

Patience is a Virtue: A Data-Driven Analysis of Rooftop Solar PV Permitting Timelines in the United States

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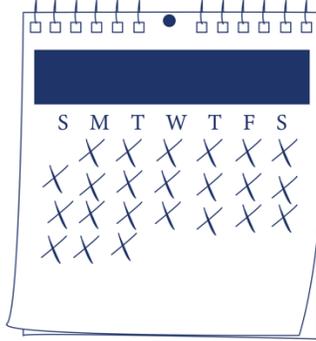
² Lawrence Berkeley National Laboratory

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Key Takeaways

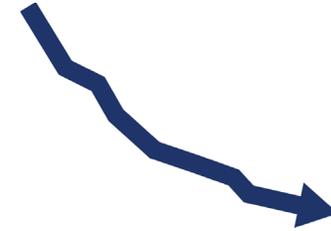
Permit durations vary significantly



Permitting authorities (e.g., inspectors) play key role...



Durations are generally declining



... but so do installers.





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1. Introduction



Introduction

- Local PV permitting processes help ensure the safe construction and operation of small-scale rooftop or ground-mounted PV systems.
- At the same time, these local permitting processes can pose a barrier to PV adoption.
 - ▣ Variation in procedures can increase installer effort to navigate the permitting process. Increased installer effort and permit fees translate to higher PV system prices.
 - ▣ Onerous permitting processes can result in lengthier PV installation timelines, which may result in more customer cancellations or deter prospective PV adopters.

The PV Permitting Process

1. Application Submitted

The system installer typically applies for the permit on behalf of the homeowner.

2. Permit Issued

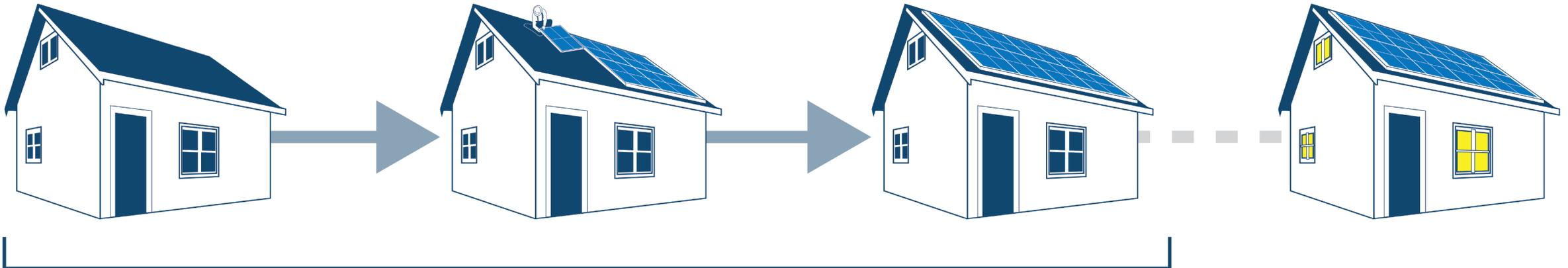
Once the AHJ approves the application, the AHJ issues a permit allowing the installer to install the system.

3. Inspection Passed

AHJ personnel inspect the installed system for code compliance and approve the system, completing the permitting process.

4. Interconnection

The utility approves and interconnects the system to the grid. Interconnection may occur separately from, but in parallel with, the permitting process.



Scope of this study

Research Questions

What are typical permit durations, and how do those vary over time, across states and AHJs, and by installation?

What are the factors that explain differences in PV permit durations, i.e., the number of days from permit application to completion?

Do AHJ-level policies affect permit durations? If so, which policies result in shorter permit durations?

Is there evidence that AHJs “learn” to reduce PV permit durations with more experience?

Is it possible to leverage AHJ-level learning through policies, tools, and practices to share experience across AHJs?



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2. Data

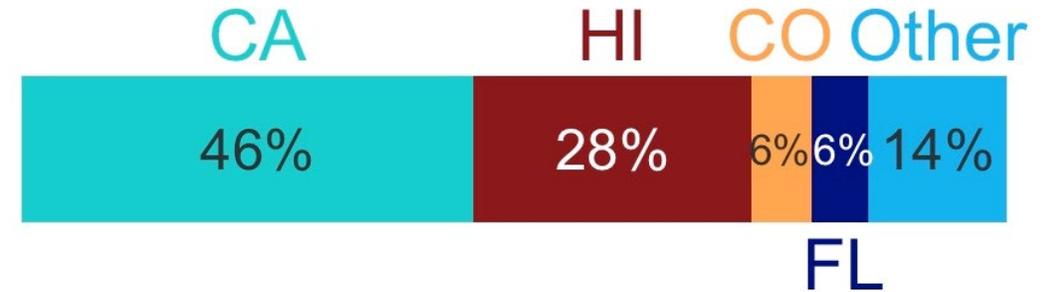


Analysis Data Set

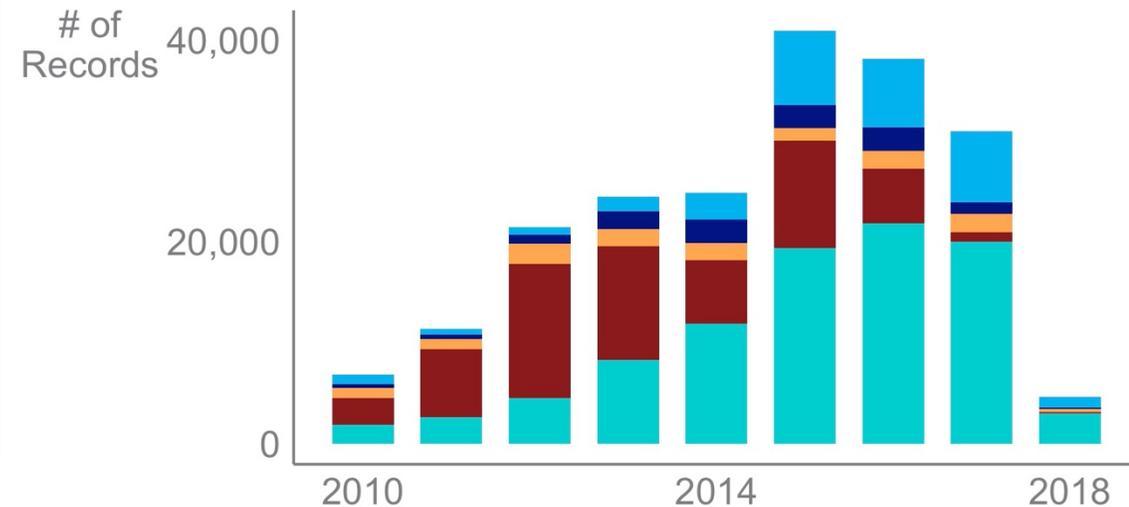
Analysis Data Set Key Facts

- Data from BuildZoom
- **N = 203,590** records
- Records from **368 AHJs** in **39 states**, concentrated in California and Hawaii.
- Records with application dates from **2010 – March 2018**.

