SolarAPP+ Performance Review (2022 Data)

Jeff Cook, Rosalie Yu, Kaifeng Xu, Sushmita Jena, Tim Rivard, and Jessica de la Paz

National Renewable Energy Laboratory

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NREL/TP-6A20-85827
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Executive Summary

Solar Automated Permit Processing Plus (SolarAPP+) is an online platform that facilitates instant permits for code-compliant residential rooftop solar photovoltaic (PV) and battery storage systems. SolarAPP+ allows PV contractors to upload system specifications, have that information automatically reviewed for code compliance, and receive instant approval for code-compliant systems, reducing the authority having jurisdiction (AHJ) staff time needed for review. SolarAPP+ also provides inspection checklists to verify installation practices and adherence to approved designs. SolarAPP+ is available to AHJs at no cost.

This report is part of an ongoing series of reviews of SolarAPP+ performance. Consistent with previous performance reviews (published in 2022), we summarize SolarAPP+ adoption trends to date and compare various metrics for PV systems permitted through SolarAPP+ versus systems permitted through traditional AHJ permitting processes.

As of the end of 2022, the National Renewable Energy Laboratory (NREL) had contacted over 1,500 AHJs with significant solar permitting volumes regarding SolarAPP+. Of those, 549 AHJs had expressed interest in the platform as of the end of 2022. Sixteen of these AHJs had begun piloting the platform and 15 others had publicly launched the platform by the end of 2022. In 2022, 206 installers submitted 11,092 permits through the SolarAPP+ platform, including 708 permits submitted as part of a solar-plus-storage pilot program. SolarAPP+ permits accounted for around 46% of all permits issued in AHJs that had fully adopted in 2022. We compare permitting timelines through SolarAPP+ to traditional AHJ permitting processes to assess the platform's performance (Figure ES-1).

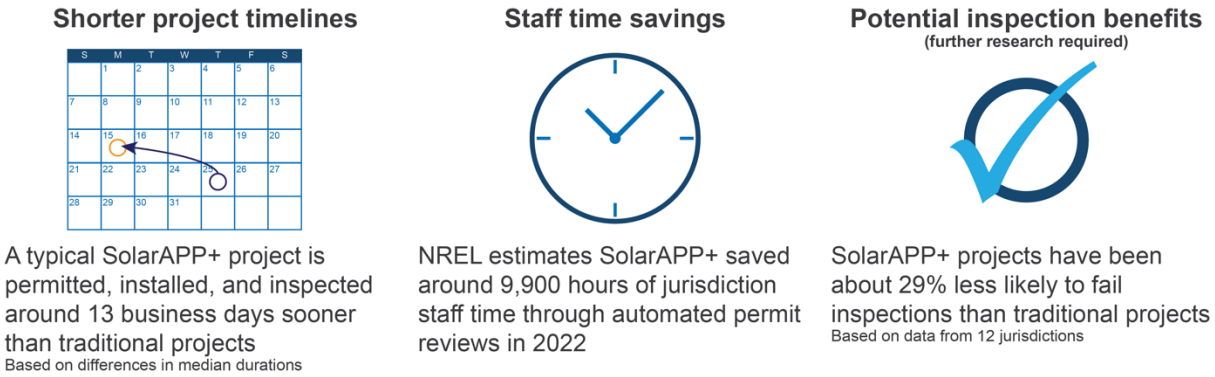

Figure ES-1. Summary of performance review results

Consistent with previous SolarAPP+ performance reviews, we find that permitting timelines are significantly shorter for SolarAPP+ projects. Based on median timelines, a typical SolarAPP+ project is permitted and inspected 13 business days sooner than traditional projects. We estimate that automatic SolarAPP+ permitting saved around 9,900 hours of AHJ staff time in 2022. We further find evidence that SolarAPP+ may improve inspection outcomes, with SolarAPP+ projects failing inspections about 29% less frequently than traditional projects. Finally, we estimate that SolarAPP+ has eliminated over 134,000 days in permitting-related delays.

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1 Introduction

The Solar Automated Permit Processing Plus (SolarAPP+) platform is an online platform that provides plan review and facilitates instant permits for code-compliant residential rooftop solar photovoltaic (PV) and battery storage systems. SolarAPP+ was developed by the National Renewable Energy Laboratory (NREL) in collaboration with local governments, code development organizations, and industry stakeholders. SolarAPP+ is available to local permitting authorities at no cost.

This report is part of an ongoing series of reviews of SolarAPP+ performance. Consistent with previous performance reviews, we summarize SolarAPP+ adoption trends to date and compare various metrics for PV systems permitted through SolarAPP+ versus systems permitted through traditional authority having jurisdiction (AHJ) permitting processes. In this section, we briefly explain the impetus for SolarAPP+ development, the functions of the platform, and the results of previous performance reviews.

1.1 The Need for Standardized PV Permitting

Most rooftop PV systems are subject to local permitting requirements implemented by local AHJs. Figure 1 depicts a typical permitting process and how it relates to the interconnection processes implemented by utilities. Rapid and accelerating rooftop PV deployment has strained the capacity of AHJs to efficiently navigate these processes (Cook et al. 2021). Conversely, although states typically set minimum requirements, individual AHJs often implement unique permitting requirements (Stanfield et al. 2012). Local permitting variability has presented a challenge to the expanding rooftop PV market by increasing compliance costs (Dong and Wiser 2013; Burkhardt et al. 2015; Cook et al. 2021) and permitting timelines (O'Shaughnessy et al. 2022). A growing number of AHJs and utilities have responded by reforming and standardizing permitting processes to reduce delays (Stanfield et al. 2012; Fekete et al. 2022). However, PV permitting reforms have, to date, occurred in a piecemeal fashion, and many AHJs lack the resources to implement reforms (Parsons and Josefowitz 2020).

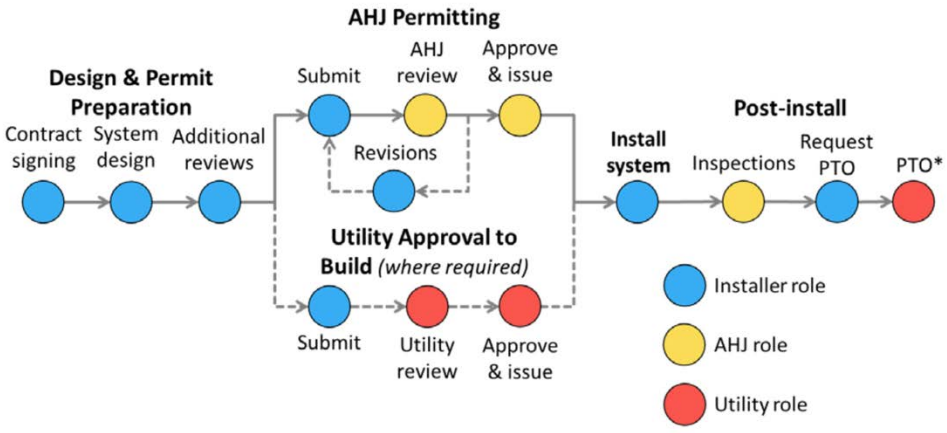

Figure 1. The rooftop PV permitting process

1.2 The SolarAPP+ Platform

SolarAPP+ was developed by NREL in response to the emerging challenges in rooftop PV permitting. NREL developed the tool in collaboration with industry and the building safety community, with funding from the U.S. Department of Energy. SolarAPP+ streamlines AHJ permitting for residential rooftop PV systems that meet certain eligibility requirements.[1] The platform automates the review of eligible systems through the steps illustrated in Figure 2. SolarAPP+ allows PV contractors to upload system specifications, have that information automatically reviewed for code compliance, and obtain instant approval for code-compliant systems. Based on the application inputs, SolarAPP+ also generates checklists for inspectors to confirm that installed systems match preapproved designs. The SolarAPP+ project formally began in September 2019 with development and testing of the software for alignment with national model codes. NREL piloted the software with five communities in 2021 (Williams et al. 2022), and SolarAPP+ was then officially launched in July 2021.

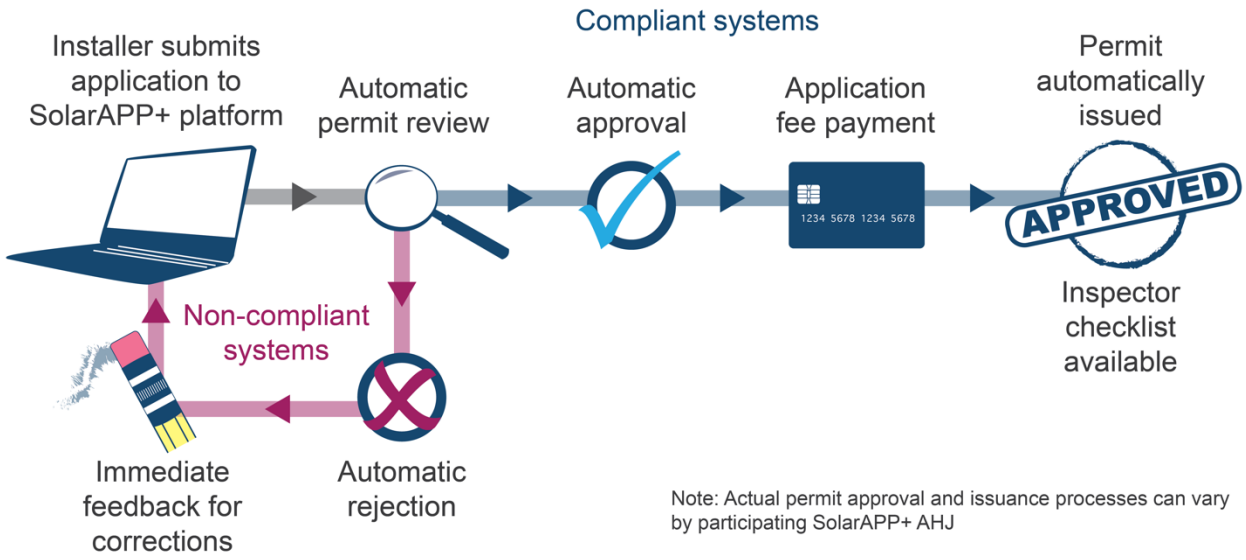

Figure 2. Example SolarAPP+ permit application and approval process

Note: In most AHJs, the fee payment and permit issuance occurs via the AHJ's existing permitting system

1.3 SolarAPP+ Performance

NREL has published two reviews of SolarAPP+ performance to date. Williams et al. (2022) analyzed the performance of five SolarAPP+ pilots, and Cook et al. (2022) evaluated platform performance in 10 AHJs that had piloted or implemented SolarAPP+ by the end of 2021. Both reviews reached similar conclusions:

[1] For a complete list of the eligibility requirements, see https://help.solar-app.org/article/43-what-types-of-systems-are-not-eligible-for-solarapp-review.

- SolarAPP+ saves AHJ staff time that would otherwise be spent on permit and revision reviews. Cook et al. (2022) estimated that the platform had saved around 3,300 hours of staff time, cumulatively, by the end of 2021.

- SolarAPP+ reduces average permit review times (permit submission to issuance) to less than one day, compared to median review times of around 9 business days through traditional permitting processes.

- SolarAPP+ projects have similar inspection durations and passed inspections at similar rates as other projects.

- SolarAPP+ projects complete the full permitting timeline (permit submission to passed inspection) 12–13 business days faster than projects using traditional permitting processes, on average.

This report builds on these previous performance reviews with updated results for projects permitted in 2022.

2 SolarAPP+ Implementation

As of the end of 2022, NREL had contacted over 1,500 AHJs as potential users of the SolarAPP+ platform. Of these, 549 were interested in implementing SolarAPP+.[2] Interested AHJs were geographically distributed throughout the United States and were at various stages in the implementation process (Figure 3). Of the 549 interested AHJs, 169 AHJs were in a technical demonstration stage, 71 AHJs were evaluating and testing SolarAPP+, 18 AHJs were in pilot onboarding, 16 AHJs were in a pilot stage, and 15 AHJs had publicly launched the platform. Interested AHJs encompassed a range of demographic features; 117 interested AHJs met the typical criteria for a disadvantaged community (median income less than 80% of state median income).

