

VNEM Full Market Potential

A Report Exposing the Full Market Potential for the Virtual Net Metering tariff within the Multi-family Building Sector

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About this Report

The *Virtual Net Metering Market Development Project* is one of 15 projects that make up the United States Department of Energy’s SunShot Solar Market Pathways Program, which aims to bolster solar adoption throughout the United States.

This *Virtual Net Metering Full Market Potential Report* is one deliverable associated in the *Virtual Net Metering Market Development Project* Statement of Project Objectives and is intended to assess the current state of the market and expose remaining market potential for the Virtual Net Metering tariff within the multifamily building sector. This report will include information relevant to both the affordable housing and market-rate customer segments, but will have a heavier focus on the market-rate sector due to lower uptake levels and the need to boost participation. A previously published project report, *The NEM-V Market Assessment Report*, was used as the foundation to this report, and was modified to include further levels of detail into the multifamily building stock density and types, updated policy information, financing, and tariff adoption levels.

Each section in this report was modified and supplemented with further levels of detail. The Finance section was also added.

The term *market* can refer to “the group of consumers or organizations that is interested in the product, has the resources to purchase the product and is permitted by law and other regulations to acquire the product.”¹ This report looks at the VNEM market, as it relates to locale, adoption process and market actors, as well as financing and other implementation models.

This report will be published on the Virtual Net Metering Market Development Project webpage² and disseminated to other Solar Market Pathways awardees, as well as provided directly to the Department of Energy as a reporting requirement under award *DE-EE0006902*.

¹ <http://www.netmba.com/marketing/market/definition/>.

² www.energycenter.org/smp.

I. Background

The California Legislature established the Net Energy Metering (NEM) tariff in 1996 with the enactment of Senate Bill 656. With the growth of solar through the successful implementation of NEM, California has created different sub tariffs that extend and build off the successes NEM created. Virtual Net Energy Metering (VNEM) has become one of the important derivatives of traditional net energy metering because it allows residents in a multitenant building to share in the tariff benefits of a common system on the roof of their building. By allowing a multitenant building to install a single solar electric system for the benefit of multiple tenants, it enables more cost-effective design as compared to the traditional NEM solar arrangement of one solar electric system physically installed and connected to each utility account.

To address low-income residential customers and affordable housing projects, the CPUC created the Multifamily Affordable Solar Housing Program (MASH) in October 2008.³ Recognizing that tenant access to the direct benefits of the solar system production was a critical component of the rebate, the need for a new utility tariff was apparent, which resulted in the low-income VNM tariff.

Figure 1: Electric Service Territories of the IOUs Offering NEM-V in California



In July 2011, the California Public Utilities Commission (CPUC) released Decision 11-07-031,⁴ which ordered the three large investor-owned utilities⁵ (IOUs) to create a tariff for non-low-income multitenant housing properties similar to VNM,⁶ but with participation limited to a single service delivery point (SDP), to be known as the NEM-V tariff. The three IOUs filed proposed tariffs in September 2011 to fulfill the CPUC's order to

³ CPUC Decision 08-10-036.

⁴ CPUC Decision 11-07-031, p. 65, Ordering Paragraphs 1 and 2.

⁵ San Diego Gas & Electric; Southern California Edison; Pacific Gas & Electric.

⁶ VNM is the low-income solar tariff which allows multiple accounts to benefit from a common solar electric system, within the three large IOU service territories. The VNM tariff is not subject to the same SDP restrictions as the NEM-V tariff.

create a virtual net metering tariff for general market multifamily housing and multimetered properties. There were a variety of topics that needed to be addressed in such a tariff, all of which were subject to protests, disputes and competing opinions as to how the tariff should be structured. Each utility proposal had elements controversial to the various solar parties, and the CPUC issued a decision in April 2012 ordering changes to the proposed tariffs.⁷ This resolution led to the current NEM-V tariff structure, as we know it today. At present, there are no other utility providers in California offering this model of a virtual net metering tariff for general-market multitenant properties with on-site generation. Figure 1 shows the service territories of the three large IOUs offering NEM-V.

In January 2016, the CPUC approved Decision 16-01-044 adopting a NEM successor tariff (NEM-ST) that continues the existing NEM structure while making adjustments to align the costs of NEM successor customers more closely with those of non-NEM customers. The Utilities filed Advice Letters with the CPUC implementing the new requirements in February 2016, which were approved by Energy Division Staff in July and August 2016.

The NEM-ST maintains the existence of Virtual Net Metering, but does include a few modifications to the tariff policy and naming conventions. These changes are summarized below.

The NEM-ST took effect in the SDG&E territory in June 2016. PG&E’s NEM-ST is expected to go into effect by the end of 2016, and the SCE service territory is expected to transition over during summer 2017, no later than July.

Table 1: NEM1 v. NEM2-ST

NEM 1.0 Original Tariff		NEM 2.0 Successor Tariff	
All IOUs: NEM		SCE: NEM-ST SDG&E: NEM-ST PG&E: NEM2	
Affordable Housing Virtual Net Metering Tariff	Market Rate Virtual Net Metering Tariff	Affordable Housing Virtual Net Metering Tariff	Market Rate Virtual Net Metering Tariff
<u>SCE</u> : MASH-VNM	<u>SCE</u> : NEM-V	<u>SCE</u> : MASH-VNM-ST	<u>SCE</u> : NEM-V-ST
<u>SDG&E</u> : VNM-A	<u>SDG&E</u> : NEM-V	<u>SDG&E</u> : VNM-A-ST	<u>SDG&E</u> : NEM-V-ST
<u>PG&E</u> : NEMVMASH	<u>PG&E</u> : NEMV	<u>PG&E</u> : NEM2VMSH	<u>PG&E</u> : NEM2V

⁷ CPUC, Resolution E-4481, April 29, 2012.

For market-rate projects (NEMV), any meter within a single property/premises can participate (SDP restriction lifted)

- Reference the applicable territory's' current NEM-V Electric Schedule tariff sheet for definition of PROPERTY or PREMISES

Participating accounts are no longer exempt from non-bypassable charges

- All Qualified Customers taking service under this schedule [affordable housing and market rate] are responsible for paying non-bypassable charges which pursuant to D. 16-01-044 are defined as Public Purpose Program (PPP) charges, Nuclear Decommissioning (ND) charges, the Competition Transition Charge (CTC), and the Department of Water Resources Bond Charge (DWR-BC). These charges are calculated based on the total energy delivered by the Utility, during each metered interval recorded over the course of each monthly billing period.