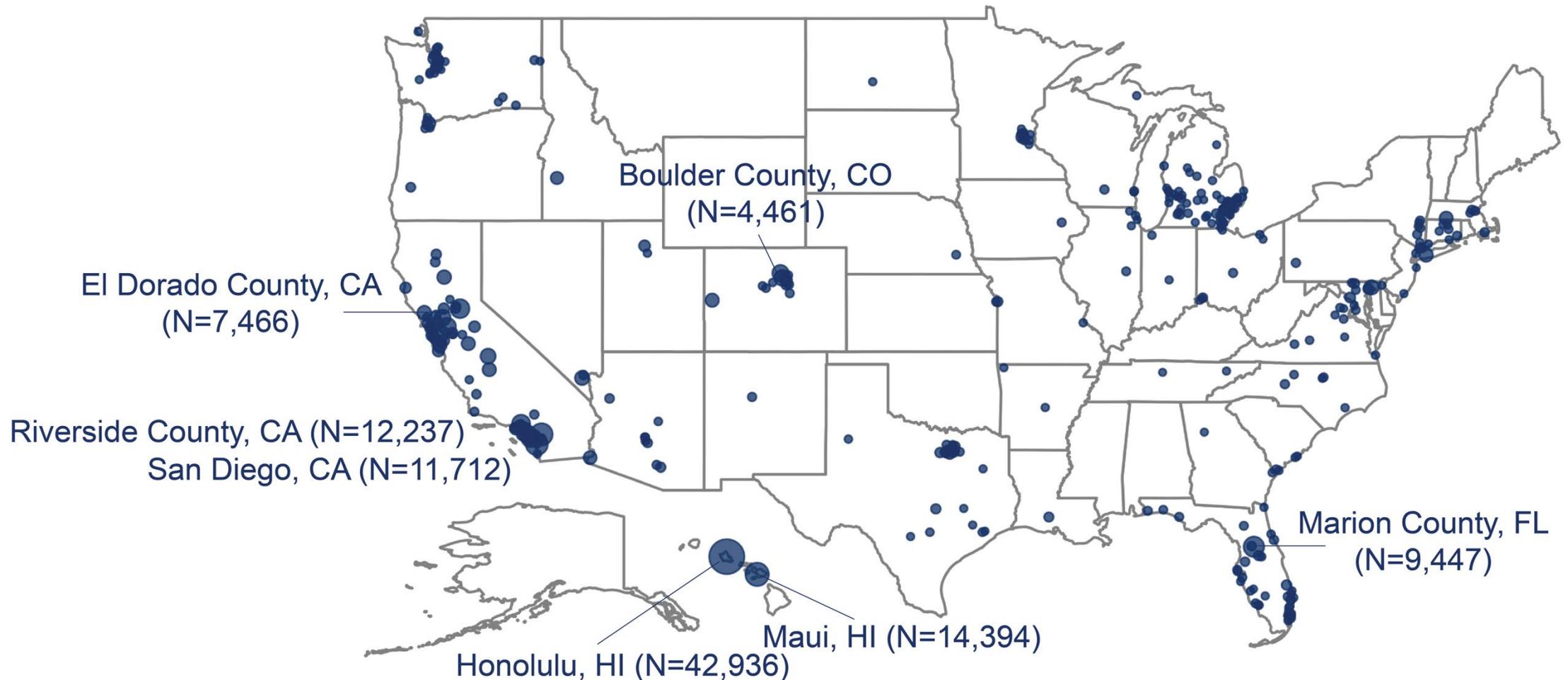
Share of Records by State



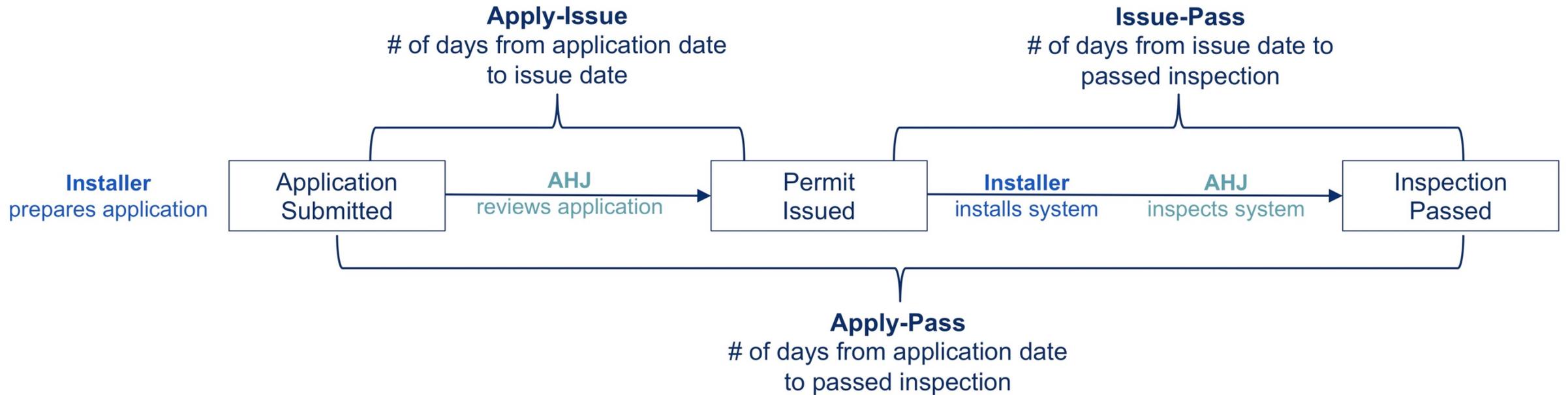
of Records by Year



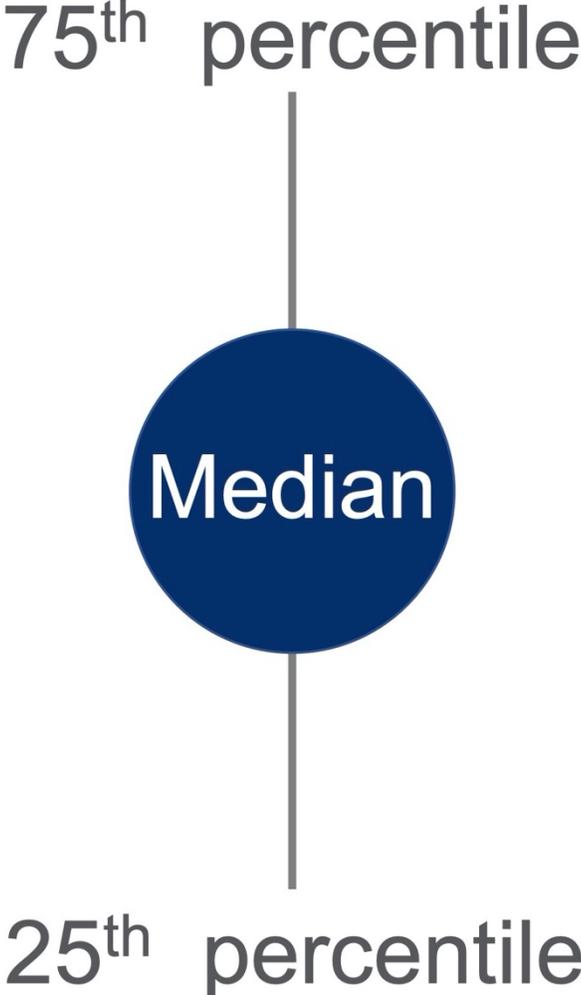
Analysis Data Set: Geographic Coverage



PV Permit Durations



PV Permit Durations: Key Metrics



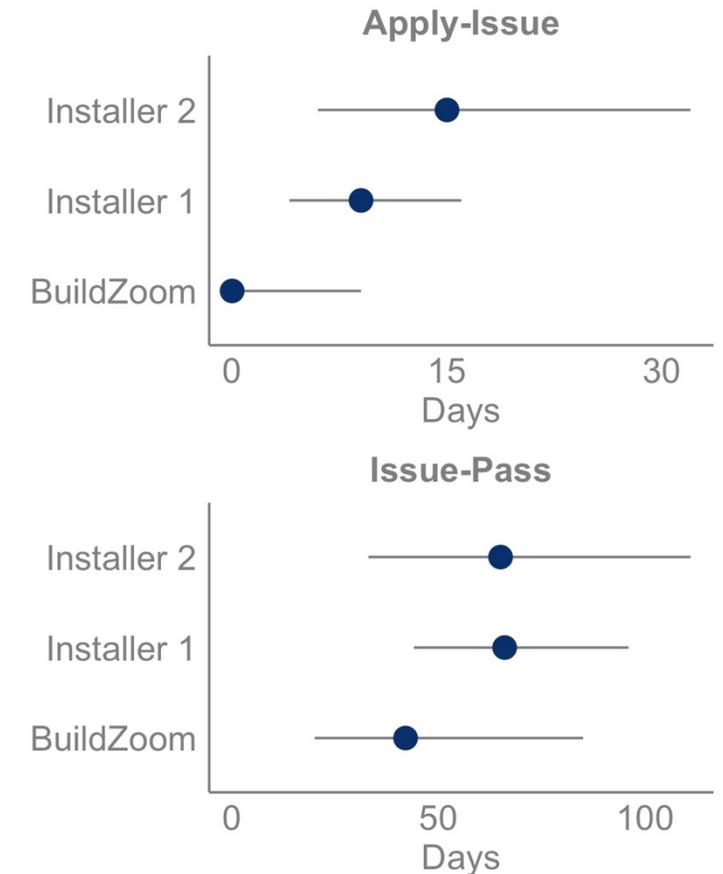
Data Limitations and Caveats

Data Coverage

- The BuildZoom data sample is not necessarily representative.
- **The sample is likely biased towards states and jurisdictions with greater online data availability, which may tend to be areas with faster permit processes times.**

Data Entry

- The BuildZoom apply-issue durations are significantly shorter than durations reported from installer survey data.