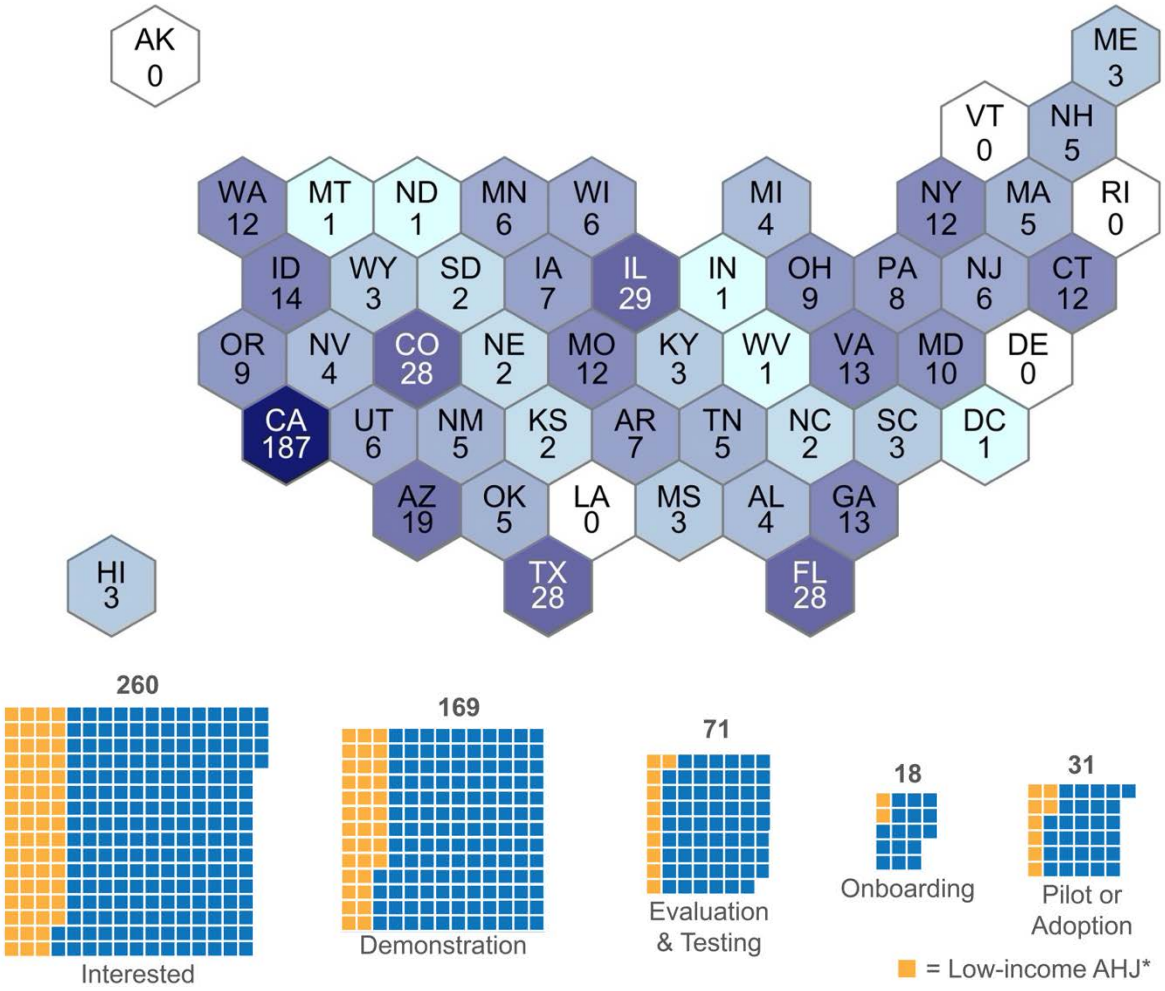

Figure 3. Number of AHJs that have expressed interest in SolarAPP+, by state (top pane), and by adoption stage (bottom pane), as of the December 31, 2022.

* Refers to AHJs with median income less than 80% of state median income

[2] An expression of interest occurs when an AHJ follows up on an initial contact, and it includes AHJs at any level of implementation: demonstration, evaluation, testing, pilot, or adoption.

Figure 4 depicts platform implementation timelines for the 34 AHJs that had at least piloted SolarAPP+ by March 2023, ordered by the timing of the first interaction. Our study focuses on the 31 AHJs that had at least begun piloting SolarAPP+ before the end of 2022. The median duration from first interaction to pilot was 231 days, and the median duration from pilot to public adoption was 137 days. There is some evidence that the SolarAPP+ adoption process is shortening over time: The median duration from first interaction to pilot was 288 days for AHJs with a first interaction before 2022, compared to 201 days for AHJs with a first interaction in 2022. Similarly, the median pilot-to-public adoption duration was 142 days for AHJs with a first interaction before 2022, compared to 96 days for AHJs with a first interaction in 2022.

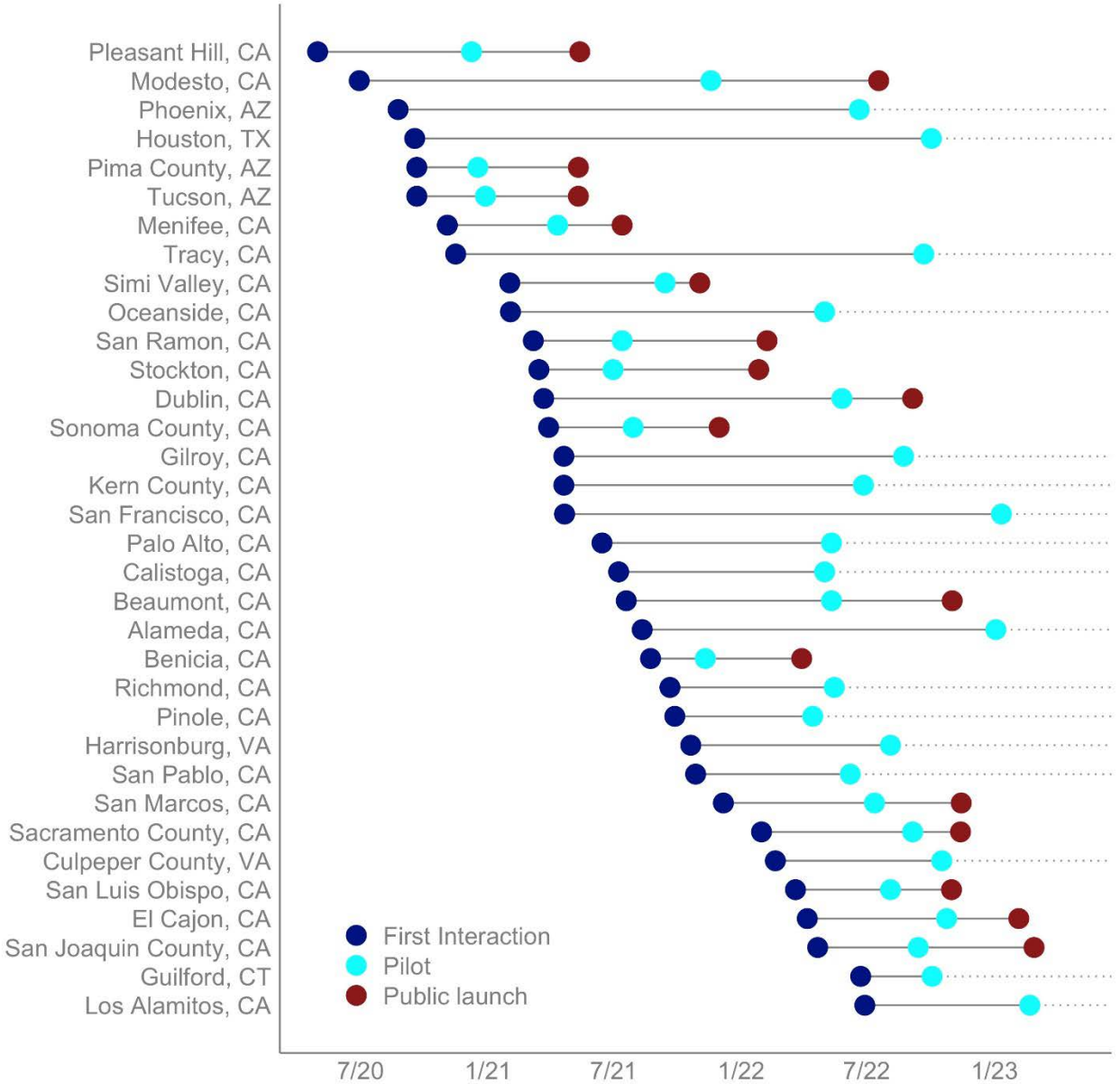

Figure 4. AHJ SolarAPP+ implementation timelines as of March 1st, 2023.

An additional 150 AHJs have explored SolarAPP+ but have delayed implementation due to various adoption barriers. Figure 5 summarizes the challenges to SolarAPP+ adoption most frequently cited by interested AHJs. AHJs most commonly cited issues associated with integrating SolarAPP+ with existing permitting software and conflicts with local codes (e.g., building, electrical, fire, or zoning codes).

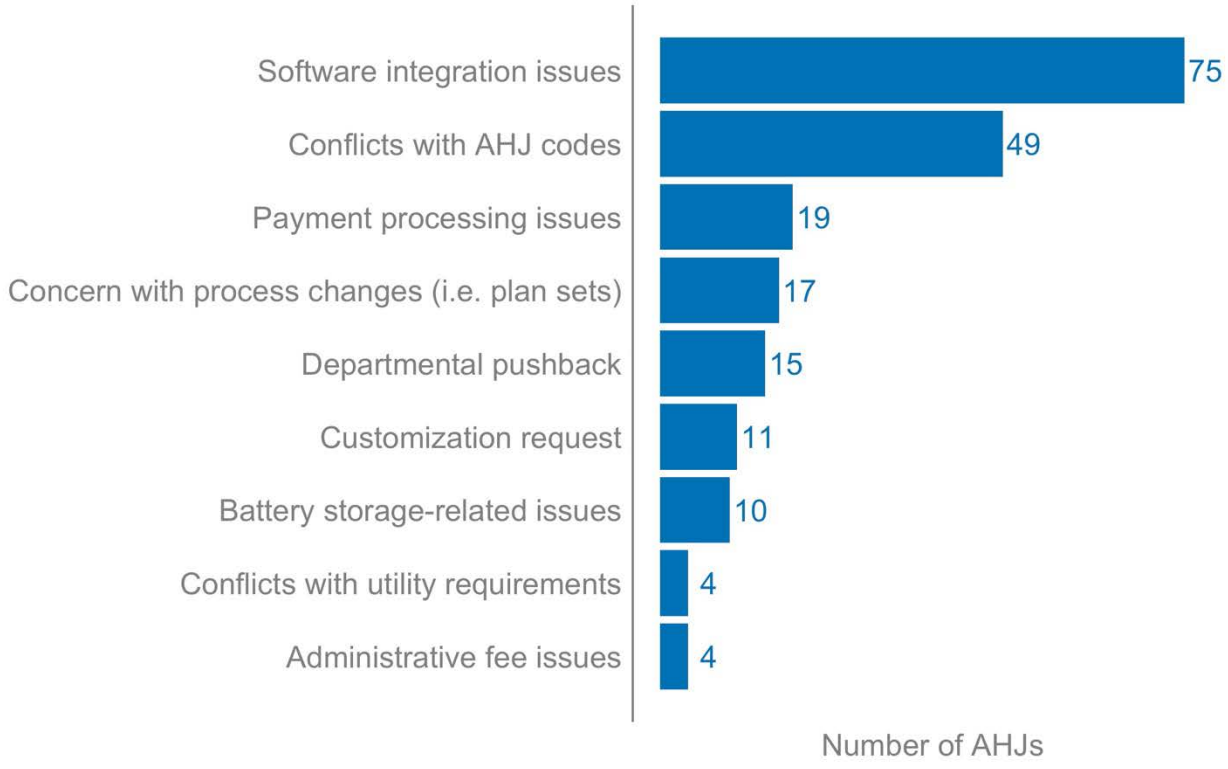

Figure 5. Challenges to SolarAPP+ implementation

Note that some AHJs cited multiple challenges

Eighty-one of the roughly 1,500 contacted AHJs ultimately decided not to adopt SolarAPP+. Figure 6 shows the reasons provided by these AHJs. Most of these non-adopters are satisfied with their existing permitting systems.