Mandatory TOU Rates

- Qualified Customers must receive service on a TOU rate schedule
 - SCE and PG&E tariff sheets simply state that Qualified customers must take service under a TOU rate schedule to be eligible for NEM2V-ST.
 - The SDG&E tariff sheets states that, "Residential Qualified Customers may choose to be served under an applicable optional Time-of-Use ("TOU") rate. Qualified Customers who complete their interconnection application for service under this schedule within a period of 120 days after SDG&E's 2016 General Rate Case Phase 2 ("GRC P2") proceeding (A.15-04-012) TOU rates become effective shall be permitted to 1) take service under the new TOU rates or 2) take service under existing TOU rates or tiered rates in effect at the time their interconnection application was completed for a period of time up to 5 years from the date they take service.
 - SDG&E Residential Qualified Customers who complete their interconnection applications for service under this schedule 120 days after the effective date of the implementation of SDG&E's 2016 GRC P2 are required to take service under an applicable TOU rate and shall not have the ability to opt-out to a non-TOU rate."⁸

⁸ SDG&E Schedule NEM-V-ST, Effective July 5, 2016

Despite having been operational since 2011, the use of the NEM-V tariff has been extremely limited. This report seeks to summarize the existing NEM-V market and expose the untapped potential within California.

II. Market Assessment Approach

This report seeks to assess the existing NEM-V market within California, as well as expose the overall market potential for rooftop solar in multifamily buildings. This Section describes the approach to assessing the existing NEM-V market of which the findings are explained later in this report.

In order to conduct an assessment of the NEM-V market and inform the market context of NEM-V in California, we employed a variety of primary and secondary data collection methods that are summarized in Tables 1 and 2.

Primary data was obtained through surveys, in-depth interviews and data requests, as well as working group meetings with market stakeholders, including property owners and managers, solar contractors and utility representatives. The team also used secondary data to inform its research (Table 2). More details on the primary data collection are provided.

Table 2: Primary Data Collection Methods

Primary Data			
	Property Owners/Managers	Solar Contractors/Installers	Utilities
Surveys	42 responses	116 responses	N/A
Interviews	2 interviews	9 interviews	1 interview each with PG&E, SCE & SDG&E
Working Group Meetings	N/A	4 meetings, averaging 16 attendees	N/A

Property owner/manager survey: The electronically administered survey gauged the knowledge, decision factors and experience of going solar and the NEM-V tariff. The survey was disseminated through the various channels:

- Apartment Association of Greater Los Angeles (AAGLA) – Survey sent through a “Products and Services” email, as well as linked in their monthly newsletter
- Building Owners and Management Association (BOMA) – Survey description and link was distributed in a monthly newsletter, as well as advertised on their “news” page for the duration of the active survey
- San Diego County Apartment Association (SDCAA) – Agreed to distribute the survey link in their weekly newsletter, as well as in their monthly digital newsletter
- Building Industries Association (BIA) – Distributed news of the survey to San Diego members through a targeted email, as well as advertised the survey in their newsletter

Table 3: Secondary Data Collection Methods

Secondary Data	
Data Type	Source
California building stock data	American Community Survey 2014 Estimates
Number of interconnected NEM-V projects	Utility Data Requests for all 3 IOUs

Due to the variety of dissemination avenues and facilitators, it is unclear how many recipients received the final survey. The survey yielded a total of 42 responses from decision makers (property owners and managers) in California. The respondents represented a mix of people who had installed solar and those that had not installed solar.

Property Owner Interviews: Based on the survey results, seven property owners were identified as having experience with the NEM-V tariff. We contacted respondents who reported contact information for follow-up interviews and completed two interviews. In addition, we interviewed two more through referrals, resulting in a total of four interviews.

Solar Contractor/Installer Survey: The contractor survey sought to inform the project team on the awareness and activity of installers working with the NEM-V tariff, adoption levels and location of NEM-V projects and challenges faced in the development process. The contractor surveys were administered electronically and distributed through the project team's internal list of 350 contractor contacts, including contractors within California who participated in the California Solar Initiative (CSI) incentive program. The survey process included several email reminders to prompt further participation, which yielded a response rate of 33% or 116 complete responses.

Contractor Interviews: Based on survey results, we identified a total of 15 contractors who reported to have experience with the NEM-V tariff. We reached out to those contractors and completed nine contractor interviews.⁹

Utility Interviews: To accurately assess the NEM-V process from the point of view of the utility, the project team utilized semi structured interview scripts to understand the interconnection process and requirements of NEM-V within each utility territory. The interview questions were sent to utility representatives prior to the interview to allow them to gather information from different staff/departments that would be useful during the interviews. The interviews were administered in person and via conference call. The interview team confirmed the documented responses with the utility representatives and the results were sent back to the interviewees to ensure accuracy and quality of each response. Utility representatives provided minor edits allowing the project team to feel confident with the level of detail and accuracy in the interviews.

Working Group Meetings: This assessment also is supported with information gained from four NEM-V Working Group meetings with contractors operating in the Southern California region and held as part

of our Friends of NEM-V Santa Monica Pilot project during September-December 2015. Each meeting hosted a series of speakers and topics, exploring different aspects of implementing NEM-V in the multifamily building space. Topics included tariff eligibility, interconnection process, financing, permitting, rent control and the value proposition for apartments and condos. The four meetings averaged 16 attendees.

The following sections of this report present the findings of these efforts.

The approach for determining **Building Stock Estimates, Needed Solar Capacity, and the Technical Potential for Solar on Multifamily Buildings** is also described in Section III.

III. California Market Potential

California has significant potential for the deployment of NEM-V given the volume of multitenant building stock in the residential and commercial building sector. In this section we will focus on the potential in the residential sector only as this has been the center of this team’s SMP project deliverables to date.

About a third of all households in California reside in multifamily structures (Table 4). Most of these are apartments and a smaller fraction are condominiums. The multifamily housing stock is especially prevalent in the three largest cities in California, with over 40% of households located in these structures in Los Angeles and San Francisco (Table 5). To understand the scope of potential across the IOUs, we broke the data out by utility (Table 6).

Table 4: Multifamily Housing in California¹⁰

	Number of Units	Percent of Building Stock
All Multifamily structures (2+ units)	3,943,593.00	31%
Owner-occupied housing units (2 + units)	395,182.00	3%
Renter-occupied housing units (2+ units)	3,548,411.00	28%

¹⁰ 2014 American Community Survey 1-Year Estimates, California. Tenure by Units in Structure, Universe: Occupied housing units.