- The disparity may reflect some type of sample selection or differences in how BuildZoom systems and installers define key dates.
- Alternatively, and more problematically, the disparity may reflect reporting errors.
- At the same time, the comparisons show that the BuildZoom issue-pass durations are somewhat shorter than but largely similar to the survey durations.
- **We therefore proceed noting some potential downward bias in apply-issue estimates but with more confidence in issue-pass estimates.**



Duration distributions for BuildZoom data and two installer-reported data sets



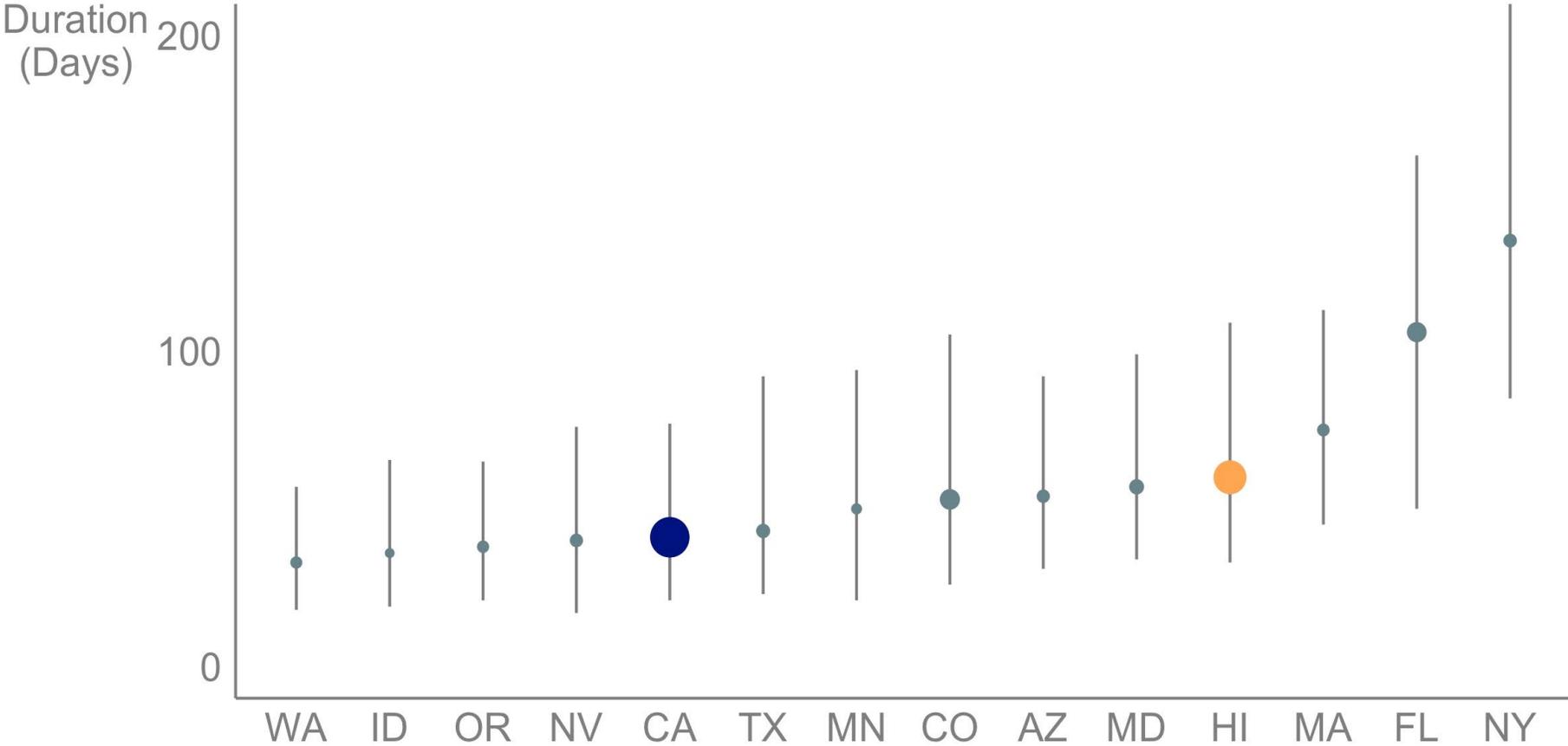
3. Descriptive Results



Distribution of Permit Durations

	Apply- Issue	Issue- Pass	Apply- Pass
Minimum	0	0	0
P25	0	20	26
Median	0	42	50
P75	9	85	97
Maximum*	357	364	364

