95 Memorandum by Randall J. Litteneker and Stacy W. Walter, "Pacific Gas and Electric Company's Proposal for Net Energy Metering Successor Tariff," August 3, 2015, accessed February 22, 2016,

96 "Clean Energy Solutions," Pacific Gas and Electric Company, last modified January 7, 2016, accessed March 26, 2016, <http://www.pge.com/en/about/environment/pge/cleanenergy/index.page?>.

97 Memorandum by Randall J. Litteneker and Stacy W. Walter, "Pacific Gas and Electric Company's Proposal for Net Energy Metering Successor Tariff," August 3, 2015, accessed February 22, 2016,

98 *Ibid.*

99 *Ibid.*

landed in the range of 0.39–0.40 demonstrating that a substantial amount of the financial burden of solar adoption would fall on the non-participants.¹⁰⁰ While these RIM numbers indicate that a greater share of the cost associated with NEM customers would fall on non-solar customers, the burden on non-solar customers was even greater under the previous NEM tariff. If solar customers continue to subsume larger percentages of PG&E’s market, as projected, the cost would need to be shifted more onto them, as opposed to non-solar customers. PG&E did add a provision that the tariff be evaluated every three years to ensure that it is financially sustainable.¹⁰¹

Table 1: Results of Public Tool Runs for PG&E Customers on PG&E’s Proposal

Scenario	PCT	RIM	2025 Cost Shift (\$ Million s)	RIM as % of Rev Req	% COS of Residential Customers	2017-2025 Installations (MW)
Bookend_High_TwoTiers	1.70	0.72	(\$620)	3.28%	95%	6,213
Bookend_Low_TwoTiers	1.02	0.38	(\$491)	2.28%	83%	2,106
Independent_PGE_TwoTiers	1.91	0.40	(\$1,322)	6.28%	91%	7,220
Bookend_High_TOU4to8	1.74	0.70	(\$590)	2.59%	97%	5,906
Bookend_Low_TOU4to8	1.07	0.36	(\$573)	2.59%	83%	2,150
Independent_PGE_TOU4to8	1.96	0.39	(\$1,338)	6.09%	93%	6,698
Bookend_High_TOU2to8	1.78	0.68	(\$549)	2.51%	99%	5,494
Bookend_Low_TOU2to8	1.10	0.35	(\$590)	2.78%	83%	2,215
Independent_PGE_TOU2to8	2.02	0.39	(\$1,298)	5.99%	94%	6,497

Table 3. This table demonstrates the results of the PCT, RIM and other metrics compared with the cases provided by the CPUC to show the effects of the different pricing options.¹⁰²

Differences between NEM 2.0 and PG&E Proposals

The big differences from the first NEM tariff and PG&E’s proposal are the following: the implementation of a monthly minimum fee; the implementation of time-of-use (TOU) billing, based on season and time of day, and the switch from annual truing-up to monthly truing-up.¹⁰³ The minimum monthly fee would be \$10, which ensures that PG&E receives revenue from all its solar customers, regardless of net energy production.¹⁰⁴ The implementation of TOU billing would make electricity more expensive during peak hours (likely 4 to 8 p.m.), when lower amounts of solar electricity are being generated.¹⁰⁵ It would also encourage more frugal use of electricity during these parts of the day. Finally, monthly truing-up means that the extra energy generation that customers produce in the summer would not be able

100 Ibid.

101 Ibid.

102 Ibid.

103 Ibid.

104 Ibid.

105 Ibid.

to cover their dependence on the grid in the winter.¹⁰⁶ Each of these new facets of PG&E's proposal would generate more revenue for PG&E from its solar customers. This would shift less of the cost of new installations onto non-solar customers.

While PG&E's proposal is not exactly the same as the new CPUC proposal, there are some similarities. Both proposals introduce TOU billing, with the same stated goal: to bring added revenue from solar customers and encourage them to use less energy from the grid during peak hours.¹⁰⁷ PG&E also introduced a small interconnection application fee (though the proposal mentions it only briefly) in the same way that the CPUC does.¹⁰⁸ Finally, although PG&E supports its Solar CARE (its solar program for low-income consumers and neighborhoods) users, it does not mention a charge on other consumers to cover the cost of these low-income projects or projects to increase energy efficiency.¹⁰⁹