Table 5: Large Cities: Population, Housing and Renters¹¹

City	Population	Total Occupied Housing Units	Total Apartments	Apartments Percent of All Housing
San Francisco	837,442	354,651	142,598	40%
Los Angeles	3,884,340	1,320,167	563,413	43%
San Diego	1,355,885	480,730	139,116	29%

Table 6: Multifamily Housing Breakdown by IOU Service Territory¹²

	PG&E	SCE	SDG&E
Total households	4,320,333	4,139,577	1,186,479
Households in multifamily structures (2+ units)	1,209,693 (28%)	1,117,685 (27%)	403,402 (34%)
➤ Condominiums (2+ units)	3%	3%	5%
➤ Apartment (2+ units)	25%	24%	29%

The data does not differentiate between affordable housing and market-rate housing; however, the sheer number of multitenant dwellings that exist within the three IOU territories is an indicator of the large NEM-V market potential in all utility territories. The number of households in the three IOUs roughly corresponds to 1,695 MW of load that could be served by solar power generation.¹³

¹¹ 2014 American Community Survey 1-Year Estimates, California. Tenure by Units in Structure, Universe: Occupied housing units.

¹² 2014 American Community Survey 1-Year Estimates, California. Tenure by Units in Structure, Universe: Occupied housing units.

¹³ For this estimate we utilized average energy consumption data provided by the U.S. Energy Information Administration, Office of Energy Consumption and Efficiency Statistics, Forms EIA-457 A and C-G of the 2009 Residential Energy Consumption Survey. An apartment household in Western USA has an average electric consumption of 5442 kWh/year. This corresponds to an average load of 0.62kW per household.

In Depth Assessment of Selected Areas in California

To provide a more comprehensive picture of the potential of solar energy installations in the multifamily housing sector we take a deeper dive into 5 counties in California. This section will provide insights gleaned from analyses into determining the number of multifamily building, the solar capacity needed to offset the total multifamily electric loads, and, finally, the technical potential of solar energy installations for that building stock. We selected counties that contain a high density of multifamily households; are located within one of the three major IOU service territories; and where cost and access pertaining to datasets that inform the building stock analysis were not prohibitive. We selected the following areas based on the above criteria:

- San Diego County
- Fresno County
- San Francisco County
- Alameda County
- Los Angeles County (SCE regions only)
- City of Santa Monica (inside LA County)

Building Stock Estimates

The building stock analysis sought to determine the number of multi-family buildings or multi-family complexes (if buildings belong to the same owner or are managed together) for each zip code in each county. In addition, we broke down building estimates by type (apartment vs condominium) and size (small, medium, and large) when the data provided sufficient detail. Similar to the IOU building stock data presented in Tables 3-5, these building stock estimates represent all multifamily buildings, including those categorized as affordable housing, because the data did not distinguish between the two customer segments.

We obtained building number estimates from analyzing the counties' assessor data (Secured Roll, as of April 2016) utilizing information on parcel owner name, land use code, tax parcel code, number of units and address. The assessor dataset's layouts and level of detail varied between the counties, and thus, different approaches were taken for each County to estimate the number of buildings and types (apartments and condominiums). In general, assessor tax parcels coded as multiple family residences contain only one building. However, there are also cases in which multiple buildings are located on single tax parcel, or where a single building spans multiple parcels, although these cases are less common. Identifying estimates for condominium complexes required additional steps as each condo is assigned its own tax parcel. Thus, each condominium building complex is comprised of multiple different tax parcels. We used a combination of identifiers (address, APN number segments, building characteristics when available) to aggregate tax parcels in order to estimate condominium building stock. Table 7 shows the building stock estimates for each area.

Table 7. Multi-family Building Stock in selected areas in California.

	Alameda	Fresno	LA County	San Diego	San Francisco	Santa Monica
Condo Small			6550	1898		665
Condo Med			1467	572		174
Condo Large			1876	1818		88
Apt Small			92159	24333	29962	2492
Apt Med			7763	2250	2165	663
Apt Large			5085	2397	1212	347
Total	23767	7949	114900	33268	33339	4429
Total Condos	1861		9893	4288	0	927
Total Apts	21906		105007	28980	33339	3502

* Table shows number of buildings/complexes. If cell is blank, dataset did not provide sufficient detail to determine subcategory.

Needed Solar Capacity

How much solar capacity is needed to provide all multi-family households with energy from the sun? To calculate the needed solar capacity for all multi-family households in our selected areas, we utilized estimates for the number of MF households from the 2014 American Community Survey¹⁴ and yearly household energy consumption estimates (average for MF households in Western Region) from the 2005 Residential Energy Consumption Survey.¹⁵ We specified solar systems to offset 80% of the household’s yearly electric consumption and applied an average annual production rate of 1,700kWh per 1KW PV solar system. The needed solar capacity estimates for each study area are presented in Table 7.

Technical Potential for Solar on Multifamily Buildings

In order to provide solar energy to all households there needs to be sufficient suitable roof space to install solar panels. We therefore calculated the technical solar capacity potential to install solar panels on multi-family buildings for all selected areas.

We modeled the technical solar capacity potential by performing different steps. The total multi-family roof space was estimated by utilizing data on building stock, household floor space and the number of

¹⁴ US Census Bureau 2014 American Community Survey 1-Year Estimates

¹⁵ Energy Information Administration’s 2005 Residential Energy Consumption Survey (RECS)

floors. We obtained data for building stock and size (number of units in building) through the assessor data analysis. We obtained floor space estimates for multi-family residential buildings from the 2005 Residential Energy Consumption Survey.¹⁶ We utilized data from the 1997 American Housing Survey¹⁷ and the 2015 New Residential Construction Survey¹⁸ to inform the distribution of number of multifamily buildings by number of floors. We estimated total floor space, a proxy for roof space, by multiplying number of units in a building (we estimate an average of 4 units in small; 14 in medium and 45 in large buildings) with the average apartment household floor space. We then divided the building footprint by the number of floors, by applying a floor distribution function in each building size segment.

In a second step, we extracted usable roof area from total roof area using an availability factor that accounts for shading, rooftop obstructions, and constraints. We adapted a suitability factor of 43% based on NREL’s (2012)¹⁹ and NREL’s (2008)²⁰ base estimates of roof suitability for solar.

In the final step, we applied solar power densities of 110 W/m² for flat roofs and 135 W/m² for tilted roofs, under average module efficiency of 13.5% based on NREL’s (2012) estimates for power densities for commercial and residential building stock. We estimate 50% of roofs to be tilted and 50% of roofs to be flat. Table 8 provides the results of our modeling efforts.

Table 8. Needed solar capacity estimates, Technical solar capacity potential estimates, and maximum load offset under technical potential capacity.

	Alameda	Fresno	LA County	San Diego	San Francisco	Santa Monica
Needed Capacity (80% offset load) MW	529.2	197.8	1820.1	980.9	596.8	91.2
Technical Potential (MW)	437.2	146.2	2,133.4	825.0	530.5	110.6
Difference (N-T) MW	-92.0	-51.5	313.3	-155.9	-66.3	19.5
Maximum Load Offset	66.1%	59.2%	93.8%	67.3%	71.1%	97.1%

¹⁶ Energy Information Administration’s 2005 Residential Energy Consumption Survey (RECS)

¹⁷ U.S. Census Bureau, Current Housing Reports, Series H150/97 American Housing Survey

¹⁸ US Census Bureau 2015 New Residential Construction Survey

¹⁹ NREL 2012: Anthony Lopez, Billy Roberts, Donna Heimiller, Nate Blair, and Gian Porro (2012). U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis. NREL/TP-6A20-51946, CO: National Renewable Energy Laboratory.