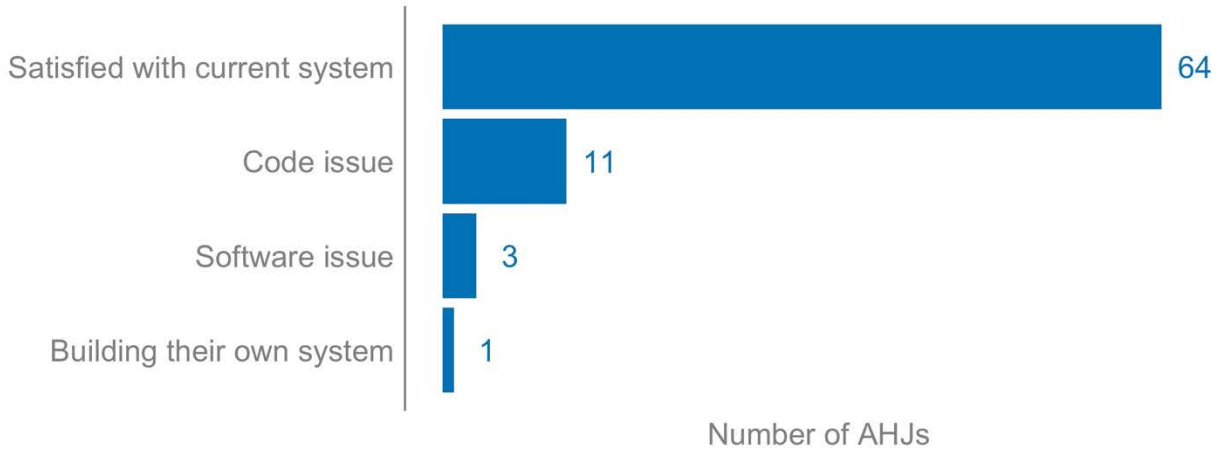

Figure 6. Reasons cited for not adopting SolarAPP+

Note that some AHJs cited multiple reasons

3 Performance Review

We review SolarAPP+ performance by comparing metrics for projects processed through SolarAPP+ to those processed through traditional AHJ permitting processes. Performance review data were collected from two sources. First, we pulled data directly from the SolarAPP+ software, including data on projects, installers, AHJ adoption challenges, interested AHJs, and detailed project-level characteristics such as system size, module brand, and home electrical upgrades (summary statistics for these project-level characteristics are provided in the Appendix). Second, we collected data from 18 AHJs that had adopted SolarAPP+ and had issued at least 30 SolarAPP+ permits by the end of 2022. These 18 AHJs provided data on permit submission dates, permit issuance dates, permit fees, inspection dates, inspection failure causes, and whether systems included battery storage. For some analyses, we used the AHJ-provided dates to calculate durations. All durations reported in days are in terms of business days. The degree of data completeness across performance metrics varied by AHJ. The distinct samples used for each analysis are identified in the figure captions.

The term *SolarAPP+ project* refers to any PV or PV-plus-storage system that was entered into SolarAPP+ by a contractor. All SolarAPP+ projects are issued approved system designs/plans, but only some projects are automatically issued a permit via the SolarAPP+ platform, depending on the SolarAPP+ integration pathway chosen by the AHJ.[3] The SolarAPP+ projects that do not receive a permit within SolarAPP+ receive their instant permit from the AHJ after the contractor uploads the SolarAPP+ preapproved system plans in the AHJ's online permitting system. The term *SolarAPP+ permits* refers to both permits automatically issued on the platform and those issued by the AHJ.

Before proceeding to the results, it is worth noting that our performance review is based on a comparison of outcomes for SolarAPP+ and traditional permits that does not control for potentially confounding factors. Potential differences between the SolarAPP+ and traditional project groups could cause misleading deviations in process durations. For instance, some installers that use SolarAPP+ more often may navigate permitting processes more or less efficiently than installers that use SolarAPP+ less often. Further, the estimated differences in the AHJs in this study are not necessarily representative of the potential impacts of SolarAPP+ in other AHJs. It is possible that the AHJs in this study had more or less efficient traditional permitting processes than an average AHJ prior to implementing SolarAPP+. For these reasons, the reported impacts should be considered approximate impacts of SolarAPP+ on AHJ permitting process durations.

3.1 AHJ Permit Volume

In 2022, 206 contractors submitted 11,092 projects and completed 2,842 revisions (including revisions during inspection) on these projects within the SolarAPP+ platform across 31 AHJs (Figure 7). Of those projects, 708 were solar-plus-storage projects submitted in 17 AHJs (Figure

[3] For the following AHJs, SolarAPP+ issues a permit on behalf of the AHJ: Calistoga, CA; Guilford, CT; Pinole, CA; Pleasant Hill, CA; San Joaquin, CA; San Pablo, CA; Tracy, CA;

8). Complete permit data are available for 8,136 of these 11,092 projects.[4] All performance analyses are based on this subsample of 8,136 permits.

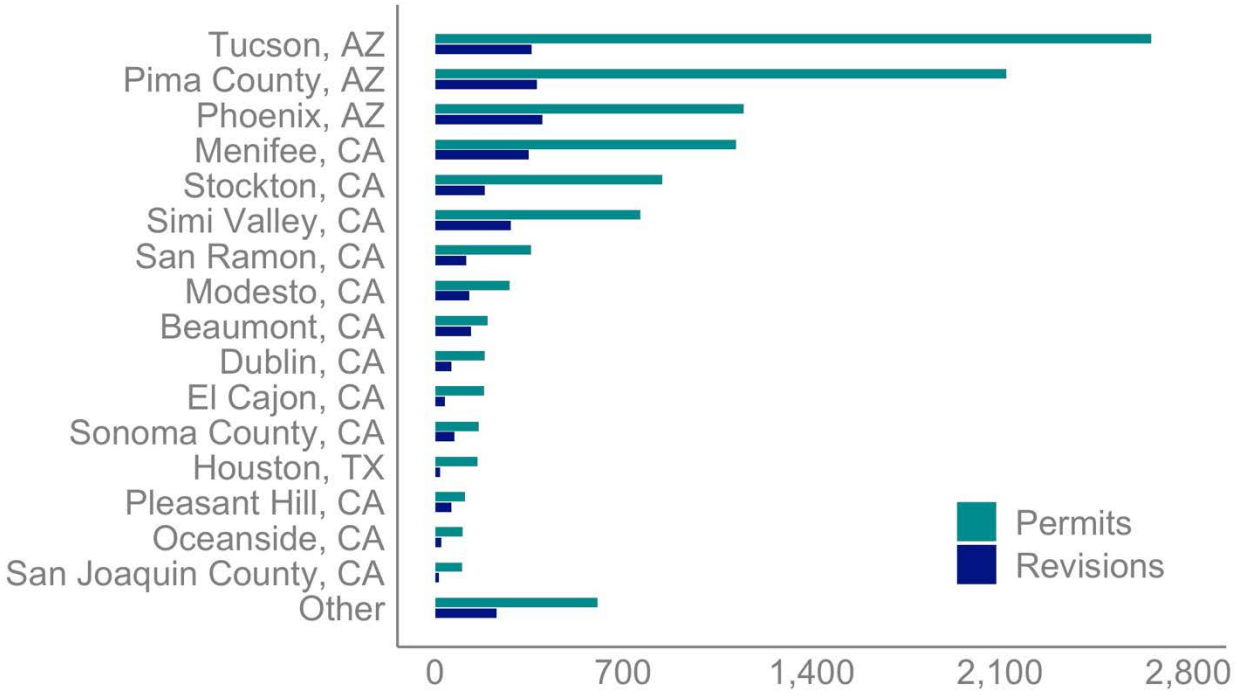

Figure 7. Number of SolarAPP+ permits and revisions by AHJ

[4] Complete permit data were available for permits submitted in 2022 that had at least scheduled an inspection by the end of 2022.

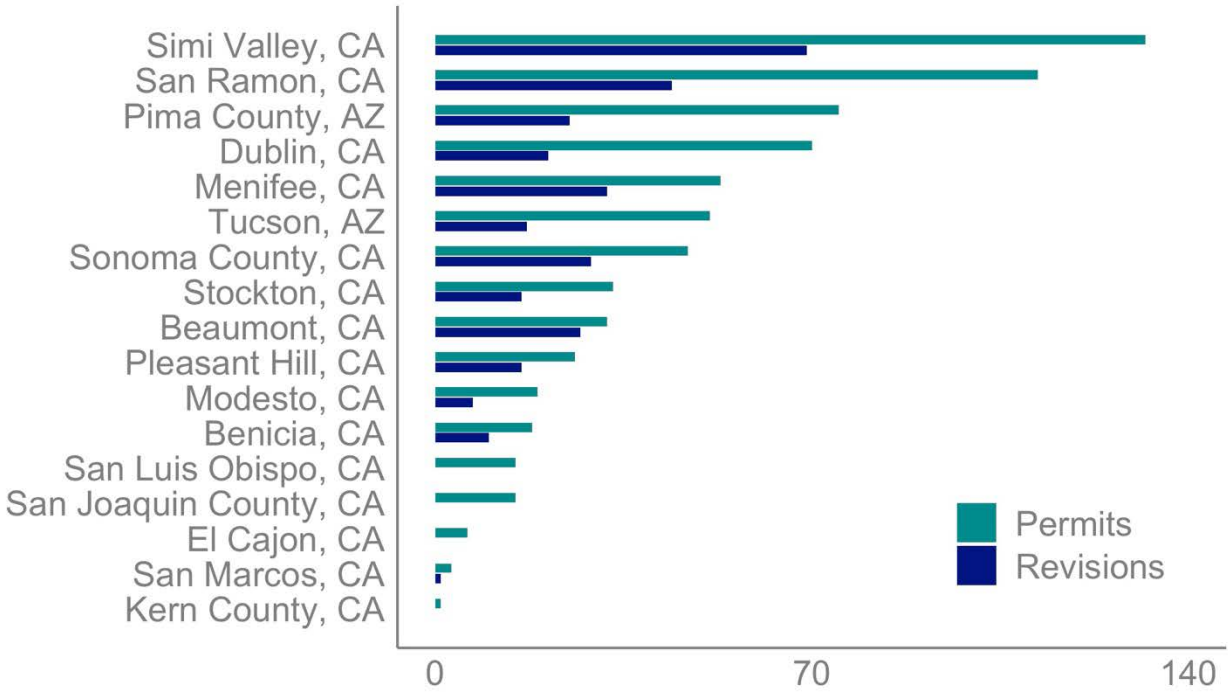

Figure 8. Number of SolarAPP+ solar-plus-storage permits and revisions by AHJ

AHJs have about 15.5 installers using SolarAPP+, on average (Figure 9). Participating installers reflect a range of characteristics and installation volumes, confirming that the SolarAPP+ platform is not used exclusively by specific types of installers (Figure 10). The data suggest that significant shares of installers participate in SolarAPP+. For instance, data from Barbose et al. (2022) suggest that around 98 installers operated in Tucson in 2021 (the latest year with available data). Although more installers were likely active in Tucson in 2022, the comparison suggests that around half of installers in Tucson used SolarAPP+. In total, 206 installers submitted at least one SolarAPP+ permit in 2022, and six installers participated in the PV-plus-storage pilot.