Close examination reveals that the CPUC's decision falls short of the changes the PG&E would have liked to see implemented. According to PG&E, the biggest shortcoming with the CPUC's proposal is that it does not properly address the cost shift to non-solar customers, and in fact, will shift about \$2.5 to \$5 billion each year until 2025.¹¹⁰ The easiest way to address this issue, per PG&E, is to decrease the price that solar customers earn for each kilowatt-hour they produce.¹¹¹ PG&E further posits that the CPUC's proposal is "legally and factually flawed," because it does not fulfill the stipulations set forth by AB 327, the bill that called for the first NEM tariff. AB 327 states that NEM must "ensure that the total benefits ... are approximately equal to the total costs" and "ensure that customer-sited renewable distributed generation continues to grow sustainably." PG&E feels the CPUC's new proposal fails to fulfill both of these requirements.¹¹²

Natural Resource Defense Council Proposal

Background

The Natural Resources Defense Council (NRDC) is a tax-exempt, environmental non-profit organization whose mission is "safeguard[ing] the earth—its people, its plants and animals, and the natural systems on which all life depends."¹¹³ Since its founding in 1970, the NRDC has worked to prevent and mitigate environmental exploitation and degradation. The NRDC currently prioritizes six main environmental issues: global warming; clean energy; ocean and water sanctity; endangered wildlife and wild places; pollution and health; water safety/sufficiency, and community

106 Ibid.

107 California Public Utilities Commission, Proposed Decision, (Cal. 2016).

108 Ibid.

109 Ibid.

110 Memorandum by Randall J. Litteneker and Stacy W. Walter, "Pacific Gas and Electric Company's Reply Comments on the Proposed Decision Adopting a Successor to the Net Energy Metering Tariff," January 15, 2016, accessed February 22, 2016, <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M157/K698/157698042.PDF>.

111 Ibid.

112 Ibid.

113 NRDC, 2016, accessed July 17, 2016, <http://www.nrdc.org/about/mission.asp>.

sustainability.¹¹⁴ The NRDC drafted a proposal for the NEM 2.0 tariff, which is detailed in the following sections. It aimed to reduce the projected monetary burden of non-solar homeowners, but had greater incentive to ensure growth of sustainable solar practices, particularly behavior that reduces overall energy consumption.

Key Changes from the NEM 1.0

First, the NRDC suggested that the CPUC implement a regulation that would deny NEM-solar customers the ability to use NEM as a means to credit out their minimum bill. In July 2015, the CPUC imposed a minimum energy bill so that the least amount everyone pays is an amount up to \$10/month (usually a lower amount for low-income customers).¹¹⁵ This differs from a monthly flat fee charge, which hurts low-income customers and discourages thoughtful energy consumption by adding a flat fee onto a customer's monthly bill, regardless of their level of consumption.¹¹⁶ As a caveat to the CPUC's minimum bill, the NRDC proposed that all solar-owning residents pay their monthly bills without using credits. This would ensure that solar-residents would contribute to the maintenance of the electricity grid in a fiscally fair manner and that utilities companies would charge a fair price to both non-solar and solar-owning customers.

The second component of the NRDC's proposal involved implementing "a variable demand charge for solar-owning consumers." The demand charge would be determined by transmission and grid services.¹¹⁷ A demand charge measures the amount of power a consumer uses at a given instant.¹¹⁸ Demand charges reveal variability in energy consumption, the cost needed to maintain grids and the amount of energy required to deliver electricity to a household. Furthermore, demand charges take into account whether or not customers are consuming electricity at energy-intensive times. At peak times, it can be more costly for utility companies to deliver energy because they may have to run more plants or purchase energy to cover additional demand. If customers wish to use electricity during such hours, they would incur a higher fee. By merely charging customers based on net energy use, utility companies ignore efficient energy use. Although two customers may consume an equal net energy, one may consume energy more efficiently than the other.

114 Ibid.

115 Carter, Sheryl. "Utility Rate Decision in California Can Help Transition to Cleaner Electric System - Could Be Much Better." NRDC. July 3, 2015. Accessed July 17, 2016. http://switchboard.nrdc.org/blogs/scarter/utility_rate_decision_in_calif.html.

116 Ibid.

117 Bull, Pierre. "Nrdc Proposal to Evolve Net Metering in California." NRDC. August 18, 2015. Accessed July 17, 2016. http://switchboard.nrdc.org/blogs/pbull/NRDC_Proposal_to_Evolve_Net_Metering_in_California.html.

