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One Year In: Tracking the Impacts of NEM 3.0 on California's Residential Solar Market

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On December 15, 2022, the California Public Utilities Commission passed an overhaul of the net metering program for the state's investor-owned utilities (IOUs). The changes replaced the long-standing net energy metering (NEM) tariffs with a new net billing tariff (NBT) structure (colloquially known as NEM 3.0, as its predecessor had been known as NEM 2.0). The defining feature of NBT is that it that it provides lower compensation for the portion of a PV system's generation exported to the grid. As a transition mechanism, the new tariffs include a temporary incentive adder as part of the export credit rate. Those adders, which will be phased out over time, differ by utility, and higher adders are provided for customer enrolled in a low-income rate discount program or that reside within a disadvantaged community or California Indian Country.

Importantly, the new tariffs did not immediately go into effect. NEM continued to be available for new interconnection applications until April 15, 2023, and NEM systems could continue to be installed after that date, as long as they had applied for interconnection beforehand.[1] However, starting on April 15, 2023, essentially all new interconnection applications could be submitted only under the NBT structure.

Now, one year later, we have an opportunity to evaluate how the California solar market has evolved under this new compensation regime. This technical brief reviews market data over the past year, describing changes in installation volume, quote activity, battery storage attachment rates, the distribution of solar adopters by geography and income, third-party ownership, system sizing, pricing, and installer market share.[2] The analysis presented here focuses solely on the residential market, as project development lead-times for non-residential systems are longer, and so the effects of NBT on the non-residential, behind-the-meter PV market have yet to meaningfully materialize.

To be sure, not all of the trends presented can be attributed entirely to NBT, as other important factors have also been at play, including sharp increases in retail electricity rates, continuing deliberations around fixed charges, the state's solar mandate for new homes, and new federal tax incentives, among others. In addition, implementation of NBT is not uniform across the state, as export credit rates vary across the IOUs, and the state's community choice aggregators (CCAs) can set their own export credit rates for the generation service portion of customer bills. Lastly, it should be noted that, while the transition to NBT has had its fair share of contention, the purpose of this brief is not to assess the merits of the policy, nor to evaluate the economics of solar under this new structure, but rather to provide initial empirical insights into how the market has evolved over the past year, confirming some expectations while also revealing several striking surprises.

[1] Pre-existing systems installed prior to the Commission's order were also grandfathered under the existing NEM tariffs.
[2] The trends are based primarily on public data from the CPUC's "Currently Interconnected Applications" dataset.

PV installs in the year since NBT went into effect were roughly equal to the year prior, but most were NEM systems. Passage of NBT in December 2022 set off a surge of applications seeking to qualify under the NEM tariffs before their sunset in April of the following year. That surge in applications led to a corresponding spike in NEM installations during the summer months of 2023, as shown in Figure 1, followed by a steady decline in the months since. Installations under NBT did not begin to pick up until the latter end of 2023, and averaged roughly 8,000 per month over the first quarter of 2024, lower than in any month under NEM going back to May 2020. To date, about 50,000 systems have been interconnected under the new NBT structure, in addition to 200,000 NEM systems interconnected over the same period—roughly the same total number of installs as over the 12 months prior, and higher than in essentially any 12-month period before that.

What these particular data portend for the future of the market is not altogether clear, given that so much of the install activity over the past year revolved around clearing the backlog of NEM applications. Some of the customers who "got in" during the final months of NEM were likely already planning to install PV in the coming year, and may have gone forward even if NBT were the only option, while others may have been prompted to consider PV specifically because of the impending NEM sunset.[3] Another 6-12 months (or more) of install data may be required before any "equilibrium state" emerges under the new NBT structure.