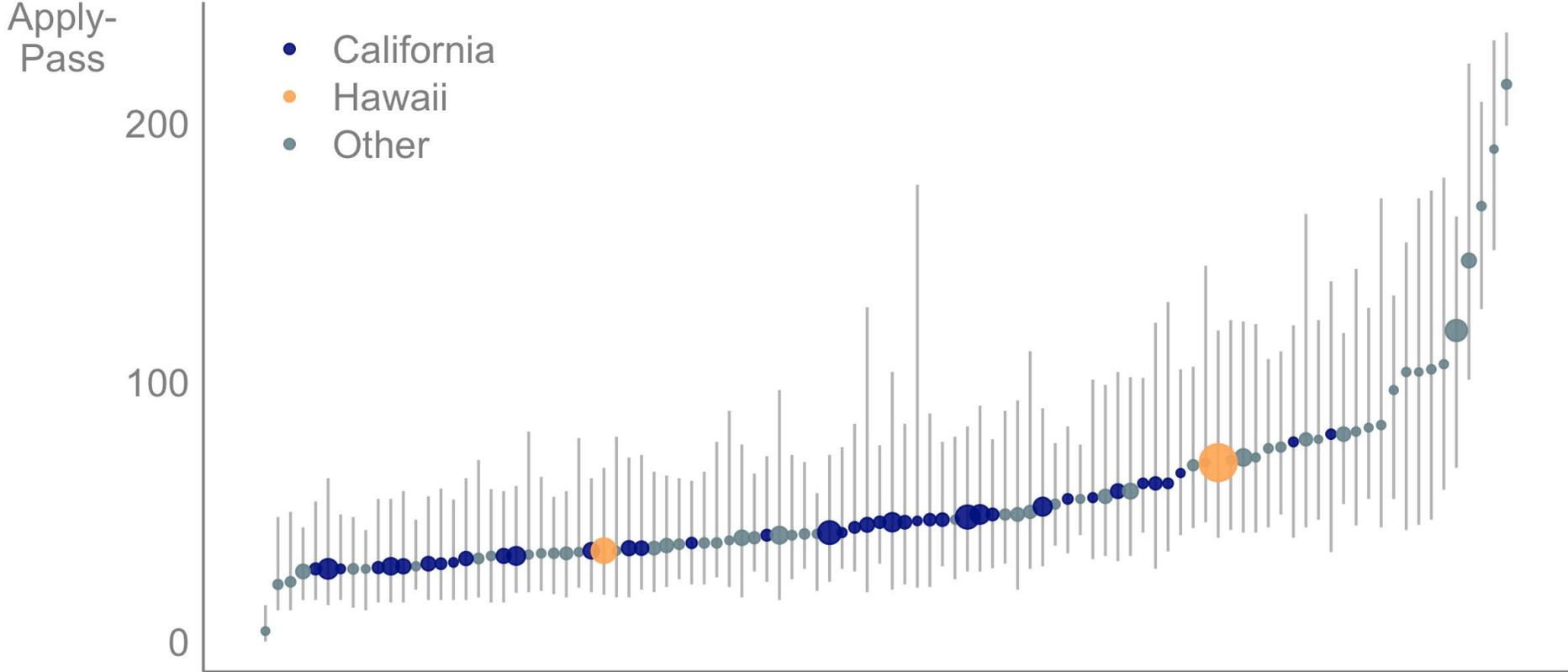
Permit Durations by State



Permit durations by state

Note: Limited to states with >1,000 records in the data. Point sizes represent sample sizes. States ordered according to median apply-pass duration.

Permit Durations by AHJ

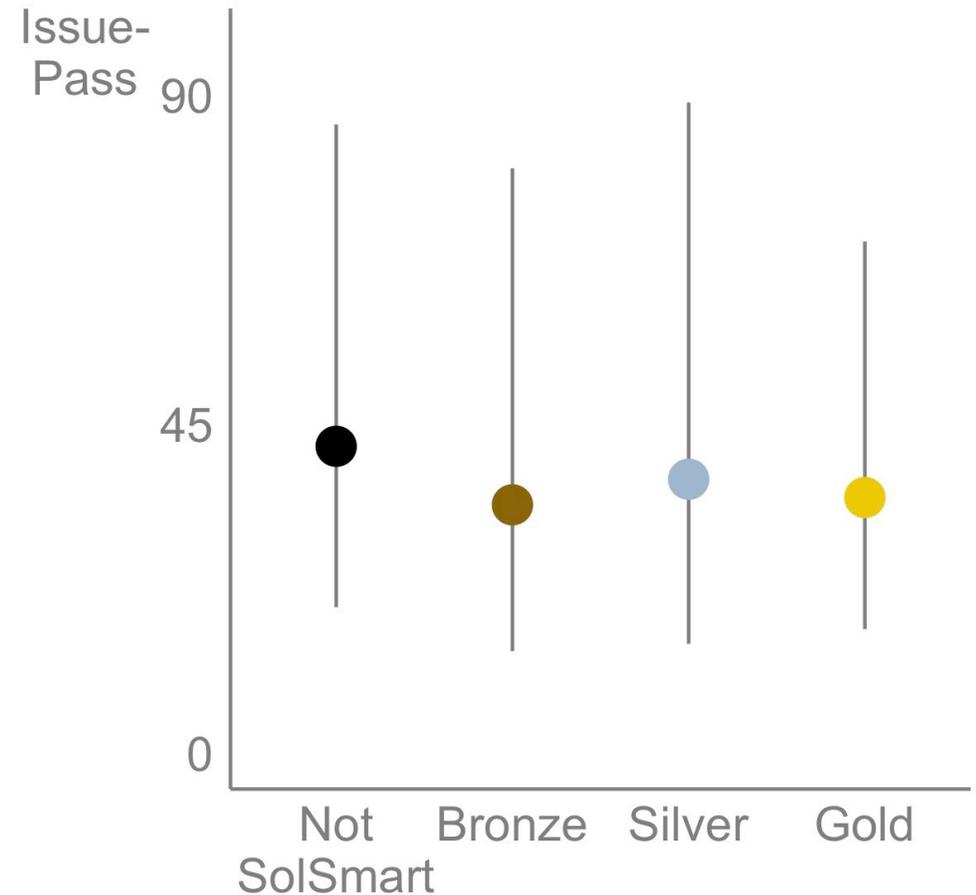


Permit durations by AHJ

Note: Limited to the 100 AHJs with the most records in the data. Point sizes represent sample sizes. Sorted on x-axis according to median apply-pass duration.