118 Lehrman, Matt. "Are Residential Demand Charges the Next Big Thing in Electricity Rate Design?" Rocky Mountain Institute. May 21, 2015. Accessed July 17, 2016. http://blog.rmi.org/blog_2015_05_21_residential_demand_charges_next_big_thing_in_electricity_rate_design.

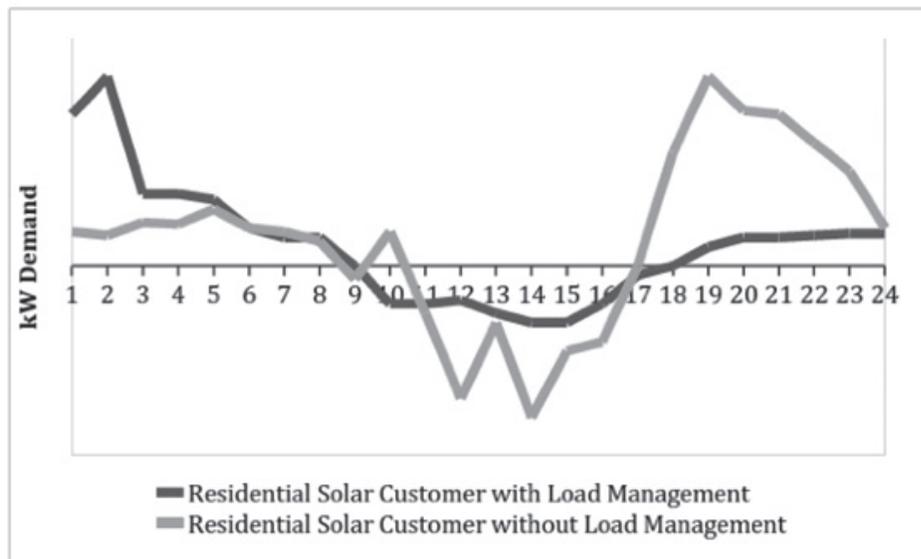


Figure 1. Energy consumption with and without load management displayed over a time period of 24 hours.¹¹⁹

Figure 1 demonstrates the effect of a demand charge. Load management takes place when energy consumption is moved from periods of high-demand to those with low-demand. During times when energy is most expensive, load management devices cut power to the customer’s unit.¹²⁰ In this way, the customer is practicing energy-efficient techniques, as evidenced by the greater stability of the blue line. They minimize energy consumption during peak times through the usage of load management. Through a demand charge that offers peak and off-peak rates, the customer with load management (blue line) would be charged less than the customer without load management.¹²¹

A demand charge is beneficial because it allows NEM-solar consumers to use/deliver energy to/from their local grid. For instance, on foggy days, solar PV systems are less effective at delivering energy and thus customers can import energy from their grid. On sunny days, solar PV systems can generate more energy than the consumer may be able to use and thus they are able to deliver it back to the grid. A demand charge encourages NEM customers to better align their energy use with demand and solar generation curves. The NRDC further wished to structure the demand charge into three categories of peak demand: a monthly charge of \$5 for peak demands of 0–3kW, \$10 for 3–6, kW, and \$15 for 6 kW onward.¹²² This price structure rewards customers who practice managing their energy demands.

Lastly, the NRDC would implement a seasonal TOU rate. The TOU rate would allow utility companies to better assess a customer’s energy usage by taking into account energy demand during certain seasons/weather. Like a demand charge, a TOU emphasizes that the time when a customer uses

119 Savenije, Davide. “SDG.” Utility Dive. February 24, 2015. Accessed July 17, 2016. <http://www.utilitydive.com/news/sdge-if-youre-not-prepared-for-the-change-its-too-late/366979/>.

120 Home Works. “Load Management.” 2016. Accessed July 17, 2016. <http://www.homeworks.org/content/load-management>.

121 Bull, Pierre. “Nrdc Proposal to Evolve Net Metering in California.” NRDC. August 18, 2015. Accessed July 17, 2016. http://switchboard.nrdc.org/blogs/pbull/NRDC_Proposal_to_Evolve_Net_Metering_in_California.html.