²⁰ NREL 2008: Denholm, P.; Margolis, R. (2008). "Supply Curves for Rooftop Solar PV-Generated Electricity for the United States." NREL/TP-6A0-44073. Golden, CO: National Renewable Energy Laboratory.

Our modeling efforts provide insights into the feasibility of offering solar to all multifamily households in 5 counties in California. LA County is the only county in our analysis that may be able to achieve full solar coverage (at 80% load offset) with rooftop generation, across all multi-family households. The other counties seem not to have sufficient available roof space to reach such a high penetration of solar across households. However, there is sufficient suitable roof space in these areas to provide rooftop solar that, on average, offsets at least 59% of a household’s load.

Overall, our analysis indicates that roof space does not present a major barrier in providing MF households with access to roof top solar.

IV. Market Adoption

Levels of NEM-V Adoption

As of May 2015, California’s three largest IOUs reported 161 interconnected NEM-V solar PV projects comprising at least 2,195 kW²¹ (AC) of installed capacity in their territories (Table 9). These systems provide PV credits to at least 752 benefitting accounts.²²

Table 9: NEM-V PV Project Adoption Across IOUs in California 2011-2015

Utility	# of NEM-V Projects	kW (AC)	# Benefitting Accounts
PG&E	114 ²³	Not available ²⁴	Not available ²⁵
SCE	11 ²⁶	232	154

²¹ 2195.77 kW is the sum of SCE and SDG&E projects. PG&E did not provide system capacity information, citing privacy concerns.

²² SCE reported 154 benefitting accounts. SDG&E reported a total of 484 benefitting accounts. PG&E was unable to provide the number of benefitting accounts, so 114 is the minimum number of benefitting accounts for their territory.

²³ Per PG&E May 2015 — Project team submitted a data request to PG&E in November 2015; however, PG&E did not provide specific NEM-V projects within their territory, citing privacy concerns.

²⁴ PG&E did not provide NEM-V system capacity information, citing privacy concerns.

²⁵ PG&E did not supply the total number of benefitting accounts for NEM-V projects within their territory, citing privacy concerns.

²⁶ Per SCE December, 2015 — This total differs from the May data request, which listed a total of 12 NEM-V projects. This is assumed to be an error of differentiating between low-income and general market VNEM tariffs.

SDG&E	36 ²⁷	1963	484
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Pacific Gas & Electric (PG&E), the largest IOU in California by total square miles served, has the highest adoption rates of NEM-V projects among the three large IOUs. This would seem an obvious conclusion considering PG&E has the highest adoption rate of NEM installed solar installations in California with over 2.2 GW. Southern California Edison (SCE), which serves more customers than PG&E, has a 90% lower NEM-V adoption rate compared to PG&E. However, what makes these numbers even more striking is that SCE, at just under 1.2 GW of total installed NEM projects, has 25 less NEM-V projects compared to San Diego Gas & Electric (SDG&E), although SDG&E has less than half as many total NEM installed solar projects (481 MW) in its territory. Possible explanations are that in both PG&E and SDG&E territories the process to date for installing NEM-V projects may be simpler and more transparent than the process in SCE territory, communicating with the utility may be more difficult and financing methods may be less available in SCE territory.

Data Issues

While these adoption levels were reported by the utilities as NEM-V projects, the interpretation of the reported numbers requires some caution. The reported number of NEM-V projects cannot be directly translated into a number of participating *properties*, as meters within a property may be connected to different service delivery points (SDPs), under the original NEM policy. Clusters of meters that are connected to different SDPs require separate NEM-V interconnections, thus some properties, or even buildings, will have more than one NEM-V project associated with it. Due to this, our team does not have complete insight into the exact number of properties that have utilized the tariff. Public information regarding SDP layouts for properties does not exist, and it is difficult to gain this information from the respective utility planning department maps or records.

On December 15, 2015, however, the CPUC published the proposed decision for the net energy metering successor tariff (NEM 2.0) proceeding, which was approved, and eliminated this SDP restriction, and thus allows for any accounts within a NEM-V eligible property to receive credits from a single solar electric system, regardless of point of service or SDP.

Quantity of Benefitting Accounts

²⁷ Per SDG&E, November 2015.

Another interesting fact gleaned from our utility data requests was regarding projects reported to have only one designated benefitting account. These single-account NEM-V projects would more appropriately be served by the NEM tariff, as a single benefitting account does not need virtual allocation. However, we uncovered an interesting eligibility allowance and interconnection process under the NEM-V tariff, which indeed allows for a project to adopt NEM-V and only offset one customer account. Although it is the project team’s intent to promote this tariff as a mechanism of providing solar access to multiple tenants who could not benefit from onsite generation otherwise, these single account projects fit within the eligible market. Table 10 highlights the percentage of NEM-V projects within each service territory that have only a single benefitting account:

Table 10: Percentage of NEM-V Projects with a Single Benefitting Account

Utility	Total NEM-V Projects	Total NEM-V Projects with a Single Benefitting Account	Percentage (%) of NEM-V projects with a Single Benefitting Account
SCE	11	2	18%
SDG&E	36	9	25%
PG&E	114	Information not available ²⁸	

This distinct use of the tariff for means of saving on installation costs rather than for providing tenant access, is something to be recognized and exposes the fact that there could be different drivers for adopting the tariff beyond the intention of providing solar access for tenants, but rather that it is simply more cost-effective to go the NEM-V interconnection route over the non-virtual NEM route.

Why would a project employ NEM-V, as opposed to NEM, if they are simply allocating 100% of the production to a single customer account?

The cost of implementation for these two options is the driver of determining which tariff to adopt: NEM or NEM-V. In order to adopt the NEM tariff, a building’s service panel often needs to be upgraded

²⁸ PG&E did not divulge details as to the number of benefitting accounts, citing privacy concerns.

in order to handle the added generation capacity that will be flowing from the solar electric system, through the service panel, to the home's appliances. The cost to upgrade a building's service panel, if needed, is based on amperage and can range from \$2,500 to \$9,300, which could increase if further upgrades to surrounding transmission lines or components are needed. Rather than upgrading the building's service panel and employing the [nonvirtual] NEM tariff, some projects have utilized the NEM-V tariff by implementing a "line-side tap." In other words, NEM-V projects are allowed to bypass connection at the building's main service and instead physically tie to the utility side of the meter, install a net generation output meter (NGOM) and allow the flow of solar-produced electrons directly into the utility grid. From here, credits from the solar generating system are virtually allocated to a single account, mimicking a NEM installed solar project without physical connection to the building's main service. This eliminates the need to upgrade a service panel. The cost to purchase and install an NGO meter ranges from \$788 to \$13,535, depending on the meter amperage needed.