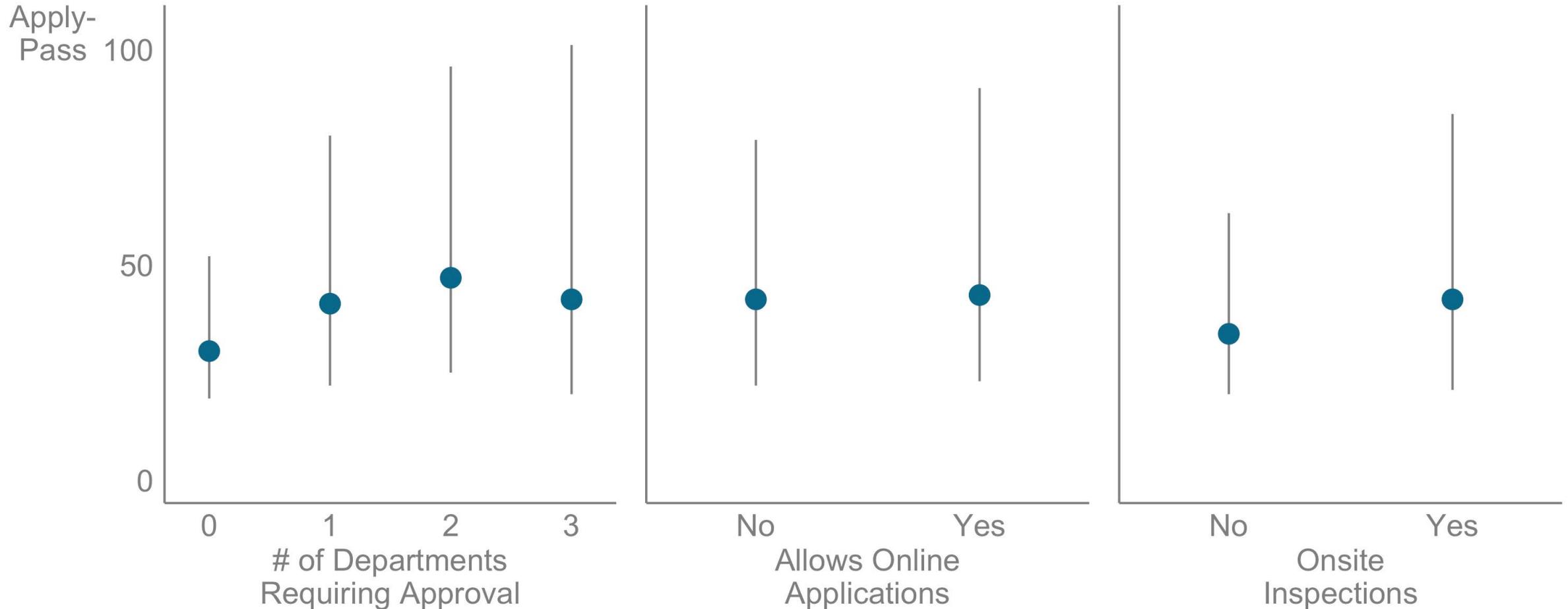
Side Analysis: SolSmart-Designated AHJs

- There are 81 SolSmart-designated AHJs in the BuildZoom analysis data set.
- Issue-pass durations are about 7 days shorter, at the median, in gold-designated AHJs than in undesignated AHJs.



Issue-pass durations by SolSmart designation

Side Analysis: AHJ Permitting Policies



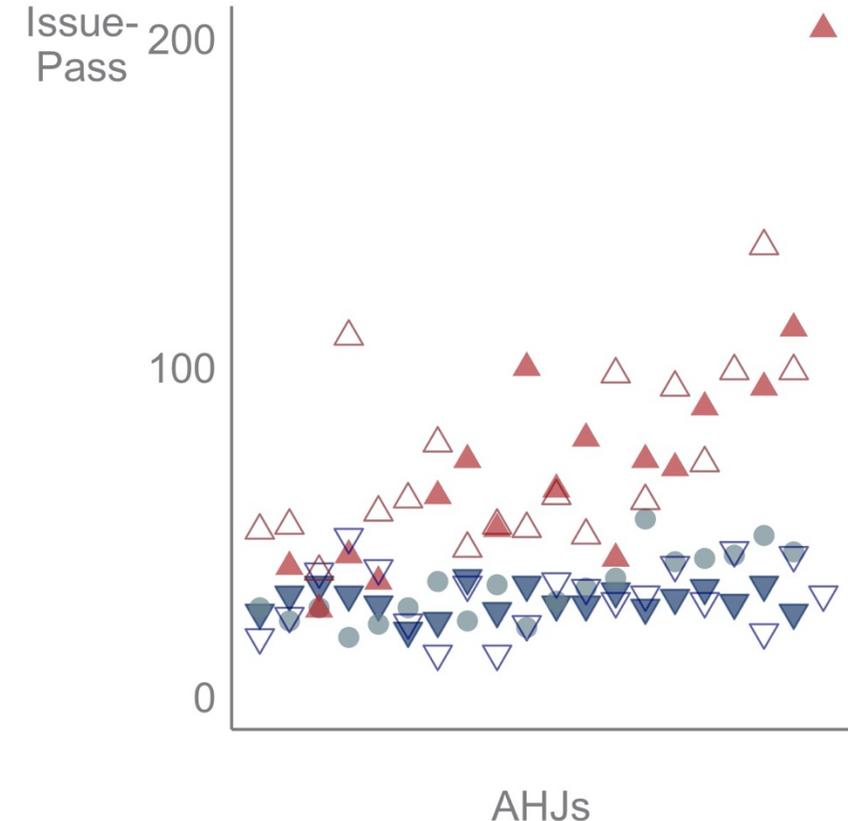
Apply-pass duration distributions by: left – number of departments requiring an approval; center – whether AHJs allow online applications; right – whether AHJs require onsite inspections

* Based on records with application dates in 2016-2018.

Permit Durations by Installer

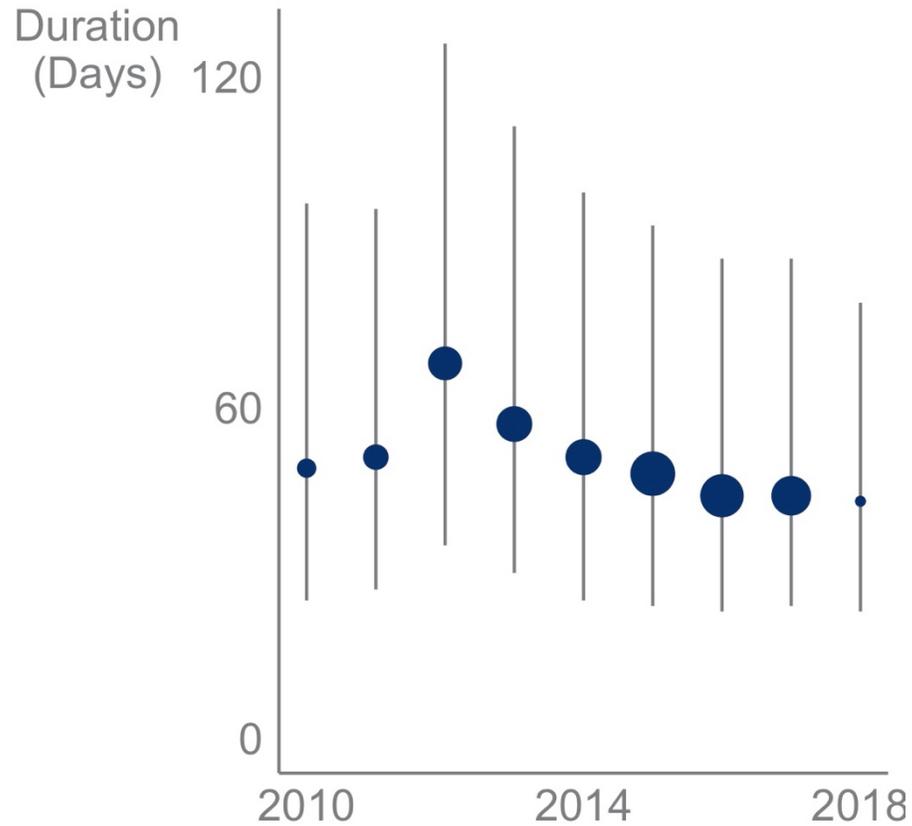
The data show that installers influence variation in permit durations in two ways:

1. Some installers are associated with consistently shorter/longer durations than others.
2. Some installers are associated with shorter/longer durations in different AHJs.