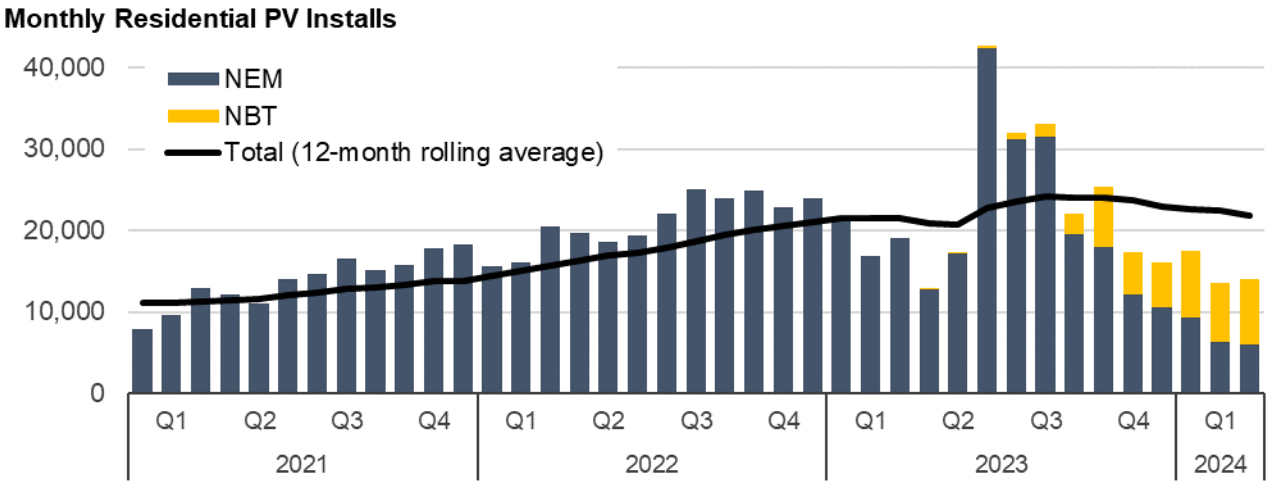

Figure 1. Residential Solar Installs under NEM and NBT

One increasingly important feature of California's residential PV market is the state's Title 24 building standard, which now requires solar PV on all newly constructed homes, both single- and multi-family, as well as accessory dwelling units (ADUs). Based on data from the California Department of Housing and Community Development, roughly 45,000 new single-family homes and ADUs were constructed within the footprint of California's investor owned utilities over the past year, plus several thousand multi-family buildings.[4] Exemptions to the standard exist, and some portion of PV systems installed on new homes over the past year may have interconnected under NEM. It is therefore unknown exactly how many of the NBT systems over the past year were new

[3] Interpretation of the data is also made more challenging by the fact that data are available only after systems have been installed and granted permission to operate; data on projects currently in the queue are not available.
[4] https://www.hcd.ca.gov/planning-and-community-development/housing-open-data-tools/housing-element-implementation-and-apr-dashboard

solar homes, but it was almost certainly a significantly larger share than has historically been the case under NEM.

Quote data from the online platform, EnergySage, show a similar pattern to the install data, but—as a leading indicator—are also suggestive of a more sustained downturn. As shown in Figure 2, quote requests spiked during the December 2022-April 2023 window between announcement and implementation of NBT. Since then, monthly quote requests have averaged roughly 60% of historical (2019-2021) levels. As with the install data, that downturn may partially represent a temporal shift in quote activity (i.e., customers who would have requested quotes later in the year, even under NBT, being prompted by the impending NEM closure to accelerate their request). However, by the first quarter of 2024, those transient effects likely settled out. While the EnergySage marketplace may not perfectly represent the California market overall, the fact that quote activity has not meaningfully picked back up is perhaps the clearest signal yet of a substantial and sustained market contraction.

Figure 2. Number of California Customers Receiving Quotes on EnergySage

NBT has driven a significant increase in residential storage installations. Net billing incentivizes customers to co-install battery storage along with PV, in order to arbitrage between low grid export rates and higher retail rates. As shown in Figure 3, storage "attachment rates" under NBT (the fraction of PV installs paired with storage) have risen to roughly 60%. This is a huge leap up from the ~10% attachment rates observed under the NEM tariffs (though notably still well below the ~90% attachment rates observed in Hawaii—which shifted to NBT many years ago). These higher storage attachment rates under NBT led to a significant uptick in new residential storage installations, particularly once the backlog of NEM applications began to tail off and NBT installations ramped up. Since November 2023, residential storage installs have averaged roughly 5,000 systems per month, more than double the monthly pace over the preceding three years.