122 Ibid.

energy is equally as important as the amount of energy consumed. The NRDC specifically wants to implement TOU rates during the Summer/Fall season; the TOU rate would not be in effect during the Winter/Spring season. Utilizing electricity during Summer/Fall, especially during the peak hours of 4–8 p.m., is more expensive and intensive compared to other seasons and times. The NRDC would create three hourly block periods with ascribed, increasing rates—off peak, mid-peak/regular usage and on-peak.¹²³

Overall, the NRDC’s proposal encouraging the CPUC to adopt demand charges and TOU rates reflected its desire to inspire more thoughtful, efficient energy consumption by consumers. Moreover, its proposal to implement minimum charges demonstrated its desire for sustainable monetary practices in the solar PV market while encouraging renewable energies.

Differences between NEM 2.0 and the NRDC’s Proposal

The CPUC released its decision for the net metering tariff, which encompasses three overarching recommendations. The first is the implementation of a one-time interconnection/implementation fee of approximately \$75–\$150 to be paid by the solar project owner. The NRDC did not propose a similar implementation fee. The second CPUC recommendation is for NEM customers to fund programs targeting low-income communities and the promotion of energy efficiency. This would help to prevent utility companies from shifting costs onto non-solar owners by guaranteeing that NEM solar owners are providing monetary contribution for said programs. Similarly, the NRDC proposed that solar customers fund public purpose programs through the minimum bill law. Finally, the CPUC proposed to implement TOU rates for customers who register in 2018 and beyond. The NRDC proposed the implementation of seasonal TOU rates. Both proposals aim to reward NEM customers for efficient practices.

Joint Compromise Proposal from Southern California Edison, Pacific Gas & Electric Company, and San Diego Gas & Electric Company

On January 7, 2016, Southern California Edison (SCE), Pacific Gas & Electric (PG&E) and San Diego Gas and Electric Company (SDGE) filed a joint compromise in response to the December 2015 California Public Utilities Commission (CPUC) proposal.¹²⁴ This compromise was submitted due to the power companies’ beliefs that the proposed decision created an NEM structure of subsidies that placed an imbalanced burden on non-solar and non-NEM customers. Furthermore, they believe that this NEM structure is no longer needed to support the continued growth of the solar industry.

The coalition of companies proposed a compromise that “maintains the benefits of the proposed decision while sharing the benefits of the federal Investment Tax Credit (ITC) extension to non-NEM customers.”¹²⁵ First, solar customers would be credited for each kWh of electricity produced by their PV system that displaces the coincident energy use by their home or business at their otherwise applicable retail rate. Solar customers would be paid a fixed export compensation rate for energy

123 Ibid.

124 *San Diego Gas & Electric Company Comments on Proposed Decision* January 7, 2016, accessed February 19, 2016, <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M157/K542/157542169.PDF>.

125 Ibid.

exported to the grid (i.e., energy that exceeds coincident on-site use). This export compensation rate would be \$0.15/kWh for all new installations before the total of all NEM and successor tariff solar reaches 7 percent of the utility's aggregate customer coincident peak demand and \$0.13/kWh after reaching 7 percent of the utility's aggregate coincident customer peak demand. These export compensation rates approximate the benefits under the proposed decision, while attempting to share a portion of the ITC extension benefits with nonparticipating customers. The rates would be fixed for all of the utilities and applicable to all customers served under the successor tariff. Solar customers, regardless of when they are interconnected under the successor tariff, would be served on time-of-use (TOU) rates beginning in January 2018. The fixed export compensation rate structure (15 or 13 cents/kWh) would apply for 10 years from the original date new solar customers interconnect, taking into account locational and time-differentiated values of customer-sited DG.

Under the Joint Compromise, the Commission would revisit this structure, reassess its impact on nonparticipating customers and the solar industry, and make additional changes that would become effective in 2019. If the Commission did not adopt SCE's proposal or the Utilities' compromise proposed above, SCE's comments also detailed other revisions that should be made relating to the collection of non-bypassable charges (NBCs). Finally, SCE's comments also addressed the requirements for customers with systems sized larger than one megawatt (MW).

V. NEM 2.0

On January 28, 2016, the California Public Utilities Commission (CPUC) voted 3-2 to adopt a finalized NEM 2.0 successor tariff.¹²⁶ This was created after taking into account the various proposals discussed above, along with extensive comments from other interest groups and the public at large. With the new policy, NEM 2.0 customers will have their accounts subject to the conditions of this successor tariff for 20 years from the date of first use. Many aspects of NEM 2.0 remain unchanged from the prior NEM 1.0 tariff. Specifically, there are no new NEM-specific demand charges or monthly grid access fees and no monthly netting of energy.