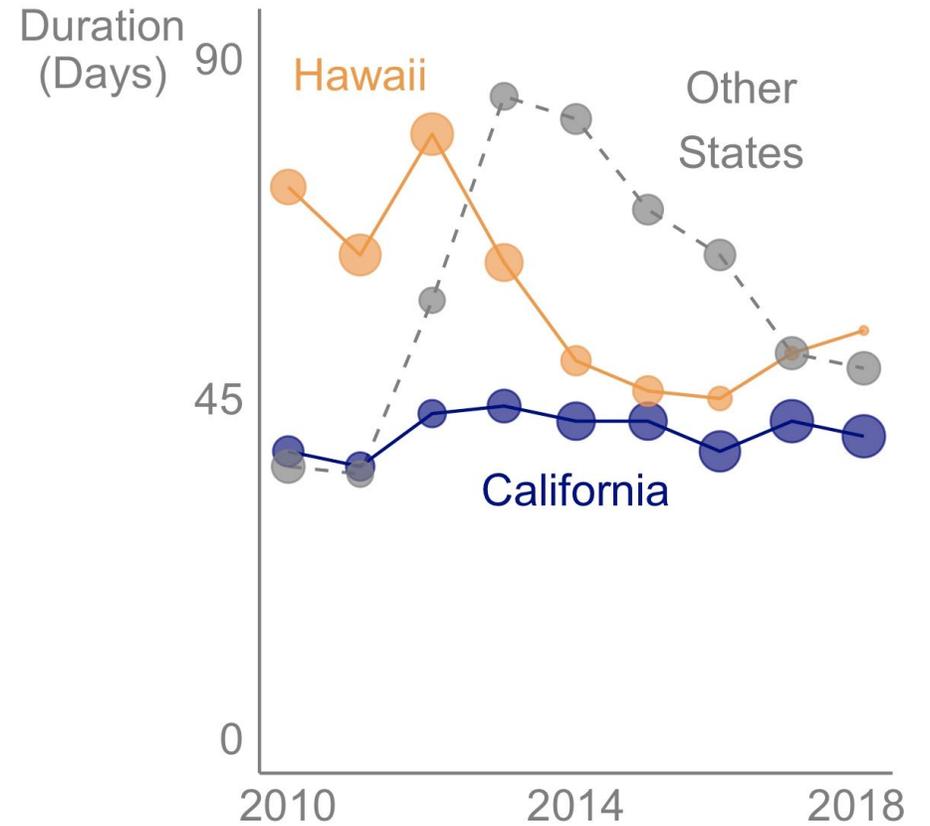


Median issue-pass durations for 5 installers in 20 California AHJs
Each marker represents an installer. See further description and interpretation of this plot in the Supplementary Slides.

Permit Durations Over Time



Permit durations by year



Permit durations by year broken out by key states

Point sizes represent sample sizes. Years based on application dates.



4. Duration Analysis

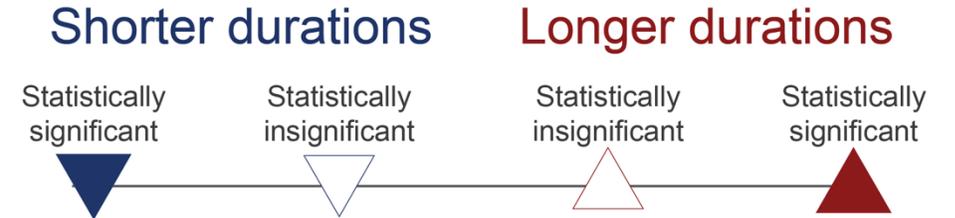


Duration Analysis Model

- To more rigorously test the drivers of variation in permit durations, we estimate the effects of different factors on permit durations through an accelerated failure time (AFT) model, a special type of duration analysis model.
- See full article or supplementary slides for methodological details.

Results

	Apply- Issue	Issue- Pass	Apply- Pass
AHJ experience	▲	▼	▼
AHJ volume	▽	△	△
Installer experience	▼	△	△
SolSmart	▼	△	▽
Electrical permit	▽	▽	▽
Roofing permit	▽	▼	▽
Other permits	△	▽	▽
Housing age	▲	▽	▼



Numerical results available in the article and in the supplementary slides



5. Conclusion



Conclusions

- **Variation:** The durations of the rooftop PV permitting processes vary significantly across authorities having jurisdiction (AHJs) and installers.
- **Reductions:** Permit durations have declined since 2012, however the data suggest that PV permitting processes *could* be reduced further.
- **AHJs:** The data suggest that some AHJs process permits more quickly than others through experience and policies.
- **Installers:** Installers play a key role in the permitting process. Any further reductions or efforts to reduce duration variation would likely require policy levers that engage both AHJs and installers.

What Factors Affect Permit Durations?

AHJ
experience

Installer
experience

AHJ
streamlining
policies

Number of
approvals

Online
processes

Housing
characteristics

Implications

- Inconsistent permitting requirements pose a barrier to PV deployment.
- Permit durations have declined over time, but still *could* be shorter.
 - 10th percentile of shortest durations for AHJs & installers are ~50% less than median
- The impact of AHJ practices is somewhat constrained given the key role of installers during the issue-pass phase.
- Future research could explore potential policy levers that optimizes the roles of AHJs *and* installers in the PV permitting process.