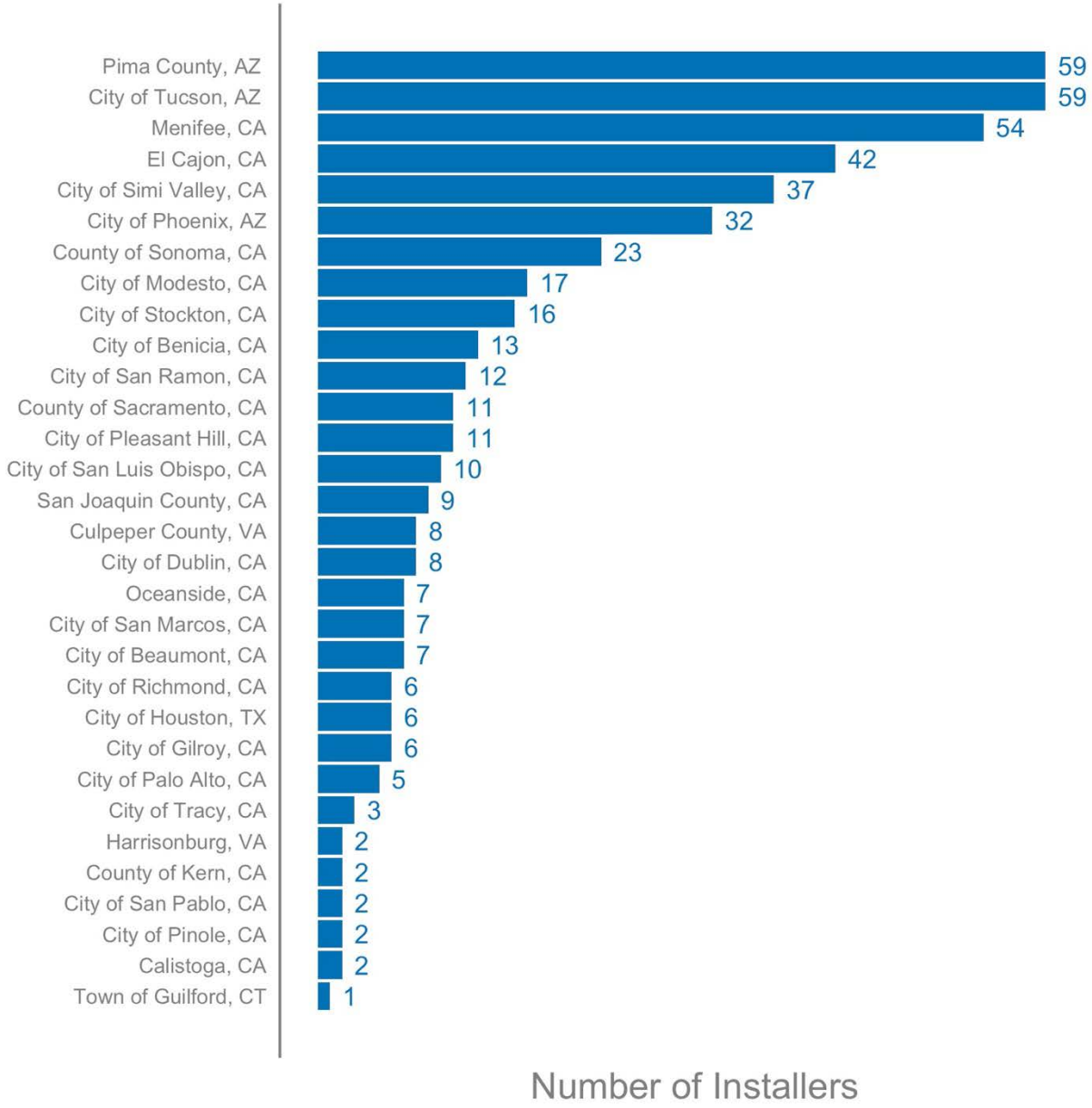

Figure 9. Number of installers using SolarAPP+ by AHJ (2022)

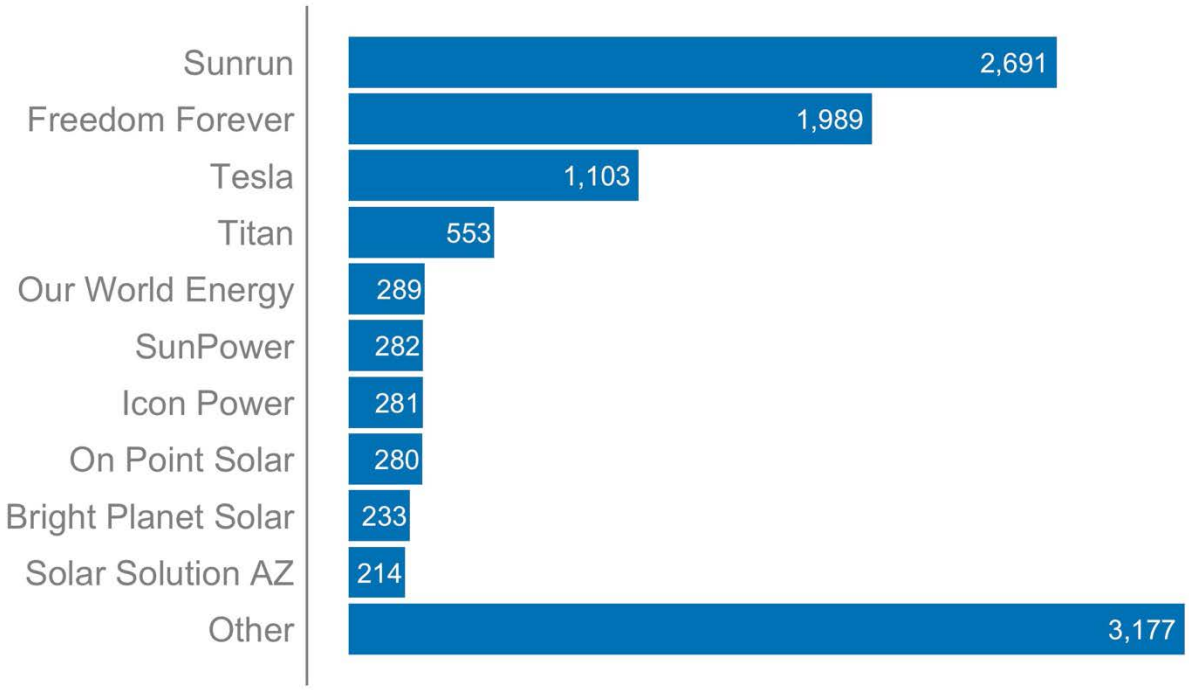

Figure 10. Number of SolarAPP+ projects by participating installer (2022)

Among AHJs that have fully adopted SolarAPP+, about 46% of permits were processed using the SolarAPP+ platform. The remaining 54% of permits were processed through the AHJs' traditional permit review process. Figure 11 depicts SolarAPP+ utilization rates by AHJ, i.e., the percentage of permits that were processed through SolarAPP+. The data suggest that SolarAPP+ utilization rates increase over time. In the 15 AHJs that had at least one SolarAPP+ permit submitted in January 2022, monthly utilization rates increased from about 27% in January to 37% in June, 44% in September, and 55% in December (Figure 12).

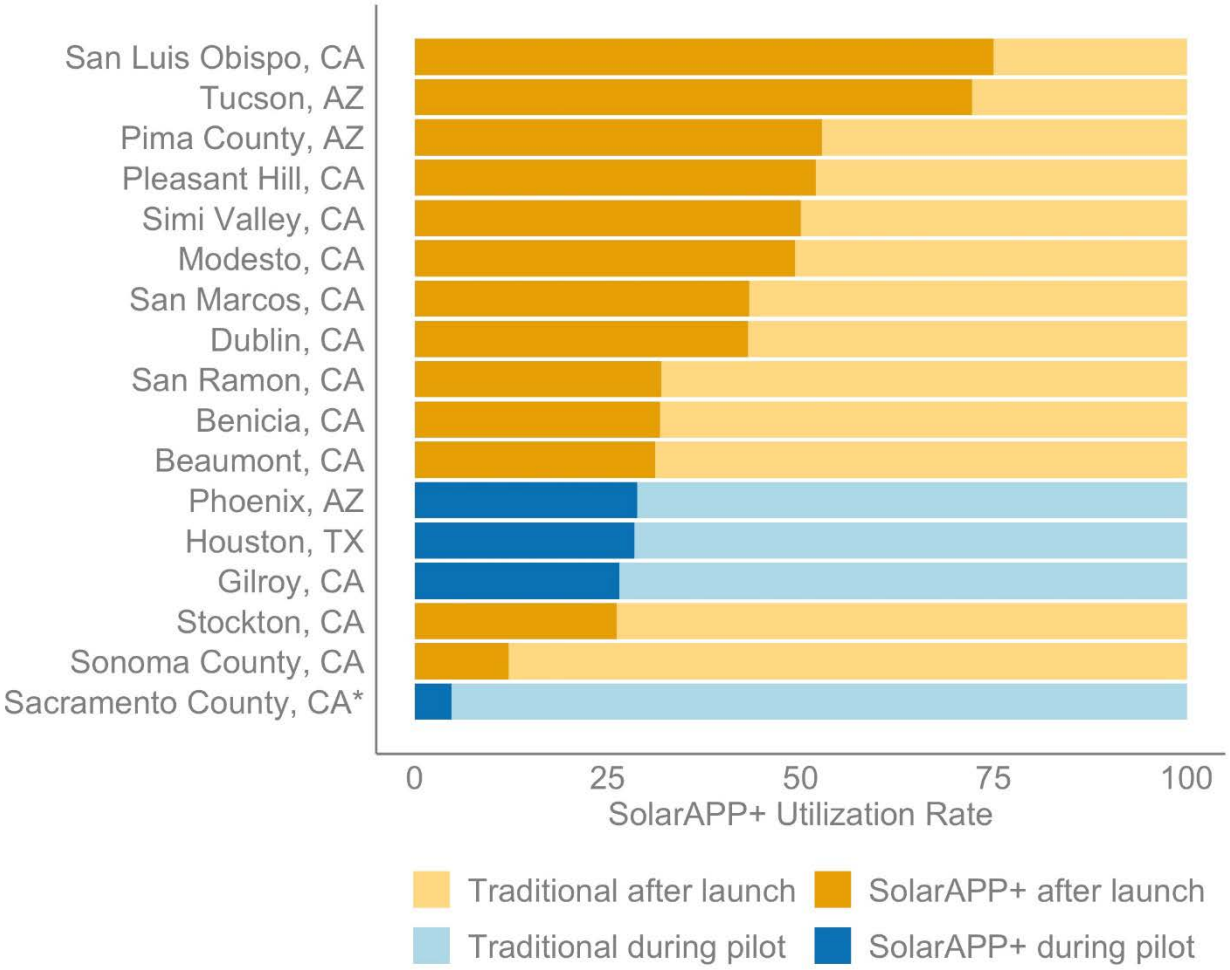

Figure 11. SolarAPP+ utilization rates (2022)

Note: This figure is based on AHJs with at least 30 SolarAPP+ permits submitted in 2022 and available data on traditional permits. *Sacramento County adopted SolarAPP+ in December 2022; post-launch data are excluded (N=1).