One of the major changes is the addition of an interconnection fee. Customers with on-site generation systems of less than 1.0 MW will be required to pay a one-time \$75–\$150 fee (actual cost will be determined by the customers utility company) to connect to the grid. There is no size restriction for generator systems for new customers', but systems larger than 1.0 MW will have to pay standard associated costs.

The second significant change in NEM 2.0 is the addition of time-of-use (TOU) rates. There will be different costs for energy at different times of day and during different seasons throughout the year. The peak periods, when energy from the grid will cost the most, will be in the late afternoon and early evening, likely from 4 to 9 p.m., and in the summer, which will most likely be defined as April or May through September. Customers will also be able to sell at those same higher rates back to the grid during the peak periods. The reason for the peak in the afternoon to evenings is twofold: first, this time

¹²⁶ *Decision Adopting Successor to Net Energy Metering Tariff* February 5, 2016, accessed February 19, 2016, <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M158/K181/158181678.pdf>

period is when residential energy use peaks and second, since most solar energy is generated in the middle of the day, more energy being consumed during the peak period comes from utility companies because there is less solar generation at those times. The goals of implementing TOU rates are to encourage less consumption during the peak period and to raise more revenue from solar customers, thus offsetting some of the cost shift to non-participants. The TOU rates will be similar across all three utilities, though SDG&E and SCE may slightly extend their summer months past what PG&E will do. Rates have yet to be decided, but default TOU rates will be set by 2018 at the latest to begin changing customer behavior through price signals.¹²⁷ Additionally, the TOU rates will only apply to all customers, solar and non-solar, in 2019. Since peak periods and TOU rates will vary among utility companies, it is difficult to adequately analyze their effects.

NEM 2.0 requires solar customers to pay non-bypassable charges for all energy consumed. These charges are unavoidable and cannot be reduced or eliminated by exporting energy back to the grid. In the initial NEM 1.0 tariff, these charges were only applied to a customer's net energy use, rather than total consumption. NEM 2.0 mandates these charges apply to customers' total amount of consumed energy. This change comes from the fact that under AB 237, charges are no longer required to be calculated based on net consumption. The following charges include: Public Purpose Program Charge, Nuclear Decommissioning Charge, Competition Transition Charge and Department of Water Resources Bond Charges. The NEM 2.0 tariff will be subject to review again in 2019 for all residential solar customers.

Regarding unchanged aspects from the first tariff, NEM 2.0 also compensates consumers for their exported energy at the retail rate. This was widely discouraged by all three utilities in the state. New customers subject to NEM 2.0 must also provide evidence that their PV system is California Energy Commission approved and has an equipment and installation warranty of 10 years. Moreover, the price of electricity produced by future PV systems under NEM 2.0 will be comparable to values obtained under NEM 1.0.

VI. Considerations for Potential Solar Customers

The changes to NEM laws in California will create changes to how residential solar currently operates. The question for current and potential solar customers remains: How will NEM 2.0 affect the costs and benefits of installing or maintaining residential solar adoption? Looking at some of the other costs and benefits provides useful understanding.

Costs

As a potential solar customer, the first and most expensive step involves setting up a PV system for a home. PV systems are measured in dollars per watt, and most residential systems currently cost \$4–\$6/watt. For the average sized 5-kW system, this will total \$20,000–\$30,000.¹²⁸ The price and size may vary depending on energy consumption, shade cover, roof orientation and price range.

¹²⁷ "Inside the Decision: California Regulators Preserve Retail Rate Net Metering until 2019." Latest News. Accessed April 04, 2016.

¹²⁸ "How Much Does a Typical Residential Solar Electric System Cost?" Center for Sustainable Energy. Accessed April 04, 2016. <https://energycenter.org/california-solar-initiative/homeowners/cost>.

PV systems typically last for 25 years. It is important to note that entrance into the NEM program requires an inverter in order to connect and export energy back to the grid. These typically cost \$1,200–\$2,000, though many companies include this cost in their estimates. NEM 2.0 is expected to have little to no effect on the cost of a PV system, since the equipment comes from third party providers unconnected to utilities.