Each site is distinct as to whether the service panel upgrade or the line-side tap and NGO meter installation is the most cost-effective.

Adoption Levels revisited

Since December 2015, the public NEM Interconnection DataSet, found on the California Solar Statistics webpage, includes a column that distinguishes which projects are interconnected under the Virtual Net Metering or Meter Aggregation tariffs. Within Virtual Net Metering, VNM-A/MASH, labeled VNEM, and NEM-V projects are meant to be differentiated, which would expose the distinct adoption levels within the affordable housing sector and the market rate sector. While this distinction would allow us to report on the total number of NEM-V projects within each territory, there has been apparent data integrity issues identified. The errors relate to which tariff has been assigned, as well as the total number of projects as we see them fluctuate up and down each month. An example of an evident mistake in tariff assignment is that there are a great number of NEM-V projects listed, which should serve market rate customers, but that also have a corresponding MASH incentive application id. If a project participated in a MASH incentive program, it is undoubtedly an affordable housing complex, and would therefore be assigned to the VNM-A/MASH tariff. Because of these issues, those totals from the public Interconnection Dataset will not be referenced in this report.

Alternatively, in June 2016, the CPUC released the CSI Annual Program Assessment, which included data, as reported by each IOU to the CPUC, on the total number of NEM-V projects, as of December 31, 2015, shown below. The report states, "As of the end of 2015, in PG&E, SCE, and SDG&E's service territory

there were 274 projects with a combined 8.1 MW of solar capacity on the VNEM tariff who are not participants in the MASH program.”

Table 11: Total number of NEM-V projects, as of Dec. 31, 2016 as reported to the CPUC by each IOU

Utility	# of NEM-V Projects	kW (CEC-AC)
PG&E	222	6,926
SCE	13	132
SDG&E	39	1,086

If the data provided by each Utility in May 2015 and December 2015 is accurate, then it exposes the fact that the tariff has faced a higher uptake level in all territories, with PG&E nearly doubling their number of NEM-V projects in 6 months.

Our project team submitted data requests to each Utility. SDG&E was the only utility to respond, and was able to provide current tariff uptake data directly from the Interconnection Team, for both the affordable housing and market-rate tariffs. The numbers below reflect the tariff uptake levels in SDG&E territory, as of September 2016:

Table 12: Total number of NEM-V projects as of September 2016 as reported by SDG&E

Utility	# of NEM-V Projects	kW (AC)	# Benefitting Accounts
SDG&E	54	2,885.5	609

29

http://www.cpuc.ca.gov/uploadedFiles/CPUC_Website/Content/Utilities_and_Industries/Energy/Reports_and_White_Papers/2016%20CSI%20APA%20FINAL.pdf . Data is through December 31, 2015 and includes CSI, NSHP, ERP and SGIP data, but not POU or RPS data.

Table 13: Breakdown of Virtual Net Metering projects between NEM1 and NEM2-ST, as of September 2016, as reported by SDG&E

Utility	Tariff Name	# of NEM-V Projects
SDG&E	VNM-A	66
SDG&E	VNM-A-ST	0
SDG&E	NEM-V	51
SDG&E	NEM-V-ST	3

These numbers are encouraging and support the fact that the NEM-V tariff is being more widely utilized in the SDG&E territory, as compared to 2015 totals.

Interconnection Process

The process to apply for the NEM-V tariff differs slightly across the three IOU service territories. Differences between IOU processes include timing of site visits, level of contractor/utility interaction prior to application submission and methods of confirming SDP locations (for NEM 1 projects). However, the documentation and information that is collected by the utility in the NEM-V application is generally standard for all three IOU service territories. Additionally, certain fees and charges may vary slightly among the territories, including the costs for each net generation output meter (NGOM) as well as the NEM-V setup and modification charges per benefitting account. Each utility is required to approve a system for interconnection within 30 days of submitting a complete application (including local government inspection), per Rule 21 standards.

The process to apply for the NEM2V-ST remains in line with the previous interconnection Policy, but eliminates the need to determine location and quantity of SDPs on site. All interconnection applications and documents will be updated to reflect NEM-ST Policy, and should be used if applying for a NEM-V-ST project.

Interconnection applications can be submitted online across all three IOU territories, and each Utility is required to approve a system for interconnection within 30 days of submitting a complete application, which includes having a passed a local government inspection, per Rule 21 standards.

Interconnection Issues

Through stakeholder interviews, there have been some concerns and inconsistencies exposed, statewide, related to the administration and billing process (consistency, timeliness, and accuracy) for Virtual Net Metering projects. 6 contractors were interviewed, who work across the three IOU territories, and are experienced with the tariff. SDG&E and PG&E were interviewed about the tariff billing process. SCE has not yet confirmed their participation in such an interview.

The 6 contractors were interviewed to understand their experience with the NEM-V process, as reported to them from their clients. Both the affordable housing and market rate virtual net metering

tariffs were discussed, as well as the NEM-Aggregation tariff which employs and requires the bill-credit mechanism, as well.

The following topics were the main areas of concern and critique:

Billing delays

2 contractors working in the SDG&E service territory reported severe concerns of commercial billing delays, for both NEM-V and NEM-Aggregation projects, which, in some cases, has resulted in an unmanageable aggregated bill, with little leniency offered for delayed payments.

SDG&E emailed that the recent transition to TOU rates for small commercial customers may be a cause for billing delays. An interview with SDG&E stated that while they “could not comment much further, the billing system is more than 20 years old and continuously being asked to handle more and more complex billing.”

Bill-credit delays

5 contractors expressed concerns about the number of billing cycles it takes for solar credits to be applied to customer accounts. These concerns were expressed specifically for the SDG&E and PG&E service territories. 3 of these statements gave specific dates exposing the time gap between PTO being issued and the bill credits showing up; with one SDG&E project example still waiting for bill credits to be applied 9 months after the system was approved to be energized.

We did not receive specific details from the property owner or contractor about the background for delay, and the cause may or may not be the fault of the host customer, contractor, or Utility.

We currently do not have insight into the typical timeframe in the SCE territory.