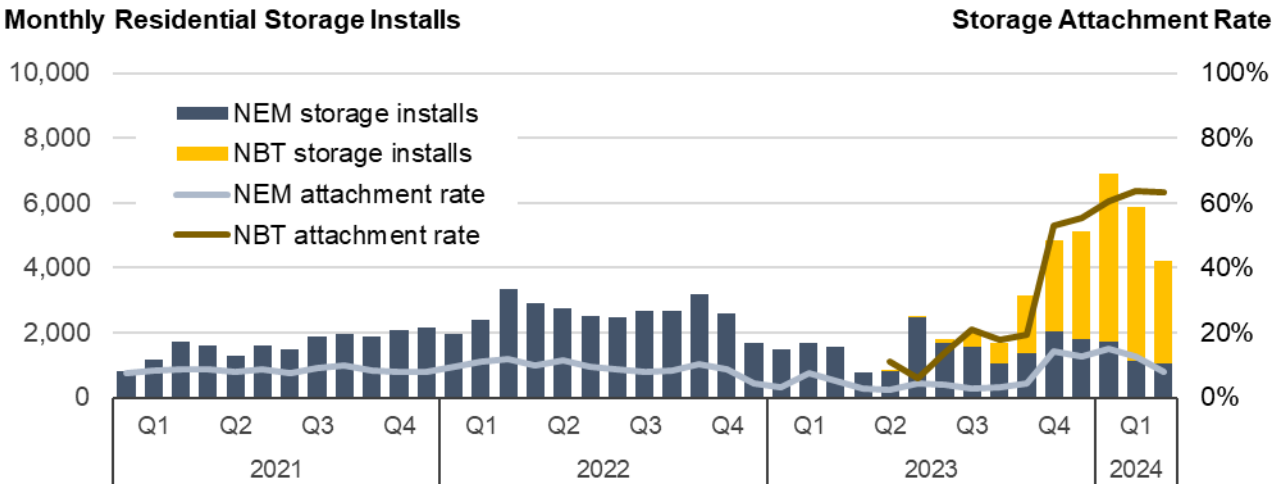

Figure 3. Residential Storage Installs and Attachment Rates

Notes: Attachment rates refer to the percentage of all PV installations each month that are paired with storage. Attachment rates are calculated based solely on PG&E and SCE data, as SDG&E's data do not identify paired systems. Monthly storage installs include stand-alone storage, through virtually all residential storage has been paired with PV.

The county-level distribution of new solar installations is largely unchanged under NBT. One might anticipate that the significant change in compensation structure under NBT would induce some shift in where PV systems get installed throughout the state—for example, shifting adoption toward utility service territories with more favorable grid export rates or toward inland regions with higher insolation and consumption levels. In fact, no meaningful shift has thus far occurred. As shown in Figure 4 below, the broad spatial distribution of new installations under NBT largely resembles the distribution over the preceding years under NEM. The most significant shift was in San Bernadino County (the large county in the southeast of the state), which saw a 4.5 percentage-point growth in market share under NBT. No other county saw more than a 2 percentage-point change.