NEM 2.0 will affect consumers regardless of whether they purchase or lease their PV systems. Several financing options exist to aid in the purchase of a system—home equity loans, property assessed clean energy (PACE) loans or local bank, low-interest, energy efficiency and renewable energy loans.¹²⁹ Once purchased, the consumer must accept NEM rates, even if they may change. While leased systems come with certain maintenance coverage, with a purchase, the solar customer is also responsible for maintenance, expenses, paybacks and determining eligibility for government incentives.¹³⁰

On the other hand, leasing options are available through entering into a power purchase agreement (PPA). In a PPA, the developer arranges for all costs of installation and maintenance, and then sells the electricity generated to the host customer at a fixed rate (dollar per kilowatt-hour). The rates are typically lower than that of utilities and serve to offset the price of electricity bought off the grid. PPA's range for 10–25 years and, at the end of the contract, the customer can choose to extend the PPA, purchase the system or remove it. It is important to note, however, that the developer—and not the customer—receives the tax credits and any other government incentives generated from the system.¹³¹ Unlike purchasing a system, when leasing, the solar customer is not susceptible to any changes in NEM laws, since their contract predetermines the rate they pay. For potential solar customers, however, changes in NEM laws may affect rates developers provide in new PPAs.

After installation of the system, the one-time interconnection fee must be paid to the electricity company to begin NEM. Though small compared to the cost of the system at only \$75– \$100, it is, nevertheless, an added cost.

Finally, both current and potential solar customers should be aware of TOU rates. The CPUC decision determined the TOU rates will be mandatory for new NEM customers and preserved the retail rate credit for existing NEM customers for 20 years after their interconnection. The rates will affect how much money can be saved or made by exported energy. In the long run, this may increase the payback time of a purchased system and, hence, decrease the amount of time in which the owner can profit.¹³²

129 Ibid.

130 Brady, Jeff. "The Great Solar Panel Debate: To Lease Or To Buy?" NPR. Accessed April 04, 2016. <http://www.npr.org/2015/02/10/384958332/the-great-solar-panel-debate-to-lease-or-to-buy>.

131 "Solar Power Purchase Agreements." SEIA. Accessed April 04, 2016. <http://www.seia.org/research-resources/solar-power-purchase-agreements>.

132 "Inside the Decision: California Regulators Preserve Retail Rate Net Metering until 2019." Latest News. Accessed April 04, 2016.

Benefits

Originally established by the Energy Policy Act of 2005, the Solar Investment Tax Credit (ITC) is a 30 percent federal tax credit for solar systems on residential and commercial properties.¹³³ The ITC can be claimed by individuals or entities that own a solar system or are in a long-term lease agreement through a solar company.¹³⁴ In December 2015, Congress voted to extend the solar ITC at the current 30 percent rate through 2019 and then lower the rate to 26 percent in 2020, 22 percent in 2021, and 10 percent in 2022.¹³⁵ In an effort to ensure market certainty for companies and continue encouraging solar investment, Congress included a commerce-construction clause, which extends the credit for any project in development to 2024.³ Since 2006, the average cost of solar has dropped 73 percent, largely a function of the ITC, which has incentivized individuals and businesses across the country to invest in solar, driving competition and yielding substantial price reductions.¹³⁶

Within the state of California, the 30 percent federal tax incentive is available to residential and commercial consumers. While there are no statewide solar tax credits, there is a property tax exemption present for solar PV systems. The property tax exclusion, which is administered by the California State Board of Equalization, allows business and homeowners to “exclude the added value of a solar system from the valuation of their property for taxation purposes.”¹³⁷ Conveniently, the financial incentive amount is on 100 percent of the solar system’s value if installed between January 1999 and December 2016.¹³⁸

VII. Conclusion

The January decision by the CPUC is ultimately a win for solar PV proponents in California. NEM 2.0 continues to compensate solar customers for solar energy generation, with minimal changes in the value of such generation. The solar industry wanted to see these benefits continue, while the utilities companies are disappointed with the result. That being said, there are obvious impacts on solar customers, with both the interconnection fee and a reduction of payback as a result of the 2–3 cent subtraction from kWh of net metered solar. However, given what the utility companies were hoping for in terms of a massive rate overhaul and a redistribution of cost burden, these changes are relatively minimal.