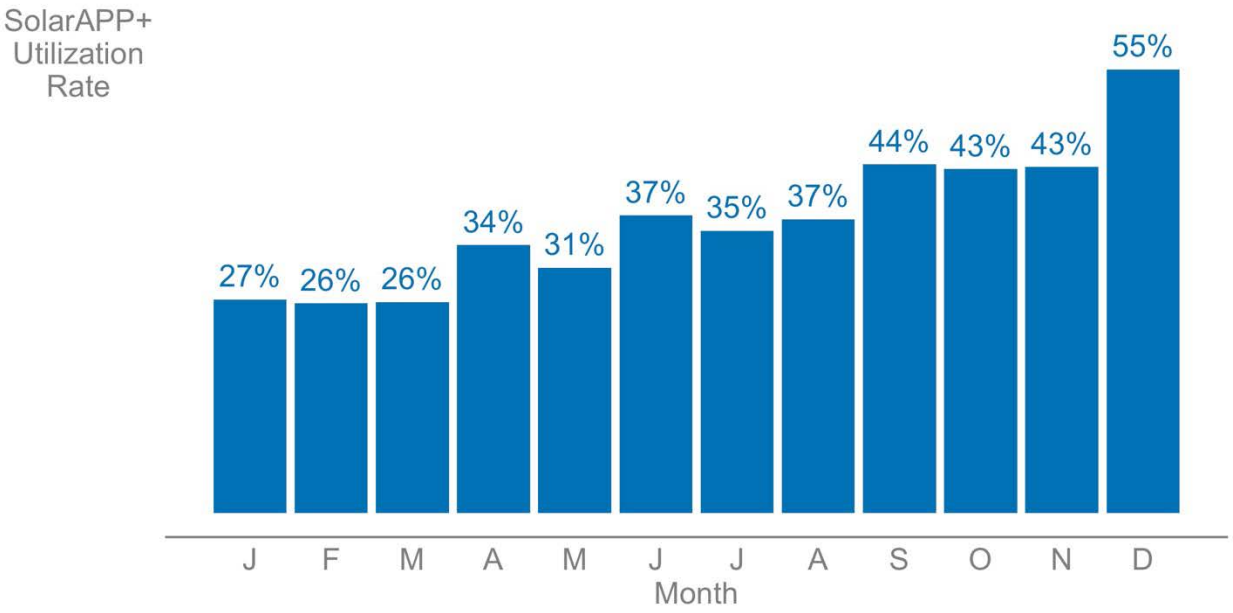

Figure 12. SolarAPP+ utilization rate by month (2022)

This figure is limited to AHJs with at least one SolarAPP+ permit submitted in January 2022

3.2 AHJ Permit Review Impacts

Permit review durations refer to the time (in business days) between a permit submission and a permit issuance. We compared permit review durations for SolarAPP+ and traditional projects to evaluate the platform's performance during the review stage (Figure 13). The median permit review time for traditional PV-only projects across all AHJs was seven days.[5] In contrast, the SolarAPP+ platform issues permits immediately for code-compliant applications, meaning that the median permit review duration for SolarAPP+ projects is zero days. Review times for PV-plus-storage projects are mostly comparable, with a median review time of six days across AHJs, although PV-plus-storage review times are significantly longer for traditional permits in some AHJs.

[5] Based on feedback from AHJs, these durations reflect timelines for a single permit entry, i.e., they do not include revisions, allowing for an apples-to-apples comparison with SolarAPP+ durations for code-compliant systems.

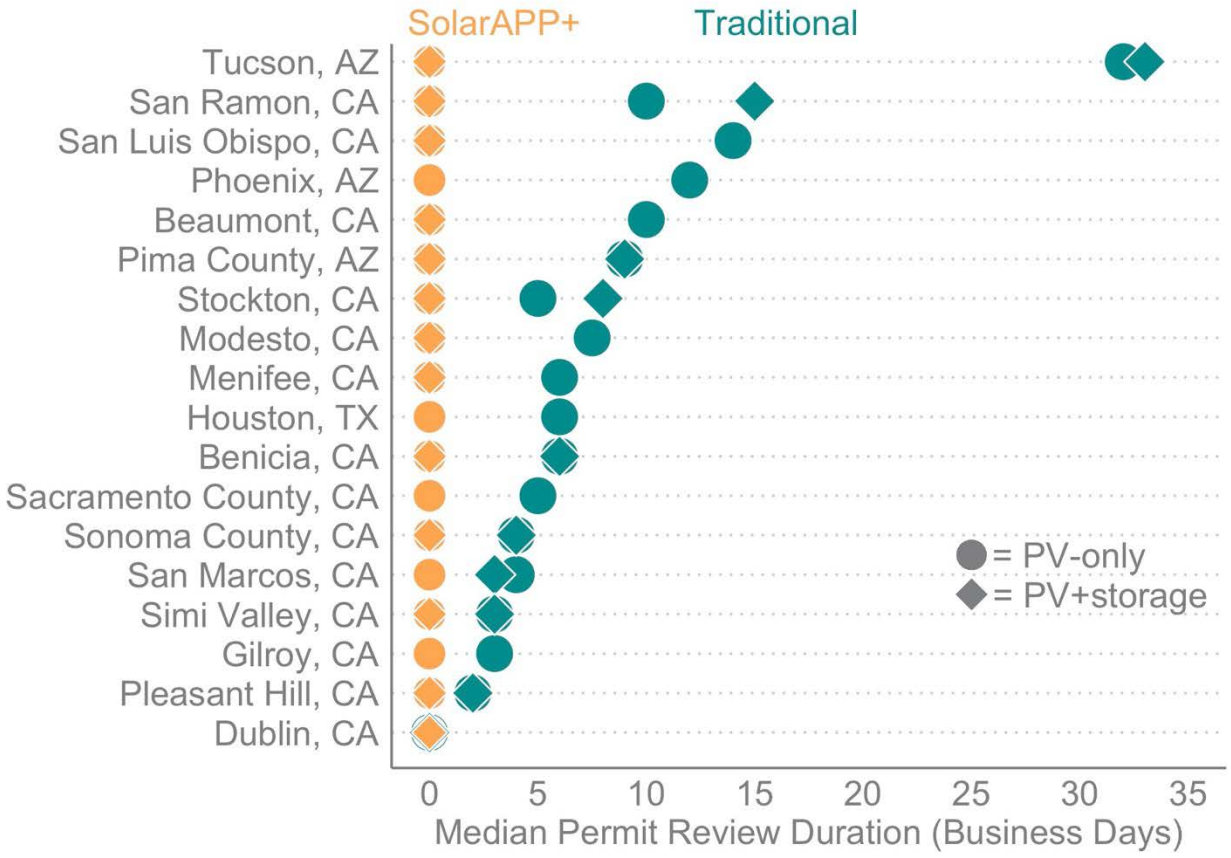

Figure 13. Median permit review times

Note: Figure excludes one outlier duration of 63 days for PV-plus-storage projects in Beaumont, CA

In addition to reducing permit review durations, the SolarAPP+ platform reduces AHJ staff review time by removing the need for individual permit reviews. The net impact of SolarAPP+ on staff time is influenced by both the time savings from automated permit reviews and the time required to implement SolarAPP+. According to feedback from AHJs reported in Cook et al. (2022), manual permit reviews require around 25–60 minutes of staff time. Figure 14 depicts the estimated AHJ staff time saved in 2022 by automating permit reviews on the SolarAPP+ platform, assuming reviews take 25–60 minutes. Overall, we estimate that AHJs collectively saved between 5,800 and 13,900 hours in staff time in 2022 from adopting SolarAPP+, the equivalent of about 3–7 full-time employees. These estimates reflect savings for PV-only and PV-plus-storage permits, while assuming that every revision must go through AHJ reviews. Note that the estimated time savings depicted in Figure 14 are purely a function of how many SolarAPP+ permits were issued in each AHJ.

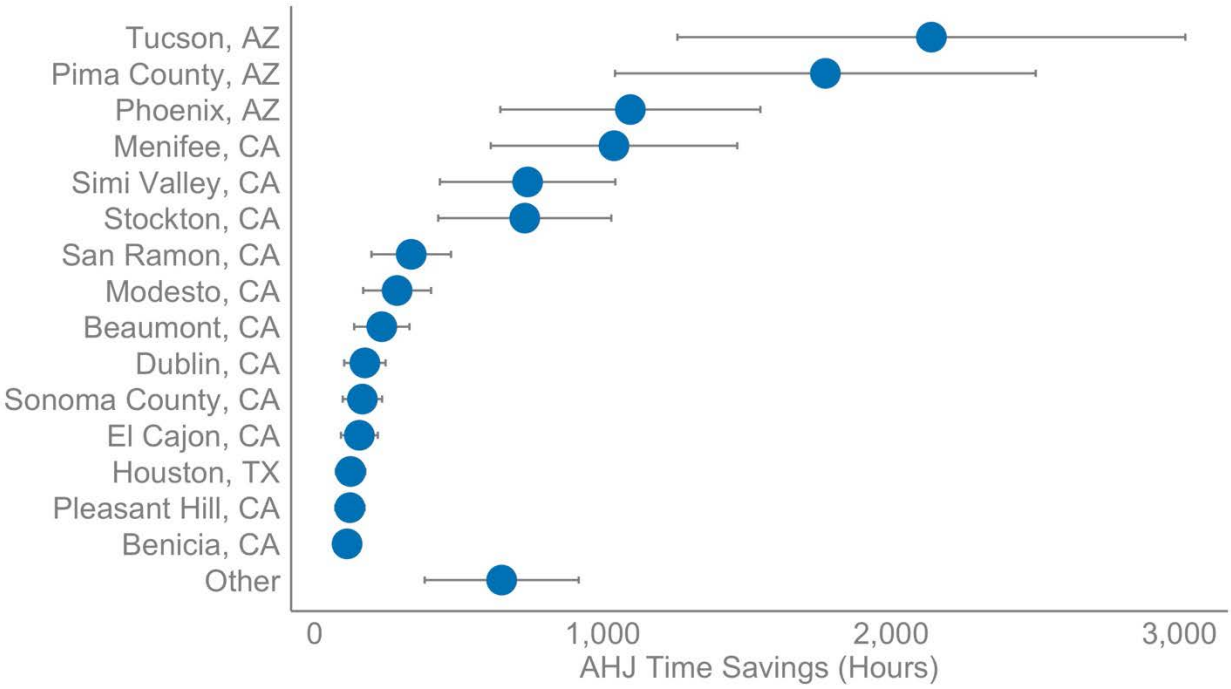

Figure 14. Estimated AHJ staff review time savings (to date) from SolarAPP+ permit processing

Note: The lower and upper bounds of the bars represent staff time savings assuming each review takes 25 and 60 minutes, respectively, while the points represent the middle of the range (42.5 minutes), based on AHJ-provided estimates of permit review time.

SolarAPP+ adoption has also reduced permitting fees in some AHJs. SolarAPP+ charges contractors a $25 administrative fee per submitted permit in addition to AHJ fees. At least four of the 31 SolarAPP+ AHJs have reduced their own fees after adopting SolarAPP+. Fee savings in these AHJs range from about $6 to $251 per permit.

3.3 AHJ Inspection Impacts

We define the inspection failure rate as the percentage of projects that failed at least one inspection. Figure 15 depicts inspection failure rates for traditional and SolarAPP+ projects across 12 AHJs with available data. SolarAPP+ project inspection failure rates are lower than traditional inspection failure rates in seven of the 12 AHJs. Across all 12 AHJs, 17% of SolarAPP+ projects failed an inspection at least once, compared to 24% of traditional projects. The differences are similar across project types: 25% of traditional PV-only and 22% of traditional PV-plus-storage projects failed at least one inspection, compared to 17% of SolarAPP+ PV-only and PV-plus-storage projects. These results suggest that, at a minimum, expedited permitting through SolarAPP+ does not drive any downstream issues with inspections. Further, the results suggest that SolarAPP+ permitting may reduce inspection failure rates. This second result should be treated as a working hypothesis; it is possible that the differences in inspection failure rates reflect preexisting differences between installers that do and do not use SolarAPP+. Further research is required to more fully understand the impacts of SolarAPP+ on inspection failure rates.