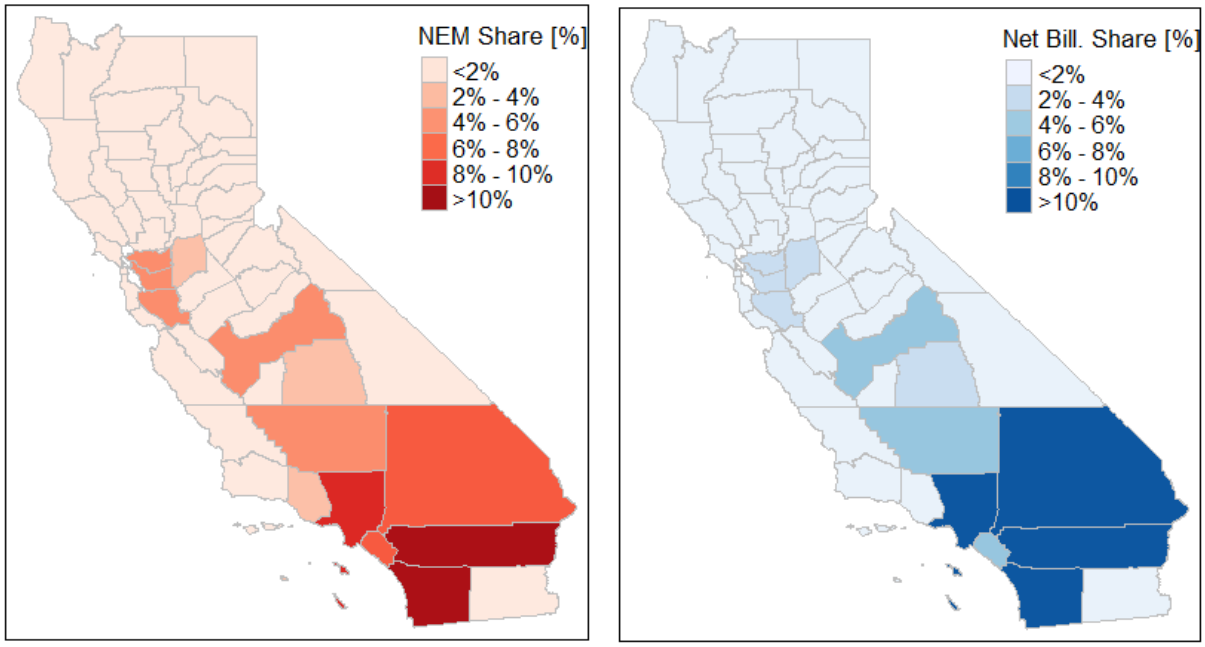

Figure 4. Percentage of Total IOU Solar Installs by County for NEM (left) and NBT (right)

Notes: Based on NEM applications from January 2020–April 2023, and NBT applications from April 2023–March 2024.

Solar adoption under NBT has shifted markedly toward less affluent zip codes. As shown in Figure 5, the transition to NBT in April 2023 coincided with a step-change in the income profile of new solar adopters, based on zip-code level average incomes.[5] This shift was especially pronounced for paired PV+storage systems, but was also evident among stand-alone PV and thus for all PV customers combined. It stands in stark contrast to the several preceding years under NEM, over which adopter incomes remained fairly flat. This dramatic downward shift is all the more remarkable given the significantly lower compensation under NBT, the move toward paired PV+storage (which costs more than stand-alone PV), and as shown later, the increase in pricing for paired systems.

This surprising shift likely reflects a number of factors. Chief among these is that NBT installs are likely much more heavily skewed toward new home construction than NEM, and thus the income profile of NBT adopters more closely reflects the zip code distribution of new home construction. Various incentives for low-and-moderate income households may be steering adoption as well, including the higher transitional adders available for low-income customers under NBT, new "bonus" federal tax credits for systems installed in low income neighborhoods, and state incentive programs, such as DAC-SASH and SGIP, that buy-down the up-front cost of solar and storage systems for low-income customers.