NEM 2.0 comes with a large degree of possible fluctuation, as TOU rates are not yet determined or

133 “Solar Investment Tax Credit (ITC).” Solar Energy Industries Association. Accessed March 15, 2016. <http://www.seia.org/policy/finance-tax/solar-investment-tax-credit>

134 “Public Welfare Investments in Solar Energy Facilities Using Renewable Energy Investment Tax Credit.” Office of the Comptroller of the Currency. January 2014. Accessed April 3, 2016. <http://www.occ.gov/topics/community-affairs/publications/fact-sheets/fact-sheet-solar-energy-invest-tax-credits-grants.pdf>

135 “Congress extends the renewable investment tax credit: What now.” GreenBiz. December 28, 2015. Accessed March 15, 2016. <https://www.greenbiz.com/article/congress-extends-renewable-investment-tax-credit-what-now>

136 “The Case for the Solar Investment Tax Credit (ITC).” Solar Energy Industries Association. Accessed March 16, 2016. <http://www.seia.org/research-resources/case-solar-investment-tax-credit-itc>

137 “Solar Tax Exemptions.” Solar Energy Industries Association. Accessed April 3, 2016. <http://www.seia.org/policy/finance-tax/solar-tax-exemptions>

138 “Property Tax Exclusion for Solar Energy Systems.” Database of State Incentives for Renewables & Efficiency. November 6, 2014. Accessed April 3, 2016. <http://programs.dsireusa.org/system/program/detail/558>

standardized. TOU rates may evolve as peak times shift with changes in consumer behavior. Not only will peak hours change, the actual rates themselves have yet to be set and could have major effects on consumers and their energy consumption. Flexibility within NEM 2.0 also exists as the CPUC is engaging in further studies to determine the possible benefits that non-solar customers may actually receive through the encouragement of solar. While cost-benefit analyses have mainly been on the cost structures customers experience when interacting with utility companies, there are other factors that should be taken into consideration and that may affect policy going forward. Some studies have demonstrated that despite this debate, net metering can often benefit all ratepayers if all costs and benefits are included in the analysis.¹³⁹ This is partially due to a growing number of studies arguing that solar energy has been undervalued and after accounting for its benefits beyond net-metering credits, the balance changes and all customers are benefitting from NEM programs.¹⁴⁰ Regardless, there is a clear need for more detailed study into the costs/benefits of net metering. There should also be research into new ways for regulators to integrate distributed-generation technologies into the grid while thinking about innovating the standard utilities models to create more beneficial rate designs.

In addition to the technical questions, the legal battle has continued. After the January decision, PG&E filed a rehearing application for the NEM proceeding on March 7, 2016.¹⁴¹ They argued that the CPUC did not meet the goals set out in AB327 through NEM 2.0 and, as such, they want the CPUC to re-evaluate their decision. The utilities continue to argue that NEM 2.0 does not take into account the cost shift of grid maintenance onto non-solar customers, thus they are continuing any legal maneuvers to disrupt the solar industry and decrease solar subsidies like NEM.¹⁴² As of now, the CPUC has not acted on the filing—agreeing to further review could prevent future consumers from installing solar. However, utilities companies could take the issue to the California Court of Appeals, further entrenching the issue in the courts.

In California, the uncertainty around NEM in California persists due to both the legal questions and the fact that net energy metering policy is up for review in 2019. That means there is only a relatively short amount of time before things could radically change. With new research and technology constantly developing, it is hard to predict what will happen. SDG&E is about to be the first utility company to implement NEM 2.0, as they have reached their 5 percent cap on solar penetration.¹⁴³ Time will tell if NEM 2.0 continues to effectively incentivize solar customers, while preventing a large cost shift and grid trouble. Given California's renewable energy goals, along with changes in solar policy in nearby states, this continuing debate about net energy metering is one to watch, as it will affect consumers, industry and, ultimately, the environment.

139 Muro, Mark, and Devashree Saha. "Rooftop Solar: Net Metering Is a Net Benefit." Brookings Institution. May 23, 2016. Accessed July 18, 2016. <http://www.brookings.edu/research/papers/2016/05/23-rooftop-solar-net-metering-muro-saha>.

140 Ibid.

141 Solar Industry Magazine. "California Utilities Launch Legal Battle Against Nem Ruling." March 08, 2016. Accessed July 26, 2016. <http://solarindustrymag.com/california-utilities-challenge-state-decision-to-protect-net-metering>.

142 Mulkern, Anne. "Utilities Challenge Calif.'s Net-Metering Protection." Governor's Wind & Solar Energy Coalition. March 10, 2016. Accessed July 26, 2016. <http://www.governorswindenergycoalition.org/?p=16425>.

143 Ola, Danielle. "California Utility to Hit Nem Cap: Enter Nem 2.0." PV Tech. June 21, 2016. Accessed July 26, 2016. <http://www.pv-tech.org/news/california-utility-to-hit-nem-cap-enter-nem-2.0>.