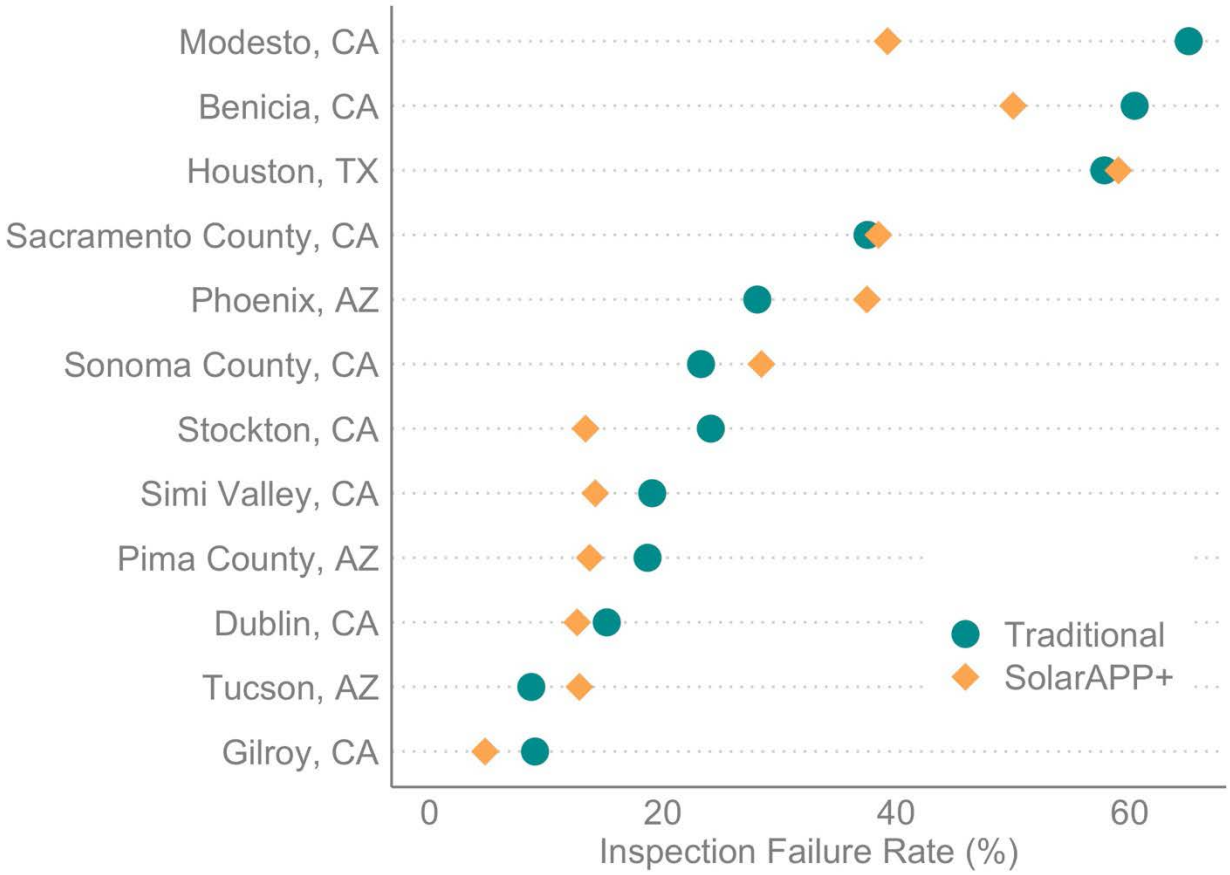

Figure 15. Inspection failure rates by AHJ (2022)

In addition to tracking the volume of SolarAPP+ inspection failures, we also tracked the reasons for inspection failure (Figure 16). 58% of the identified failures related to a work quality issue, meaning that the system was not installed per the code. 12% needed to be rescheduled, where typically an inspection did not actually occur. Of the remaining inspection failures, a combined 11% were directly related to SolarAPP+ (install did not match SolarAPP+ plan and inspection checklist was not on site). It is possible that more contractor education could result in fewer inspection failures of these types, thereby further improving SolarAPP+ inspection performance.

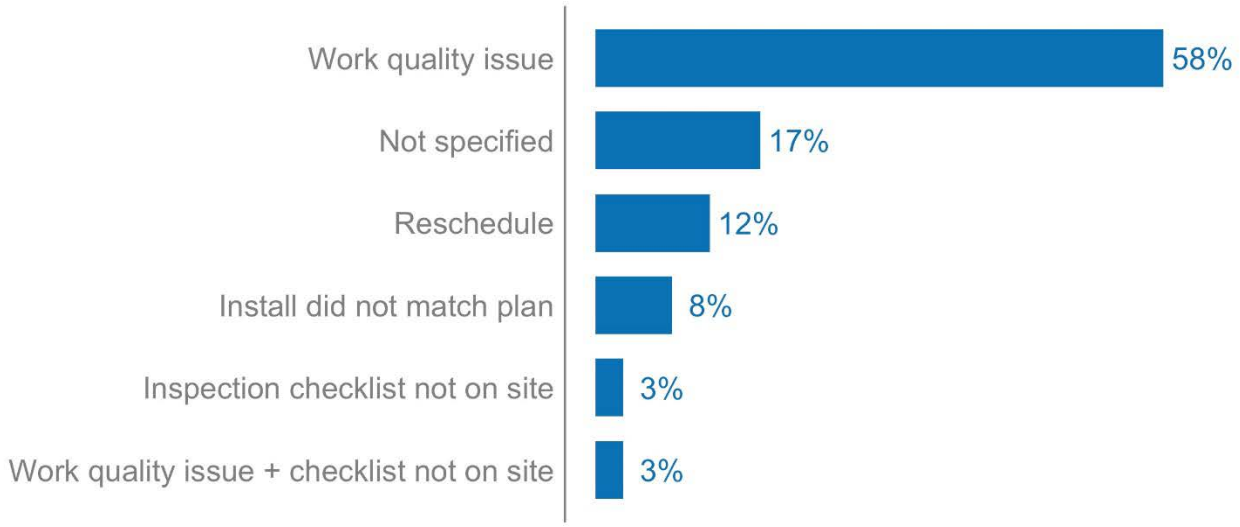

Figure 16. Known reasons for inspection failures among SolarAPP+ projects in 2022

3.4 Solar Adoption Timeline Impacts

In the previous two sections, we explored the impacts of SolarAPP+ at specific stages of the solar adoption timeline. Here, we explore the impacts of SolarAPP+ across the full timeline from permit submittal to final inspection. Across 13 AHJs with available data for PV-only projects,[6] the median duration from permit submission to final passed inspection was 38 days for SolarAPP+ permits and 51 days for traditional permits. This suggests that SolarAPP+ reduces full permitting timelines by around 13 days, or about 25% (Figure 17). In contrast, across seven AHJs with available data for PV-plus-storage projects, median durations for PV-plus-storage permits were higher among SolarAPP+ projects: 64 days compared to 55 days. Note that these durations are affected by many factors unrelated to SolarAPP+, particularly the duration from permit issuance to first inspection.

[6] These subsamples refer to AHJs for which we have available data for complete durations for both SolarAPP+ and traditional permits. In this case, the 13 AHJs exclude Menifee, CA, and Pleasant Hill, CA. The traditional median data for the AHJs depicted in the figure are based on data from NREL's SolarTRACE: https://solarapp.nrel.gov/solarTRACE.

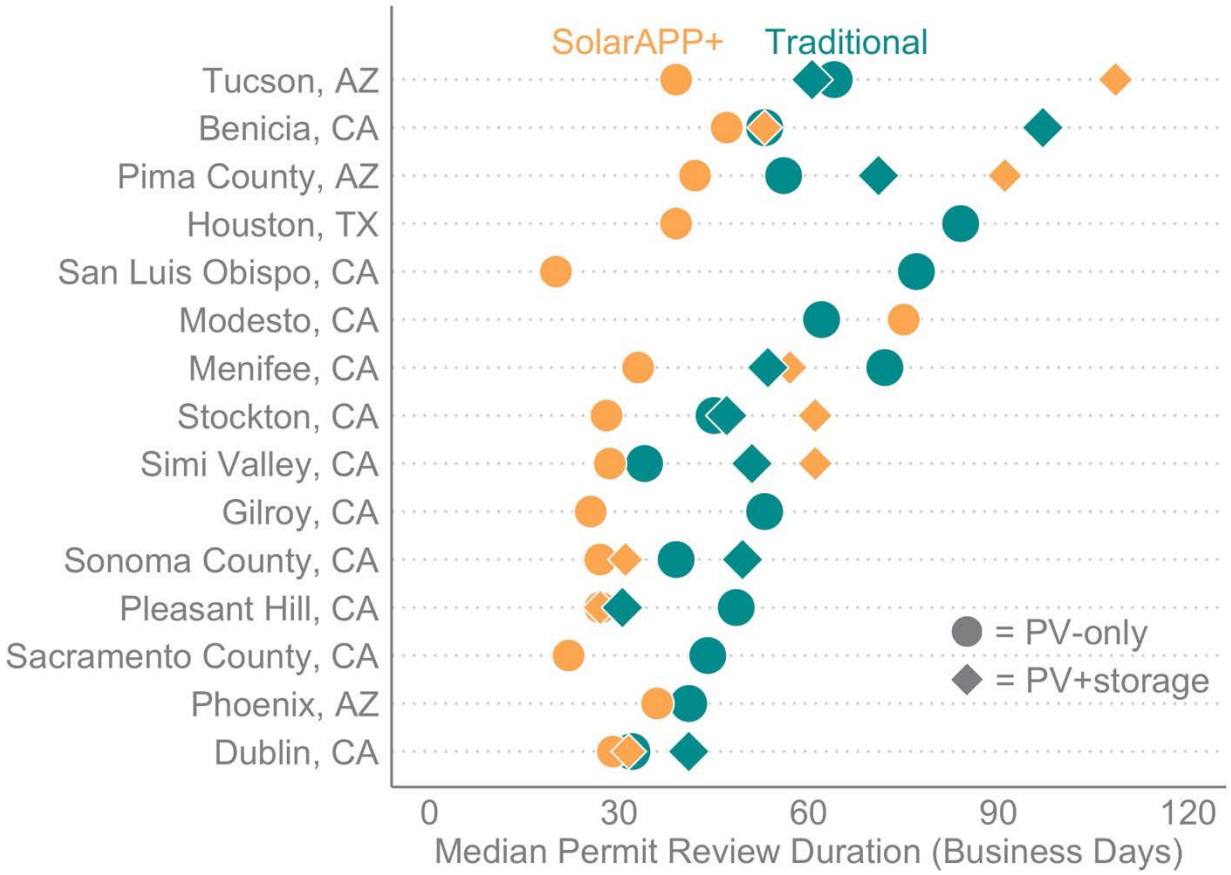

Figure 17. Median project time from permit submission to passed inspection by AHJ (2022)

Figure 18 depicts the estimated cumulative impact of the SolarAPP+ platform in the 15 AHJs with available data. The cumulative impact is mostly a function of the number of permits processed. As a result, the cumulative impact is largest in Tucson, where we estimate that SolarAPP+ has accelerated permitting timelines by a total of about 55,000 business days. Across the 15 AHJs, the total estimated acceleration is 134,000 business days.

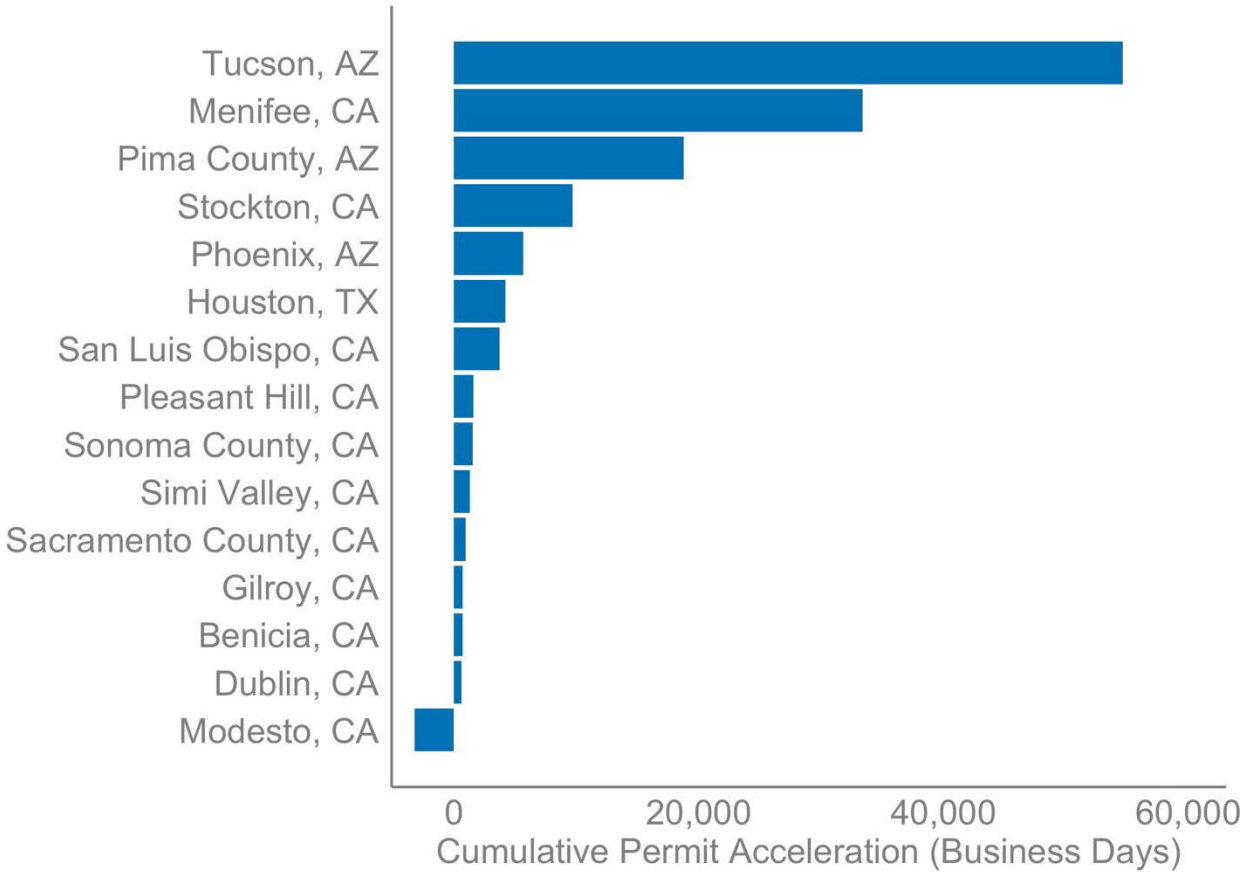

Figure 18. Cumulative estimated acceleration of project timelines (permit submission to passed inspection) across AHJs in 2022.