An interview with SDG&E quoted that the Benefitting Accounts can expect to see NEM-V credits applied “within 2 billing cycles, depending on the timing and when PTO is issued. The NEM-V tariff states to take data moving forward (to the start of next billing cycle), instead of pro-rating/backdating to the beginning of the current billing cycle.” SDG&E stated that once a NEM-V system is setup in their system, the participating accounts can expect to see credits applied each month thereafter. When asked about common causes for solar credit delays, they stated that “the most common issue may be if we can’t extract the data from the generation meter, if there are gaps in the data, or a communication error. With sites that have smart meters, SDG&E is able to go in” and troubleshoot the data.

An interview with PG&E staff explained that “it can vary. The goal is to have credits applied within 1 billing cycle. PG&E has timely billing goals, but there could be many reasons for delay, and could result in a delay of 2-3 billing cycles. Once they set up the accounts in the billing system, PG&E also makes sure that the gen-meters are sending data. For example, once a customer sees PTO, the NEM-V accounts need to get set up for NEM-V billing. This is a manual process, and for small projects (5 benefitting accounts), the setup is simple. But for larger arrangements (could be 100+ benefitting accounts), it may take more time. The NEM-V setup process is all manual, with no automation. The goal is 1 billing cycle,

but meter issues that need to be resolved with data collection, or setting up accounts, could take longer.” PG&E went on to explain that “credits should be applied each month as long as data is available from the gen-account. NEM-V is no different than any type of customer when it comes to billing delays. Some causes for bill credit delays could include gaps in data that need to be filled; meters that are not communicating; the need to retrieve missing data; integrity of data; customer issue of not providing access for monthly read meters (for non-smart meters).”

Bill-credit errors

2 contractors mentioned bill-credit errors as a source of concern. In one example in the SDG&E territory, the allocation of vacant unit credits to a designated account, most often times a house meter account, was not being performed properly. Another source of concern reported by contractors was the need to be the liaison between their client and the Utility, which is burdensome, ongoing, and oftentimes not successful due to privacy concerns of the Utility.

An interview with SDG&E exposed an interesting billing challenge related to the process of assigning unallocated credits [from a vacant unit] to a designated account, during the time of unit vacancy.

The SDG&E NEM-V-ST tariff sheet states that, “The Credit Allocation Form provides the Owner the option to designate the disposition of unallocated credits to either: a Common Area Account, or one Qualified Customer Account.” Concerningly, SDG&E quoted that “there is no default account opportunity at this time in our billing system.” For this reason, SDG&E encourages Continuity of Service Agreements (COS), which allows for a vacant unit’s Utility service to remain intact under the temporary property owner account name. With this COS in place, the kWh solar credits would remain with the vacant unit, at retail value, and could be utilized if electricity was needed during the time of vacancy, perhaps for remodeling or tenant showings. Any unused solar credits, during the time of vacancy, would be bought out at wholesale value once the unit became occupied by a new tenant.

This wholesale value (if bought out from vacant unit) versus retail value (if applied to the designated default account) is very concerning for stakeholders in the SDG&E territory, as it could severely affect the economics and pay back rate for a project that is expecting the retail valued kWh credits to be applied to a designated default, oftentimes, house account during times of vacancy.

What types of buildings are adopting NEM-V?

This assessment also seeks to understand the adoption of NEM-V across multitenant building sectors. The multitenant building sector can be categorized into residential, commercial and mixed-use building user types (Table 8). While the utility data requests did not lend insight into the sector of the solar adopters,³⁰ we were able to gain preliminary insights into NEM-V adoption across building types from the contractor surveys. The contractors indicated that the majority of NEM-V project activity takes place in the residential apartment sector. There has been little activity in the residential condominium space and commercial retail space. The higher adoption levels in the apartment sector compared to the condominium space conform to the notion that the market develops faster in the most easily accessible sector, i.e., the lowest hanging fruit. Apartment complexes are operated by a single building owner, as opposed to multiple owners in the condominium sector. This allows for a more efficient decision-making process. Securing financing may be simpler for a single-property owner, as opposed to multiple owner investors, due to the infancy of this market and the perceived risk of dealing with multiple loan recipients.

Table 14: NEM-V Project³¹ Activity across Multitenant Building Sectors, as Reported by the 29 Contractor Survey Responses

Reported as of December 2015			
	Installed	Under development	Cancelled
Residential apartments	72	143	21
Residential condominiums	0	13	1
Commercial retail	0	2	3
Commercial other	23	36	14
Residential/commercial mixed use	2	7	0

The commercial other sector, which includes office and industrial buildings, came in as the second most prevalent building type to employ the NEM-V tariff. Similar reasons could be applied to this scenario, as

³⁰ Utility categorization does not include building type. The NEM-V tariff often includes multiple benefitting accounts, all which may have different rate structures (residential or commercial), which does not provide clear indication or building type.

³¹ The totals reported in the contractor surveys for “Installed,” “Under development” and “Cancelled” do not align with the utility-reported data for the total number of NEM-V projects. This is assumed to be due to a misinterpretation of the survey question, and the numbers reported may relate to the number of units and/or benefitting accounts associated within their NEM-V project(s).

the apartment sector, however, commercial rate design and the effects of solar are more complicated and may not be as easily translated.

Overall, the reported data demonstrates low adoption levels of NEM-V across the three IOUs. Given the significant potential for NEM-V projects in all three IOU service territories and the nominal adoption rates, these statistics give reason for further investigation into challenges faced to the adoption of the NEM-V tariff.

V. Market Actors

Multitenant Property Owners

In the multitenant property space, decisions about energy upgrades are typically made by the owner or manager of the facilities. The decision-making entity may differ depending on property building sector, size and ownership model. The decision makers typically fall into one of the following categories: property owner/manager, real estate developers or homeowner associations (HOAs).

From conversations with contractors and property decision makers, we gained insight into motivations for installing NEM-V systems. Installing NEM-V projects provides the ability to market apartments to environmentally conscious renters. This boosts occupancy and may enable the building owner to charge a premium.

In Fall 2015, we administered a survey to understand the property decision makers' awareness and decisions regarding the utilization of the NEM-V tariff. Through qualifying questions at the start of the survey we identified 42 respondents as energy upgrade decision makers in the market-rate multitenant property space. The vast majority of these respondents (38) operate properties in the residential apartment sector. About half of the respondents indicated that they operate outside of the three major IOU territories. Because the NEM-V tariff is only available from the three IOUs, the following data pertain to those respondents that operate properties inside IOU territories (26). All three IOU territories are represented in the data, while five respondents operate in more than one IOU territory.

Since 2011, the year NEM-V became available in the multitenant property sector, the majority of the respondents (18) had engaged with solar on some level – from researching the possibility to installing a solar system. Six decision makers installed solar PV systems on at least one of their properties, of which three utilized the NEM-V tariff. These three companies reported one, five and twelve NEM-V projects each. Both lease and self-ownership financing modes were reported for these projects.