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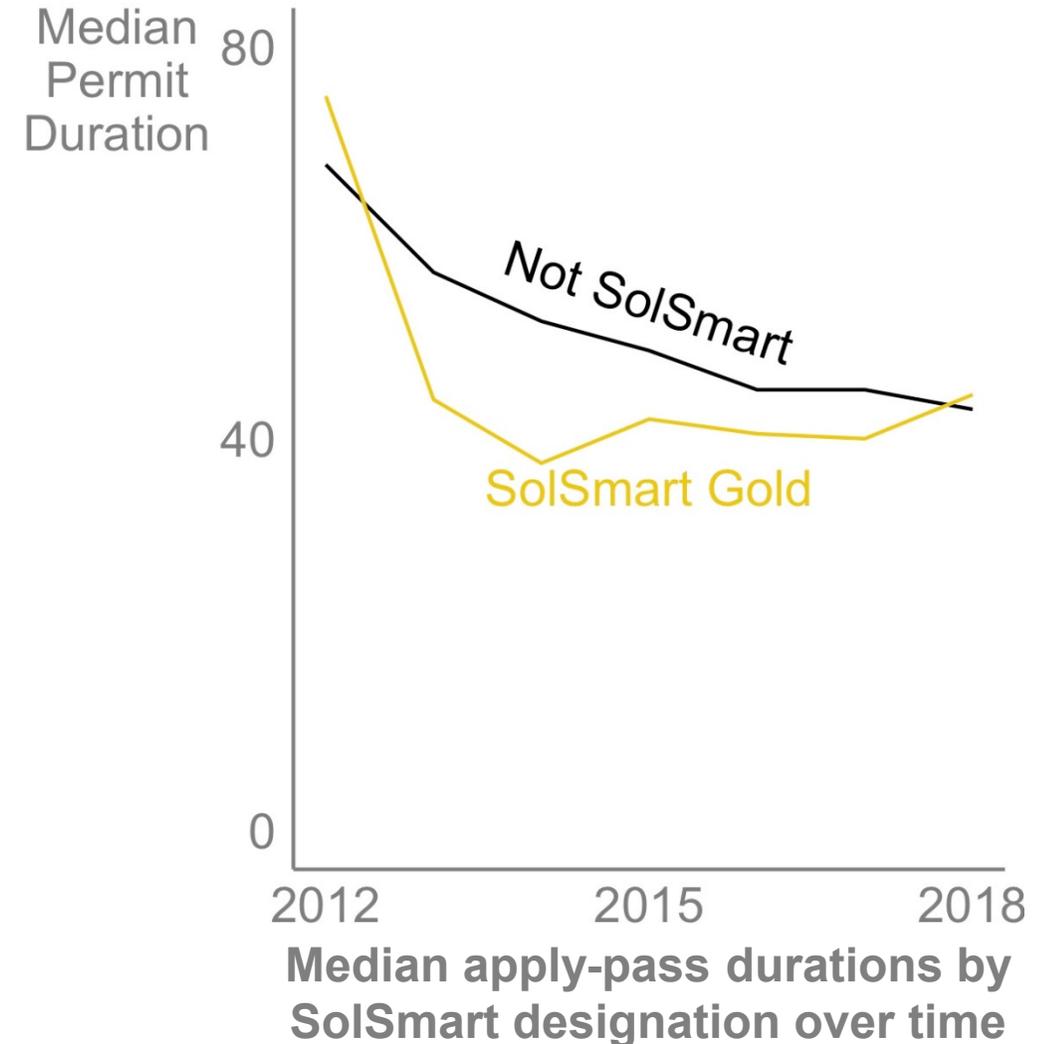


Supplementary Slides



Side Analysis: SolSmart-Designated AHJs (continued from slide 17)

- The data suggest that SolSmart-designated AHJs were associated with shorter permit durations several years prior to the SolSmart program (which began in 2016).
- Permit durations declined significantly in gold-designated AHJs from 2012 to 2014. These results suggest that SolSmart AHJs were early implementers of practices that reduced permit durations. Permit durations in gold-designated AHJs have remained stable since 2014.



Other Policies (continued from slide 18)

The installer datasets provide some interesting results in terms of which policies affect permit durations but also in terms of which policies apparently do *not* affect durations.

AC Disconnect

55% of AHJs require systems to be installed with an AC disconnect safety device. Median apply-pass durations are 8 days longer in AHJs with AC disconnect requirements, though this added time may reflect other safety requirements in these AHJs.

Onsite Inspections

83% of AHJs require an onsite system inspection. The data suggest that requirements for onsite inspections do not result in longer durations. Indeed, median apply-pass durations are 5 days shorter in AHJs with such requirements.

Policy appears to affect durations

Policy does not appear to affect durations

Inspection Windows

30% of AHJs provide an inspection window of 2 hours or less, while about 57% of AHJs provide an inspection window of 4 hours or more. The data suggest that inspection windows do not affect permit durations.

Panel Upgrades

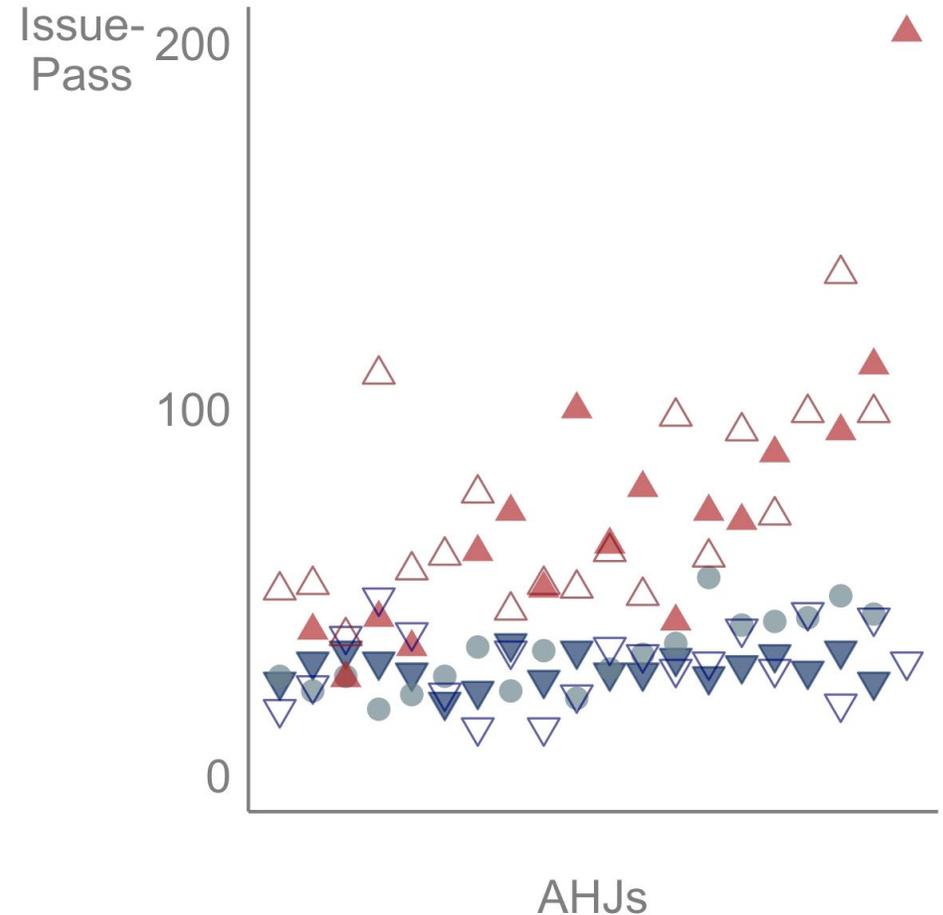
Some homes need an electrical panel upgrade before interconnecting a PV system. 85% of AHJs allow home electrical panel upgrades to be permitted separately from the PV permit. The survey data suggest that policies on panel upgrades have no effect on permit durations.