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Appendix. SolarAPP+ Project Design Characteristics

The SolarAPP+ platform provides a new data source for rooftop PV system characteristics. In this Appendix, we describe SolarAPP+ solar and battery system characteristics and discuss how SolarAPP+ projects compare to the broader rooftop PV and battery storage markets. All numbers and figures in this section reflect cumulative data, i.e., including projects permitted before 2022.

A.1 System Size

The median system size for SolarAPP+ PV-only projects is 6 kW, ranging from 0.3 to 28 kW (Figure 19). These system sizes are comparable to the sizes in the broader rooftop PV market, as indicated by the 7-kW median for systems installed in 2021 estimated by Barbose et al. (2022). Projects in the PV-plus-storage pilot tend to be larger, with a median PV system size of 7.6 kW. Further, most batteries in the PV-plus-storage pilot have similar rated storage capacities, reflecting the standardized rated output of the limited number of battery products used in the pilot. About 62% of PV-plus-storage projects had a battery storage system with 13.5 kWh of storage capacity (based on 642 projects with available data).

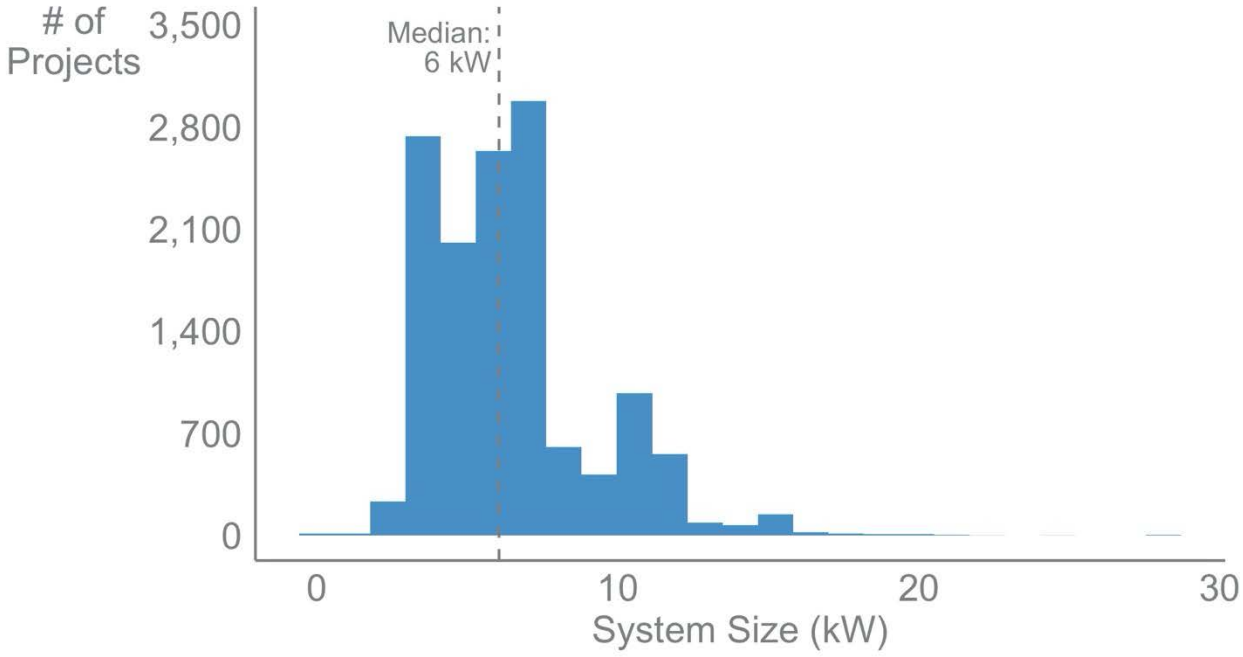

Figure 19. SolarAPP+ PV system size (kW) distribution for PV-only projects (N=13,518)

A.2 Solar Modules and Inverters

Figure 20 shows the distribution of module brands used in SolarAPP+ PV-only projects. Module brands largely reflect installer preferences and contractual agreements with module manufacturers. The SolarAPP+ module distribution is both similar and distinct from the module choices of other installers. For instance, data from EnergySage (2022) show that Silfab, Renewable Energy Corporation (REC), and LG modules are similarly popular among other installers. At the same time, SolarAPP+ projects use Hanwha Q Cells more frequently than other installers but use Panasonic and SunPower modules less frequently than other installers. In the

PV-plus-storage pilot, Tesla accounts for about 71% of PV modules, largely reflecting the predominance of Tesla batteries in the PV-plus-storage pilot (see Section A.4).

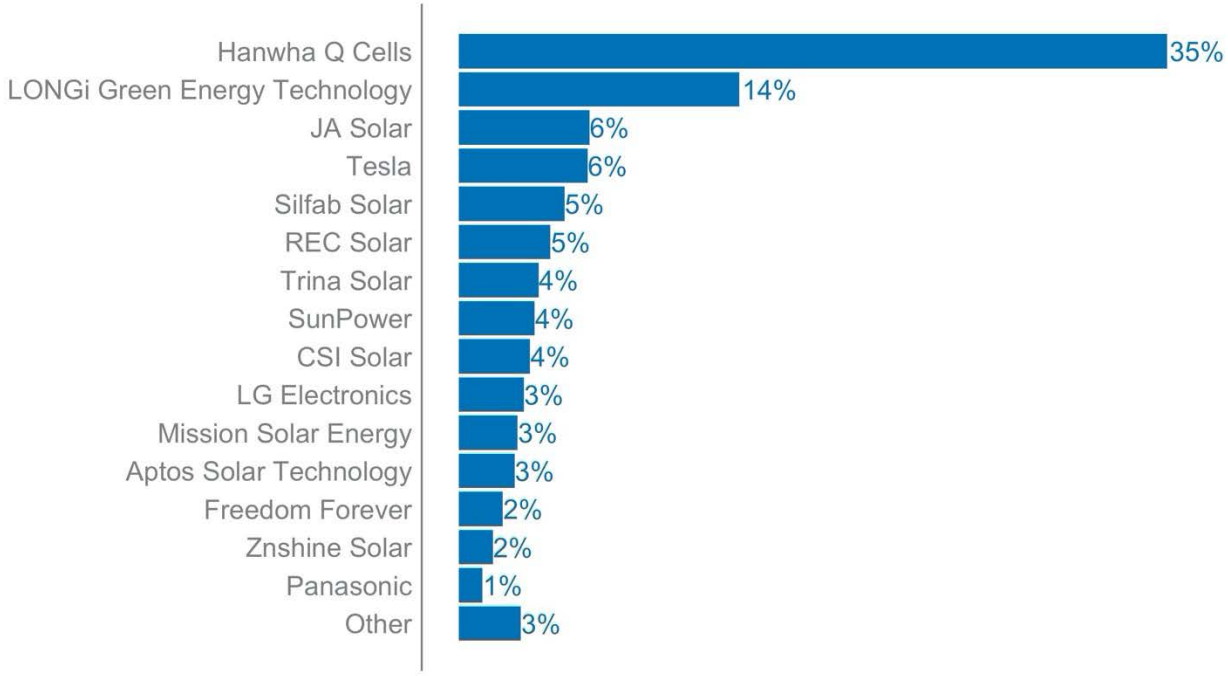

Figure 20. Module brand shares in SolarAPP+ PV-only projects (N=13,522)

About 84% of SolarAPP+ PV-only systems include module-level power electronics, specifically DC optimizers (55%) and microinverters (33%) (Figure 21). That share is slightly less than the estimated residential market-wide share of 94% (Barbose et al. 2022).

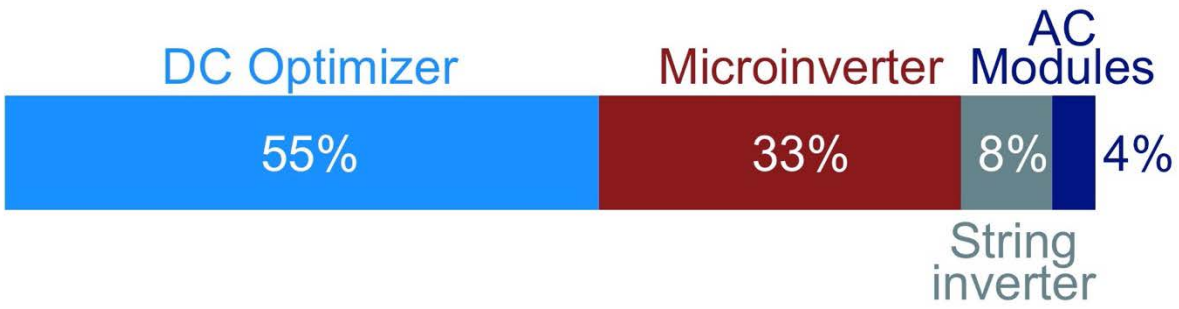

Figure 21. Inverter characteristics of SolarAPP+ PV-only systems (N=13,522)

Figure 22 shows the distribution of inverter brands used in SolarAPP+ PV-only projects. Around 83% of SolarAPP+ projects use SolarEdge or Enphase inverters, similar to the share of those brands estimated by EnergySage (2022).