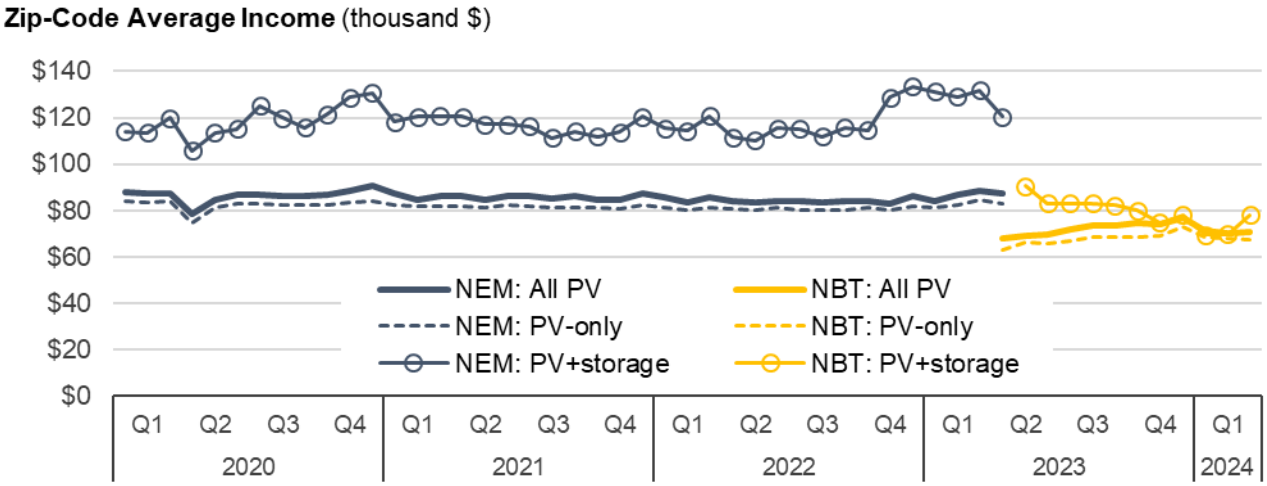

Figure 5. Solar-Adopter Incomes under NEM and NBT

Notes: The x-axis timeline is based on the application submission date. Zip-code average incomes are based on adjusted gross income data for the year 2022, published by the California Franchise Tax Board. See earlier note about exclusion of SDG&E when parsing data into PV-only and PV+storage systems.

Third party ownership rates are rising rapidly under NBT. Third-party ownership (TPO) was steadily declining under NEM, but those trends abruptly reversed course under NBT, as shown in Figure 6. What's more, while TPO rates were historically much lower for paired PV+storage than for stand-alone PV, that is no longer the case. Over the final 12-months of NEM, TPO rates averaged 26% for stand-alone PV and 11% for paired PV+storage, jumping up to 39% and 52%, respectively, under NBT (where they remain on a distinctly upward trajectory). This shift toward TPO is consistent with a higher proportional share of new homes, which historically have been more likely to be TPO, and

[5] These trends are based on data published by the California Franchise Tax Board on the aggregate adjusted gross income and number of tax returns filed in each zip code, for the year 2022. Similar results were also found using tract-level income data from the U.S Census, weighted by zip code. The same basic trends were also apparent when splitting out the data by utility, and when plotting trends against installation dates rather than application dates.

potentially also reflects shifts in the relative market shares of different solar installers (described later). Other exogenous factors may also be at play, including high interest rates, which make solar loan financing less attractive compared to TPO, as well as the "bonus" federal tax credits established under the Inflation Reduction Act that are available to residential systems only if third-party owned.

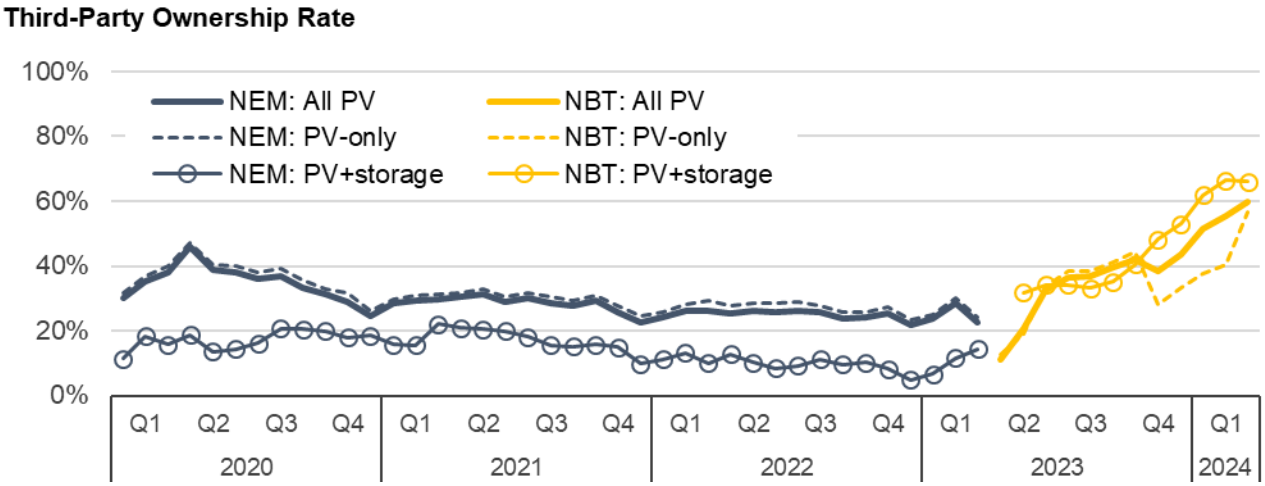

Figure 6. Third party ownership rates under NEM and NBT

Notes: The x-axis timeline is based on the application submission date. See earlier note about exclusion of SDG&E when parsing the data into PV-only vs. paired PV+storage.