Home Access

71% of AHJs require that homeowners allow inspectors to access the home during inspections. Median apply-pass durations are 1 day longer in AHJs that require inspections with home access than in AHJs that require inspections without home access.

Permit Durations by Installer (continued from Slide 19)

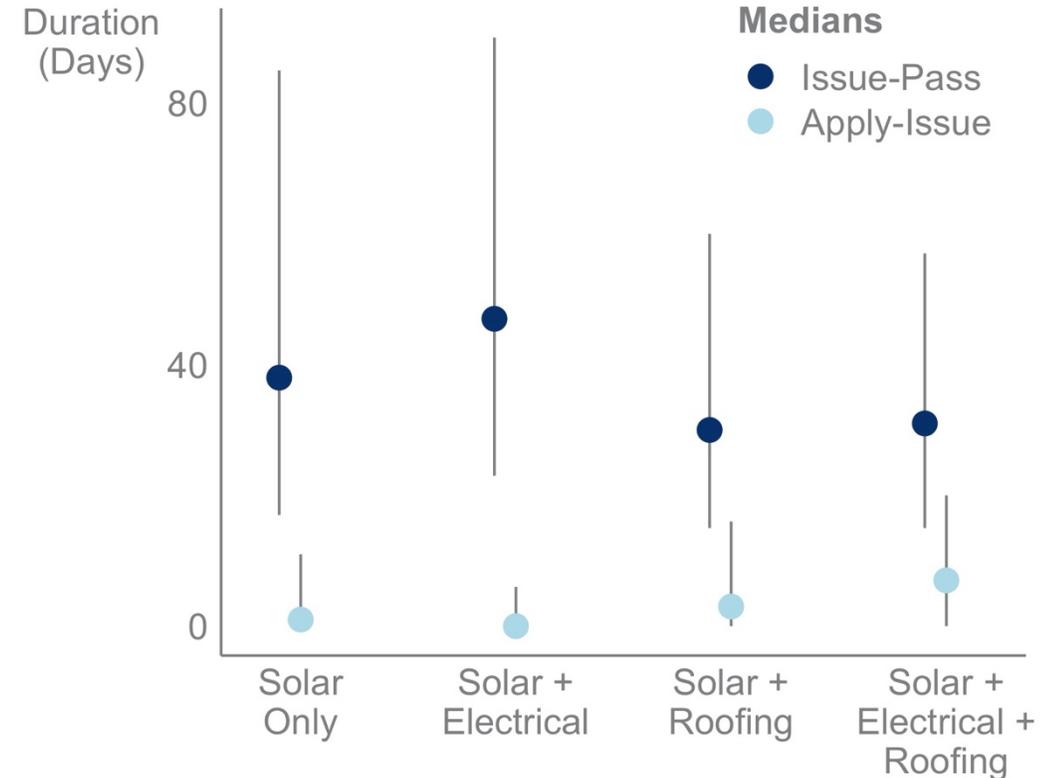
- The plot on slide 19 depicts median issue-pass durations for 5 installers (represented by different markers) in 20 California AHJs. The AHJs represent the California AHJs with the most records in the data. The markers represent the 5 installers with the most records in those AHJs.
- Consistent differences across the markers represent consistent differences in permit durations across installers, e.g., between the upward red triangles and the downward blue triangles.
- Differences within the markers across the AHJs represent differences in durations for the same installers when installing in different AHJs. For instance, the red triangle installer exhibits significantly different durations in different AHJs, whereas the blue triangle installers exhibit relatively constant durations across AHJs.



Issue-pass durations by 5 installers in 20 California AHJs

Permit Durations based on Job Characteristics

- A solar permit is a building permit allowing some electrical work for system interconnection. Some records comprise additional permit classifications (e.g., electrical, roofing). These permit classifications may serve as a proxy for job complexity. For instance, the presence of an electrical permit in a record may indicate that a main panel needed to be upgraded, or the presence of a roofing permit may indicate a job involving re-roofing.
- The data show that the median issue-pass duration of records with electrical permits is 11 days longer than records without electrical permits.
- The entire effect of electrical permits occurs during the issue-pass phase, suggesting that jobs that require electrical permits either take longer to install or require additional inspections that lengthen the issue-pass process.
- The presence of roofing permits has no discernible effect on permit durations.



Permit durations based on permit types

Duration Analysis Methodological Details (slide 22)

- We test the effects of various factors on permit durations through a duration analysis model:

$$\log t_{ij} = \alpha + AHJ_j\beta_1 + job_{ij}\beta_2 + AHJ + INST + QTR + \varepsilon$$

- Where:

- $\log t_{ij}$ is the logged permit duration (days) for record i in AHJ j
- AHJ_j is a vector of AHJ-level variables: *AHJ experience* – the cumulative number of permits processed by AHJ j at the time of record i ; *Volume* - The number of permit applications received by AHJ j in the same quarter in which application i was received relative to the same quarter in the prior year; *Installer cumulative experience* – the cumulative number of permits associated with system i 's installer in AHJ j ; *SolSmart* – Dummy variable for whether AHJ j is SolSmart designated.
- job_{ij} is a vector of job-level variables: *Electrical* – Dummy variable for whether record i had an electrical permit; *Roofing* – Dummy variable for whether record i had a roofing permit; *Other* – Dummy variable for whether record i had another permit other than solar, roofing, or electrical; *Housing Age* - Percentage of the housing stock in record i 's zip code that was built before 2000, based on U.S. Census data.
- The coefficients β are the estimated effects of the factors on permit durations
- AHJ is an AHJ-level fixed effect
- $INST$ is an installer fixed effect
- QTR is a quarter fixed effect
- The model is an accelerated failure time model (AFT) model. AFT models do not require any assumptions on the baseline probability that a process ends in any given time period. AFT coefficients may be biased by unobserved variables that influence the process duration. However, it can be shown that AFT models provide robust evidence of the sign and significance of the estimated effects.

Duration Analysis Numerical Results (slide 23)

	Y=log(apply-issue)	Y=log(issue-pass)	Y=log(apply-pass)
AHJ experience (x1000)	0.04*	-0.02*	-0.02*
Volume (x1000)	-0.00	0.02	0.007
Installer experience (x100)	-0.02*	0.003	0.001
SolSmart	-0.29*	0.04	-0.008
Electrical	-0.06	-0.02	-0.01
Roofing	-0.02	-0.09*	-0.06
Other permits	0.13	-0.04	-0.02
Housing age	0.002*	-0.002	-0.002*
AHJ FE	X	X	X
Installer FE	X	X	X
Quarter FE	X	X	X

What Factors Affect Permit Durations? (continued from slide 26)

The data provide some support for the following hypotheses to explain permit duration variation:

- Permit durations decline as AHJs and installers accumulate more experience (learning by doing).
- AHJs with policies to expedite permits (e.g., SolSmart designated, online applications) process permits more quickly; these effects may have greater impact during the apply-issue phase than during the issue-pass phase.
- Permit durations are longer in AHJs that require approvals from more departments.
- Online processes may expedite the apply-issue process.
- Housing characteristics (e.g., age) may affect the permitting process.