The three companies utilizing NEM-V learned about the tariff from the solar developer (2) or solar blogs/solar newsletters/articles (1). Two property owners/managers expressed challenges with the development of the NEM-V solar PV project, while one did not report major challenges.

The challenges involved (multiple answers were possible):

- Understanding how to make NEM-V work on my property (2)

- Working with the utility to interconnect the PV system and allocate PV credits among tenants (2)
- Understanding the financing options for a NEM-V project (1)

Of the respondents that installed solar but did not utilize NEM-V (6), five mentioned that they were not familiar with the NEM-V tariff at the time. This indicates a potential to reach out to property owners/developers and HOAs about NEM-V on multitenant properties. These decision makers also mentioned as challenges for not deploying the NEM-V tariff rent control restrictions and the difficulty of finding contractors that could make VNEM on their property work out economically.

Following those 2015 surveys, throughout 2016, discussions with property owners and developers has uncovered additional motivations and challenges affecting the reality of a NEM-V project. Motivations for employing the NEM-V tariff include:

- Environmental motivations
- Tenant appeal / “Eco-curb appeal”
- Potential for increased property value
- Return on Investment

Additional challenges observed by property owners that have been uncovered include:

- Understanding recoupment methods and logistics for monthly collections
- Understanding value proposition for the property owner, beyond the common load savings
- Monitoring project success and difficulty engaging with the Utility for potential disputes and bill-credit errors

Solar Contractors & Installers

As of December 2015, SCE and SDG&E reported 15 contractor companies that successfully installed NEM-V (Table 9). There were no contractors who had installed NEM-V projects across both service territories. The data received from PG&E related to NEM-V metrics do not provide visibility into which or how many solar contractors have successfully installed NEM-V projects within that territory. The single-family residential solar market and small commercial solar market has seen a proliferation of solar installers in California. NEM-V is still in its infant stages but this data shows that at least 15 installers have made it work.

Table 15: Number of NEM-V Project Installers Across IOU Service Territories Within California, as of December 2015

	Number of Installers	Number of Projects
PG&E	Unknown ³²	114
SCE	5	11
SDG&E	10	36

At present time, the public Interconnection dataset does not accurately distinguish between affordable-housing VNEM projects and market-rate NEM-V projects or installers. Table 10, below, depicts the total number of contractors who have installed a project within atleast one of the two Virtual Net Metering tariffs (VNM-A/MASH and NEM-V), as of June 30, 2016.

Table 16: Number of Virtual Net Metering Project Installers Across IOU Service Territories Within California, as of June 2016
 This includes installers of both affordable housing VNM-A/MASH projects as well as maret-rate NEM-V projects.

Utility	Number of Installers
PG&E	72
SCE	47
SDG&E	35

While we did not obtain information about solar contractors active in PG&E from the utility, we learned from interviews that there is one installation company has championed at least 100 NEM-V projects within PG&E service territory. The interview with this company did not glean information about which licensed contractor completed the physical installation, but it is assumed that at least one installer has been subcontracted for those projects. We did gain some insight into the business model of this company, which is explored further in the Financing section below.

³² PG&E was unable to provide the contractor information associated with the NEM-V projects due to privacy concerns. Contractor interviews confirmed there is at least one NEM-V developer working in the PG&E service territory.

The survey responses from the contractors/installers presented more insights into NEM-V activity, challenges associated with the development of these projects and awareness of the tariff and how contractors learned about the tariff.

The contractor survey yielded responses from 116 contractors, representing 105 different companies. Of the 105 companies, 13 reported to have installed a NEM-V project. Seventeen companies are currently in the process of developing a project.³³ Another six companies attempted to develop a NEM-V project but the project was canceled in the end. Altogether, 28 contractors reported to have been involved in solar business activities involving NEM-V. While these numbers may not be reflective of the entire NEM-V contractor base, it is evident that the active NEM-V contractor/installer base is very small in comparison to the more than 1,000 solar contractor/installers in California.³⁴

There are multiple reasons why the contractor activity is limited at this time. The following sections shed light on the different aspects of installer engagement deficiencies in the NEM-V market.

To gain insights into why only few contractors operate in the space, we can look at responses of contractors that, while being knowledgeable about the tariff, have not engaged in the development of NEM-V projects. The majority of contractors (34) reported barriers that they could not overcome at this time as reason for not participating in the NEM-V market segment. This shows that the entrance into the NEM-V market segment is difficult. In particular, these contractors mentioned that they were not able to find customers that would employ solar in the multitenant space or property managers did not see the value proposition of solar. The barriers also extend to the contractor side as contractors reported that they do not have the knowledge to develop a business proposition that is financially appealing to the property owner. The open responses revealed that the success rate of establishing projects is low as it takes a lot of effort to make a proposal. Despite these difficulties, almost all 34 contractors indicated that they are interested in developing NEM-V projects in the future, which leads to the assumption that the contractor base will likely increase with the evolving NEM-V market.

Knowledge of NEM-V tariff among contractors

A critical factor in activity of contractors in the NEM-V market segment is the contractor's awareness of the tariff. Of the 116 contractors that responded to the survey, only 54% reported to be familiar with the NEM-V tariff. While some of these contractors may not be active in the multitenant market

³³ Of these 17 companies, 8 have installed a NEM-V system.

³⁴ More than 1000 active solar contractors are documented in California Solar Statistics, "Currently Interconnected Data Set."

segment, the level of awareness gives reason to increase education and outreach about the tariff to the contractor base in California. Increasing the knowledge about the tariff may increase the active NEM-V contractor base as contractors who are familiar with the tariff are likely to be interested in developing projects in this space.

Information sources for learning about NEM-V

Contractors mentioned a variety of sources for learning about the NEM-V tariff. Of the 27 contractors who responded to this question, 14 referenced the utility as source of information. Some contractors attended webinars, while others called the utility representatives to learn more about the tariff. The utility websites also were accessed for more information. Three contractors learned about NEM-V from the California Solar Energy Industries Association (CALSEIA). Two contractors mentioned the CPUC websites and proceedings. One contractor stated a solar website as an information source. Given the needs for improving awareness of the tariff, the current information sources may not be sufficient and/or effective enough to achieve that. Increased and targeted outreach to contractors is necessary to achieve higher levels of awareness of NEM-V.

Challenges in the development of NEM-V projects

To understand the level of difficulty in the development of NEM-V projects we posed several questions addressing project challenges. Of the 28 contractors actively involved in NEM-V, the majority (24) reported to have experienced challenges during the NEM-V project development cycle. Most of these projects struggled with interconnection issues. Uncertainty about regulatory policies or changes of policies (such as NEM, utility rate structure) was mentioned by half of the respondents. Moreover, contractors indicated that property owners find the NEM-V tenant allocation difficult to manage, which makes it challenging for contractors to sell NEM-V to customers.