PV system sizes are smaller under NBT. As shown in Figure 7, the median PV system size of systems NBT interconnection applications was roughly 9% lower than under NEM in the year prior (5.8 kW vs. 6.4 kW). That difference is confounded to some degree by the differing mixes of stand-alone PV and paired PV+storage systems, as PV systems in paired configurations tend to be larger. When comparing across similar configurations, the declines in PV system sizes under NBT are more pronounced: 15% smaller among stand-alone PV systems and 17% smaller among paired systems, compared to the same system type under NEM. These size declines stand in contrast to broader, longer term trends in the U.S. residential solar market, which has seen system sizes increase by roughly 3% per year, on average, over the past decade.

The smaller sizing under NBT is not unexpected, as the lower compensation for exported generation will naturally incentivize customers to install smaller systems. In addition, system sizes installed in residential new construction, and by less affluent households, have historically tended to be smaller. Insofar as those groups constitute a larger share of NBT installs, that may also contribute to smaller system sizing.

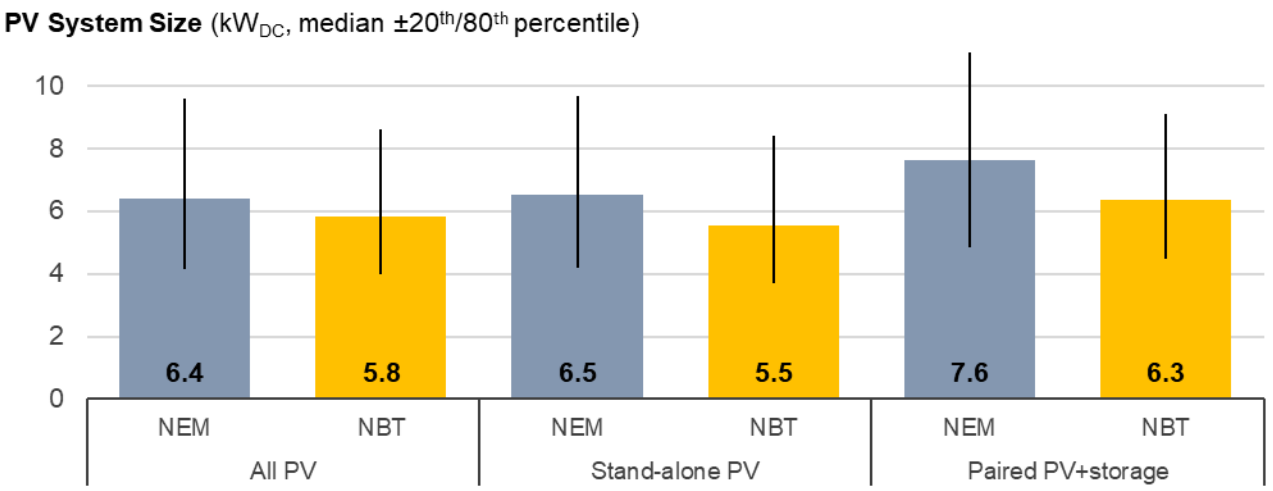

Figure 7. PV system sizes under NEM and NBT, for different system configurations

Notes: Based on NEM applications submitted over the 12 months prior to April 15, 2023 and NBT applications submitted over the 12 months after that date. See earlier note about exclusion of SDG&E when parsing data into stand-alone PV vs. paired PV+storage systems.

Installed prices for paired PV+storage systems are higher under NBT. As shown in Figure 8, installed prices reported for paired PV+storage systems were significantly higher under NBT than under NEM the year before. Specifically, median prices for customer-owned paired systems were 17% higher ($6.1/W vs. $5.2/W), and were 8% higher for TPO systems ($5.6/W vs. $5.1/W).[6] The higher prices for paired PV+storage systems under NBT are likely attributable at least in part to the sudden increase in demand, and related shortages of equipment and/or trained installers. Smaller PV system sizing under NBT may also contribute to the higher prices, though the size differences would likely equate to no more than a $0.1/W difference in median prices (so certainly is not the primary factor).