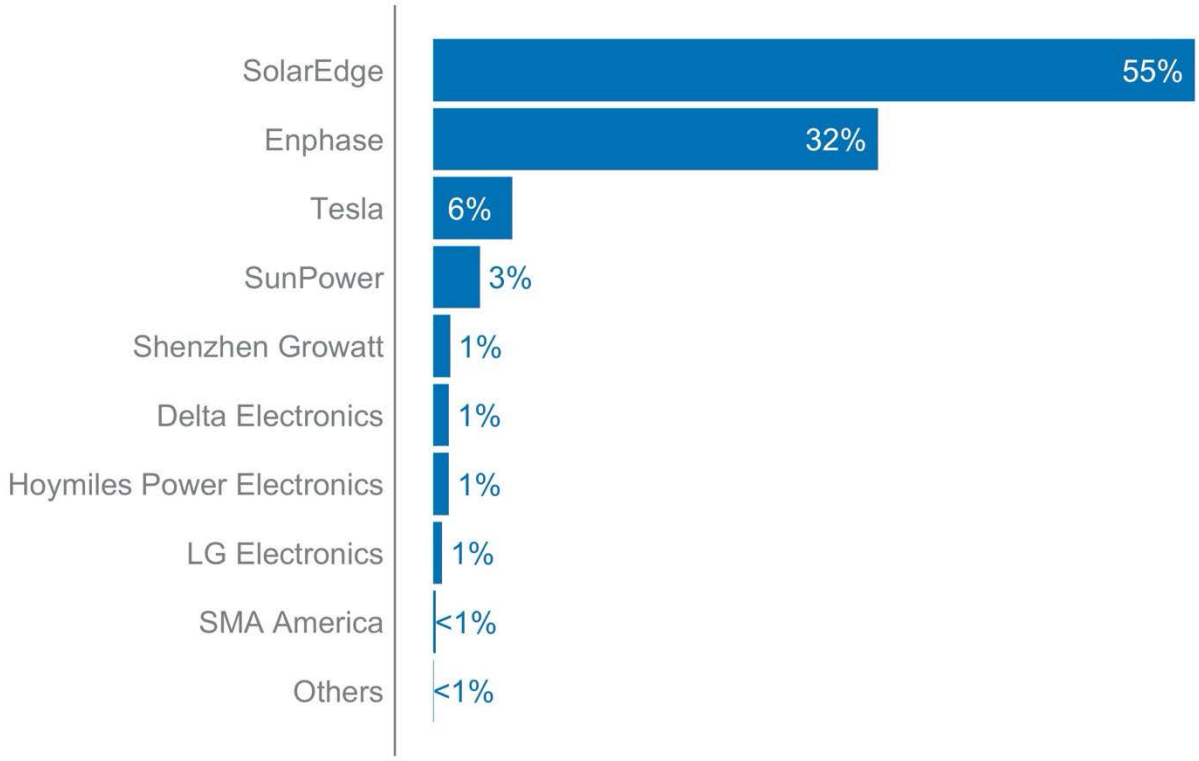

Figure 22. Inverter brand shares in SolarAPP+ PV-only projects (N = 13,522)

A.3 Home Electrical Upgrades and Interconnection Methods

In certain cases, residential PV system installations require upgrades to home electrical systems. About 16% of SolarAPP+ PV-only permits and 7% of PV-plus-storage permits were associated with a main panel upgrade (Figure 23). Further, about 7% of PV-only permits and 3% of PV-plus-storage permits were associated with derating (reducing) the power limits of the home's main breaker, required in cases where the PV system could cause the home to exceed amperage limits set by the local utility. SolarAPP+ also tracks the main service panel rating, reflecting the range of variation in service panels on which PV systems are installed, including 100 amps (16% of systems), 125 amps (5%), 150 amps (3%), 175 amps (8%), and 200 amps (67%). Finally, most SolarAPP+ PV-only systems are connected to the grid using the 120% rule, meaning that the installed system amperage cannot exceed the home meter's safety limit by more than 20%. In contrast, the most common interconnection rule in the PV-plus-storage pilot is the sum-of-breakers rule, which requires that the sum of the home's load and electrical supply (i.e., from PV and batteries) does not exceed the rated capacity of the busbar connecting the home to the distribution grid.

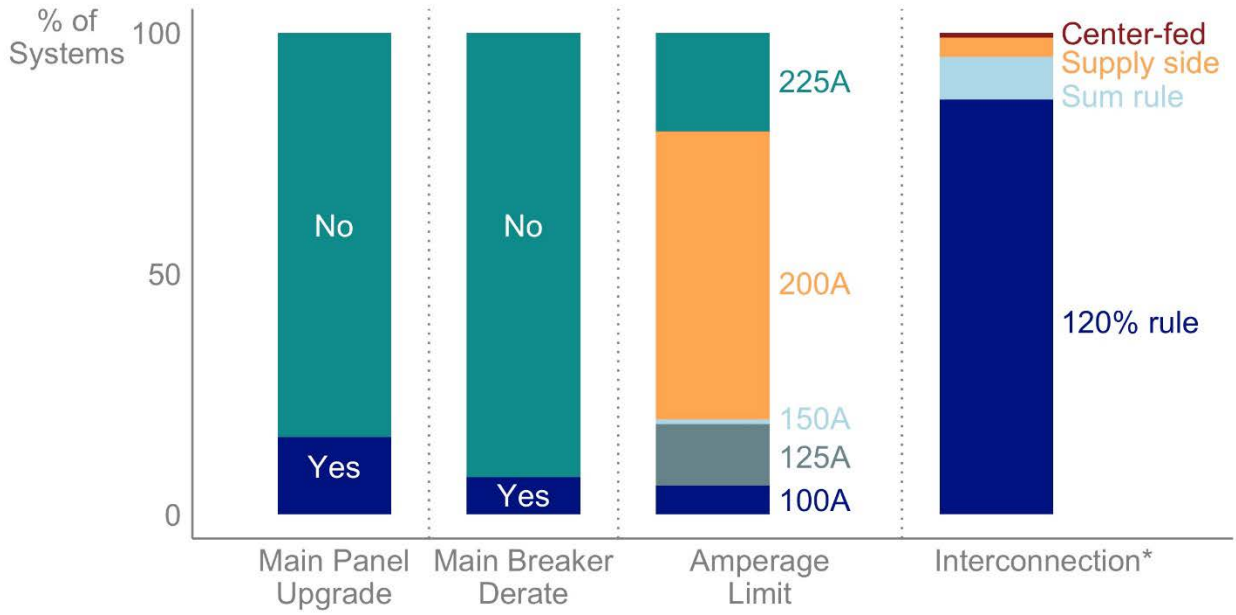

Figure 23. Electrical upgrade features of SolarAPP+ systems

*Sum rule = sum of breaker rule; supply-side = supply-side connection; center-fed = 120% rule on center-fed panels

A.4 Battery Characteristics

The following four figures depict data on battery system characteristics. Note that each figure is based on a subsample of the available data. In some cases, missing data may skew the distributions. For instance, Figure 24 shows the distribution of battery manufacturers for 569 systems with available data. This distribution is substantially different from other reported distributions (e.g., EnergySage 2022), either because of data reporting issues or because installers that use SolarAPP+ prefer different manufacturers.

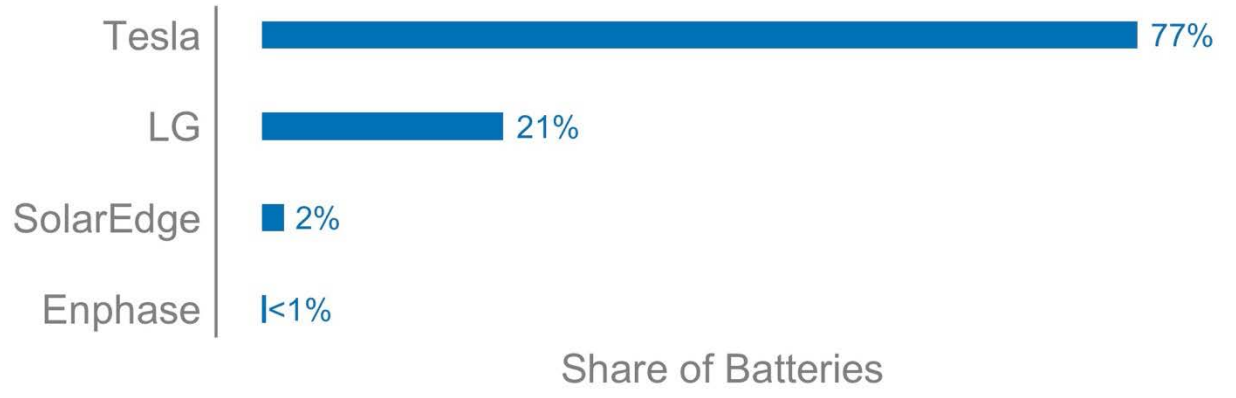

Figure 24. Distribution of battery manufacturers (N=569)

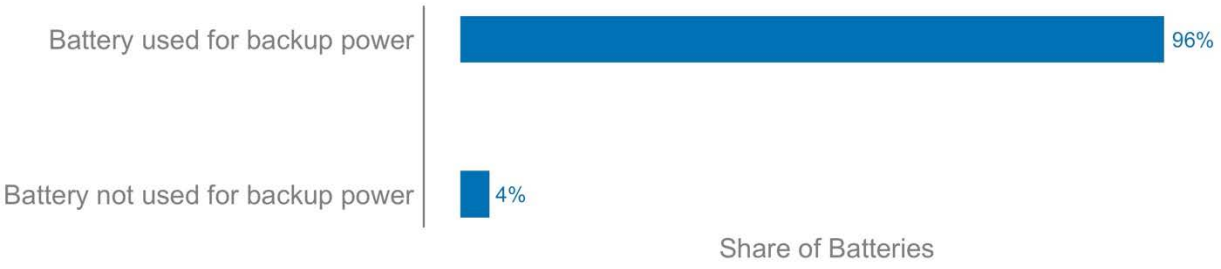

Figure 25. Distribution of batteries used for backup power (N=949)

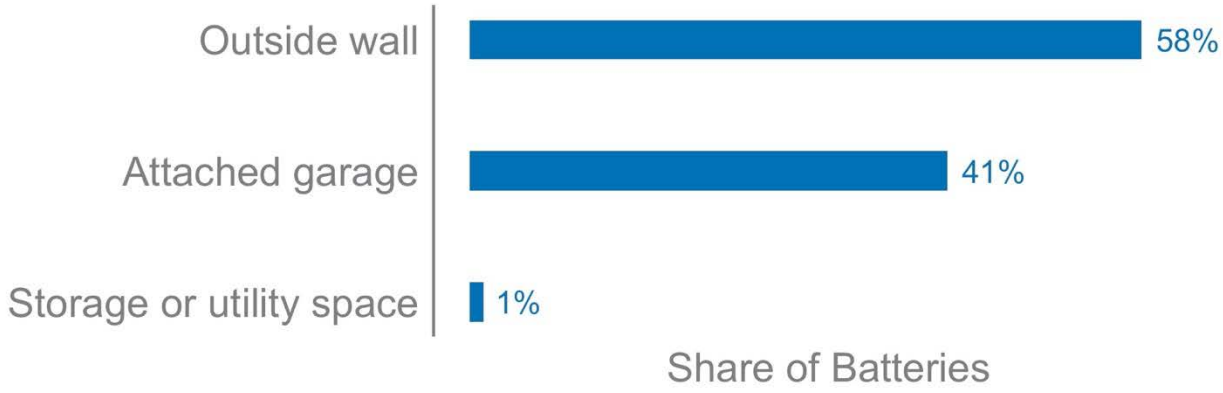

Figure 26. Distribution of battery storage mount locations (N=246)

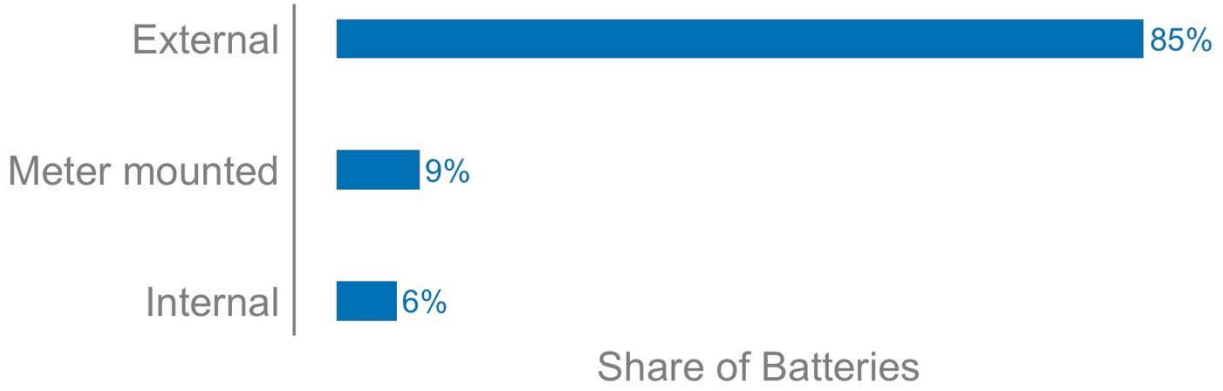

Figure 27. Distribution of battery storage initiation device locations (N=867)