Contractors reported these challenges in different phases of the interconnection process:

- A lack of understanding of the tariff by utility employees
- Utility disapproval of NEM-V equipment
- Difficulty communicating with the utility, e.g., response time to requests and finding a contact person
- The challenge of identifying the location of the service delivery points, as well as the virtual credit allocation restriction to one SDP only

Comparison of Difficulty of Project Factors NEM-V to NEM

Comparing the level of difficulty of a project process of a nascent market segment compared to a well-established market segment can give us more insights into the trajectory of the new market segment. Therefore we asked contractors how they would rate the ease or difficulty of certain critical project factors of NEM-V compared to the more established NEM (Table 11).

Table 17: A Comparison of Difficulty of Project Factors NEM-V to NEM
 (Contractors rated the ease or difficulty of certain critical project factors of NEM-V compared to NEM)

	Much less difficult	Slightly less difficult	About the same	Slightly more difficult	Much more difficult	Responses
System sizing	2 7.1%	2 7.1%	6 21.4%	12 42.9%	6 21.4%	28
System financing	2 7.1%	1 3.6%	14 50.0%	6 21.4%	5 17.9%	28
Customer communication/tariff knowledge	1 3.6%	0 0.0%	4 14.3%	12 42.9%	11 39.3%	28
Utility communication/utility process	0 0.0%	0 0.0%	2 7.1%	9 32.1%	17 60.7%	28

Overall, all project factors listed were rated more difficult for NEM-V compared to NEM projects. Most strikingly, more than 60% of respondents reported system sizing to be more difficult for NEM-V compared to NEM. The large majority (80-90%) stated that engaging with the customer as well as the interaction with the utility is more challenging compared to NEM projects. These responses indicate that the development of the NEM-V market might still be far from the adoption rate of NEM projects in the solar market.

VI. Financing

Financing options for Virtual Net Metering projects align with those typical avenues used for single family home projects, including cash, lease, or PPA. In addition to these three options, a fourth option that we will refer to as the “Roof-Lease” model, offers property owners a unique avenue to acquire solar for common and tenants loads, with less financial or administrative burden as compared to cash, lease, or PPA. A cash purchase can be made using existing capital or by taking out a loan. Some loan options include HELOQ loans, solar loans, and PACE loans. PACE loans have been utilized in the apartment sector, however, due to the logistics of where a system may be installed within a condo community, PACE loans do not serve as a valuable financing product for condo communities seeking to utilize Virtual Net Metering. A lease arrangement entails a fixed monthly payment. This monthly payment would ideally be less than the sum of all of the current tenant and common load monthly utility electric bills. A power purchase agreement entails a fixed price/kWh produced, paid monthly. This price/kWh should be less expensive than the price/kWh paid to the utility. The roof-lease model is a third-party ownership model by setting up PPA’s with the tenants living in the property rather than with the property owner, as well as a component that provides the property owner with monthly roof income. Additionally, the company enters into an agreement for a fixed length of time with the property owner to allow the installation of the solar system on the building roof, essentially renting roof space. Under such a business structure, the building owner is not responsible for operating, maintaining or fixing the system.

Table 18: Overview of Virtual Net Metering financing options

Method	Ownership of System?	Access to ITC?	Methods for recouping investment/paying monthly fee	Other Considerations
Cash	Yes	Yes	<ul style="list-style-type: none"> • Increase rent by a portion of utility savings • Separate monthly "energy fee" 	<ul style="list-style-type: none"> • Can use upfront capital or loan • System owner responsible for O&M • Potential for increased property value
Lease	No	No	<ul style="list-style-type: none"> • Increase rent proportionally • Separate monthly "energy fee" 	<ul style="list-style-type: none"> • Typically 20-year lease duration • In general, little or no upfront costs • Not responsible for O&M • Possible performance guarantees
PPA	No	No	<ul style="list-style-type: none"> • Separate monthly kWh fee 	<ul style="list-style-type: none"> • Typically 20-year PPA duration • Not responsible for O&M • Performance guarantees
Roof-Lease	No	No	<ul style="list-style-type: none"> • Separate monthly kWh fee • Tenant pays 3rd party System Owner directly 	<ul style="list-style-type: none"> • Typically 20-year PPA duration • Not responsible for O&M • Possible performance guarantees • Monthly income for property owner

VII. Conclusion

This *Virtual Net Metering Full Market Potential Report* further reveals the large market potential for those customers and buildings that can take advantage of the NEM-V tariff. It has also exposed the low levels of current adoption, although also shows that increased adoption levels have been witnessed over time. The volume of existing contractors within the state, as well as the volume of contractors who have worked on the similar VNM-A/MASH tariff yields great potential as a workforce that can sell these projects. The need for continued education and outreach efforts will bring more contractors into the NEM-V industry and also will allow more property owners to understand their options for solar access. The specific financing mechanisms being utilized for completed NEM-V projects have not been exposed within the data that the project team has at this time. However, given the infancy of the NEM-V market, there will be a learning curve for the finance world to understand the tariff and associated risks or issues affecting payback.

In January 2016, the CPUC approved Decision 16-01-044 adopting a NEM successor tariff that continues the existing NEM structure while making adjustments to align the costs of NEM successor customers

more closely with those of non-NEM customers. The NEM-ST maintains the existence of the Virtual Net Metering, but does include a few modifications that will relax the locational requirements of the participating meters, but also reduce the monetary value received for the solar production, due to the enforcement of NBC's.

By lifting the SDP restriction from the NEM-V-ST tariff, it allows a customer or contractor to easily identify if their site is eligible, and identify which tenants can participate. This helps in estimating system size in a more expeditious manner, and removes the concern of Utility rejection based on assumptions made about the location and quantity of SDPs on a site.

Conversely, the application of NBC's on each participating account may reduce the appeal of the tariff. The NEM-ST was intended to more closely align the costs of NEM-ST customers with those of non-NEM customers. However, forecasting the economics of a project will be more complex, will include additional assumptions about the future cost of NBC's, and overall, less appealing to a potential customer.

Finally, it is unknown if the future transition of solar customers to a TOU rate will benefit or hurt the value of solar, as it will directly relate to the approved peak and off-peak times, as well as the site's specific energy load profile.

The NEM successor tariff is currently in effect in SDG&E's service territory. PG&E's NEM Successor tariff is expected to go into effect by the end of 2016, and the SCE service territory is expected to transition over during July 2017. Our project team is hopeful that the new policy will continue to enable a growing trend in the number of NEM-V projects installed throughout California.



As a mission-driven nonprofit organization, CSE works with energy policymakers, regulators, public agencies and businesses as an expert implementation partner and trusted information resource. Together, we are the catalysts for sustainable energy market development and transformation.

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