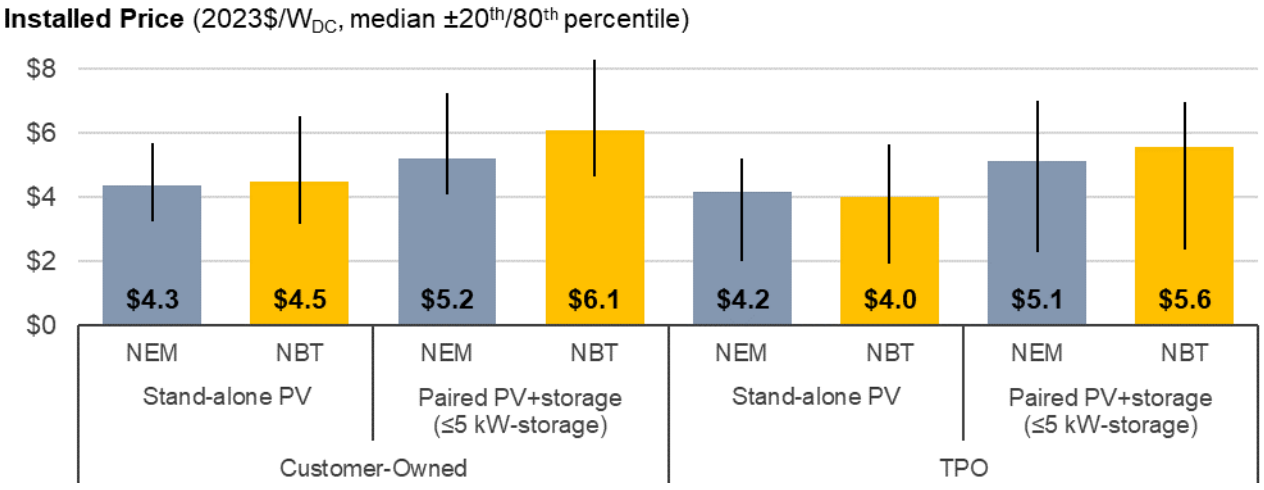

Figure 8. Installed prices under NEM and NBT, for different system configurations and ownership

Notes: Based on NEM applications submitted over the 12 months prior to April 15, 2023 and NBT applications submitted over the 12 months after that date. Installed prices are expressed per Watt of PV and adjusted to 2023 dollars. Prices for customer-owned systems are inclusive of any loan-financing "dealer fees". See earlier note about exclusion of SDG&E.

[6] These comparisons are based on PV systems paired with batteries up to 5 kW in size (the equivalent of a single Tesla PowerWall), are inflation-adjusted, and include any loan-financing "dealer fees" rolled into the reported prices for host-owned systems (which can comprise 20% or more of the total price).

In contrast to the trends for paired PV+storage systems, pricing for stand-alone PV has been relatively flat (rising slightly for customer-owned systems and declining slightly for TPO). The absence of any discernible drop-off in pricing for stand-alone systems is noteworthy, both in its contrast to the trends for paired systems, but also because of what it suggests about PV system pricing under NEM. Some have speculated that high incentives for solar PV can lead to inflated prices, and a number of published studies have supported this hypothesis. Yet, the fact that pricing for stand-alone PV systems has essentially held flat, despite the contracting incentives under NBT, casts some doubt on whether, at least in this particular case, NEM rates were artificially inflating prices. More careful analysis would be needed to draw firm conclusions on that question, however.

The installer market shows some signs of consolidation under NBT. As shown in the left-hand panel of Figure 9, roughly 2500 installation companies completed at least one PV system over the 12 months since implementation of NBT, about the same number as in the year prior. However, only half of those installers completed a system under the new NBT structure. Whether or not the remainder will ultimately exit the market remains to be seen, but these data suggest the possibility of significant consolidation within the California residential PV installer market. Indeed, the market share of the top 5 installers in the state rose from 40% during the last year of NEM to 51% during the first year of NBT, as shown in the right-hand panel. Most of that difference is associated with growth in the market share of the largest installer in the state, SunRun.

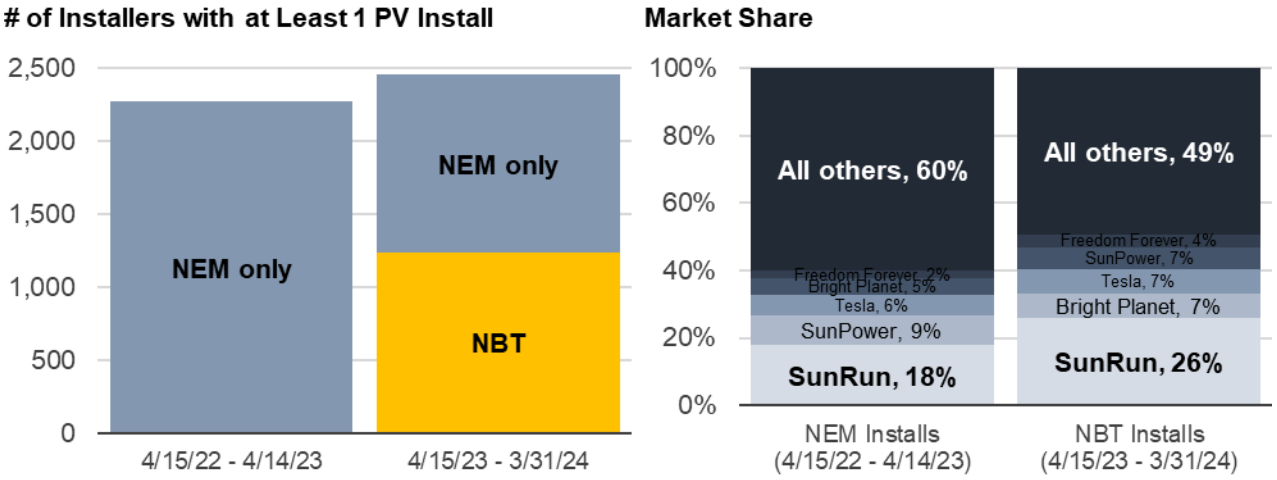

Figure 9. Active Installers and Installer-Market Share under NEM and NBT

Summary and Conclusions: One year in to California's new NBT structure, the effects are only beginning to be revealed, as much of the past year has been dominated by clearing the backlog of NEM applications submitted in the months leading up to the transition. Partly because of that, it may be too soon to draw firm conclusions about how deep and sustained the market contraction will be. Yet, market data over the past year point to several striking and, in some cases, surprising developments that accompanied the move to NBT (recognizing the many other market and policy forces also at play).

- PV installs in the year since NBT implementation (starting April 15, 2023) were roughly equal to the year prior, but 80% were NEM systems associated with the rush of interconnection applications submitted during the several months before (and installed after) the NEM tariffs closed.

- As expected, more customers are installing storage along with PV, but the pivot has been quite pronounced, with storage attachment rates jumping from roughly 10% under NEM to 60% under NBT.
- Perhaps as a result of that sudden increase in demand, inflation-adjusted installed prices for paired PV+storage systems rose by about 17% under NBT, relative to their level under NEM (this is for host-owned systems, inclusive of any loan-financing "dealer fees").
- Most surprising has been the dramatic shift in solar adoption toward less affluent zip-codes. Though the reasons for this development require further exploration, it likely reflects a larger share of NBT systems associated with California's solar mandate for new homes, as well as the growing effects of programs and policies to support solar and storage adoption by LMI households.
- Another remarkable shift has been the sharp increase in TPO rates, from 24% under NEM in the preceding year, to 44% under NBT, reversing what had previously been a steady movement away from TPO. This may partly reflect exogenous factors related to high interest rates and federal tax incentives, but is also consistent with any underlying shift toward new construction and less affluent households, both of which historically have had higher TPO rates.
- As expected, PV systems are smaller under NBT—by about 9% overall and by 17% for systems co-installed with storage. This shift is likely driven in large part by the lower compensation for grid exports provided under NBT, though systems installed in new construction and by less affluent households tend to be smaller as well.
- The installer market has become more concentrated under NBT, with the top-5 installers accounting for 51% of the market, compared to 40% under NEM (though most of that difference is associated with the state's largest installer).

These trends, and others, will no doubt come into sharper focus over the next year or so, once the NEM backlog is fully cleared and a "new normal" under NBT sets in.

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