A State-Level Comparison of Processes and Timelines for Distributed Photovoltaic Interconnection in the United States

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National Renewable Energy Laboratory

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Acronyms and Abbreviations

AHJ	Authority having jurisdiction
APS	Arizona Public Service
CPUC	California Public Utilities Commission
DGIC	Distributed Generation Interconnection Collaborative
FERC	Federal Energy Regulatory Commission
IOU	Investor-owned utility
IREC	Interstate Renewable Energy Council
PG&E	Pacific Gas & Electric
PTO	Permission to operate
PV	Photovoltaic
SEPA	Solar Electric Power Association
SGIP	Small Generators Interconnection Procedures

Executive Summary

This report presents results from an analysis of distributed photovoltaic (PV) interconnection and deployment processes in the United States. Using data from more than 30,000 residential (up to 10 kilowatts) and small commercial (10–50 kilowatts) PV systems installed from 2012 to 2014, we assess the range in project completion timelines nationally (across 87 utilities in 16 states) and in five states with active solar markets (Arizona, California, New Jersey, New York, and Colorado). We evaluate the number of business days required for:

1. Applying for and receiving utility interconnection review and approval
2. Constructing the PV system
3. Passing a final local jurisdiction building permit inspection and submitting paperwork for permission to operate (PTO, the final authorization for system operation) to the utility
4. Receiving PTO from the utility.

We also assess the portion of projects that required 20 business days (approximately 1 month) or more for either the utility interconnection application review and approval or PTO process. The threshold of 20 business days may indicate a project or process delay, because interconnection timeframe requirements typically mandate that each application and PTO process be completed within 15–20 business days (unless that application requires supplemental review or a detailed impact study).

Finally—for California, New Jersey, New York, and Colorado—we compare actual timelines to state-level timeframe requirements for utility interconnection application review and approval and PTO. All projects sampled meet the system-size eligibility criteria for simplified or fast-track review in these states. However, we cannot determine from the data whether a PV system received utility approval for simplified or fast-track processing, thus precluding an assessment of which projects required detailed study. Owing to the large range in data values, we report the median number of business days throughout. Our key findings include the following:

- Total Days for Utility Interconnection: Across all system sizes analyzed, the median timeline for the full PV interconnection process is 53 days, from the date a PV installer submits an interconnection application to the utility to the date the installer receives the utility's PTO. For the residential sample of U.S. projects (up to 10 kilowatts (kW), the median number of total days is 52. Generally, larger projects require additional time for utility studies and approvals as well as more time for construction. This is reflected in our data, which show a median period of 62 total days for small commercial installations (10–50 kW).

- Utility Interconnection Application Review and Approval: Application review and approval required the most time of any single process examined in this analysis: a median of 18 days for the full sample. Approximately 44% of residential and 50% of small commercial projects sampled took 20 days or more. For this subset of installations, the median number of days to complete the application process was 38 days for the residential sector and 39 days for the small commercial sector.[1] This indicates that projects fall into one of two categories: (a) projects that move through the process well below the typical regulated timeframes (10–15 business days), or (b) projects with significant delays (i.e., delays were typically 2–3 weeks beyond the requirement).

- PV Construction: For the residential and small commercial samples, the median number of PV construction days was 2 and 4, respectively. These numbers are in line with reasonable expectations for onsite completion of an installation. Intuitively, longer installation times for small commercial systems make sense because installation labor requirements generally increase with increasing system size (although not linearly) and electrical system complexity.
- Final Building Inspection and PTO Paperwork Submittal to Utility: The median number of days to complete the final local jurisdiction building inspection for projects in our sample was 4 days. This process includes the physical inspection of the completed PV installation for compliance with all building and fire codes in the jurisdiction (typically 1 day or a fraction of 1 day) as well as the time required for the PV installer to schedule and arrange the inspection and send all paperwork for final authorization to the utility. This result indicates that the final building inspection and paperwork submittal process is not a major bottleneck for systems up to 50 kW.
- Utility PTO (final authorization for system operation): For the residential sample, the median number of PTO days was 10. Median PTO days were slightly higher for small commercial projects, at 12 days. Approximately 17% of residential and 25% of small commercial projects sampled took 20 days or more. For this subset of installations, the median number of days to complete the final authorization process was 28 days for the residential sector and 29 days for the small commercial sector.
- State-Level Findings: Our state-by-state analysis indicates that more stringent regulations limiting the timeframe for utility application review and approval and PTO may reduce project length significantly. The potential impact of more stringent regulations is illustrated by New York, where the median process times for these two steps are roughly 40%–50% below the national level. This same analysis, however, also suggests that such regulations do not limit process timeframes for all installations to the targets specified. Even when limiting the analysis to project sizes eligible for simplified or fast-track review, we find that interconnection process delays are common and can range from days to several weeks.

[1] Any stated difference between samples (e.g., "the typical process timeframe for residential systems is longer/shorter than for small commercial systems") assumes a significant difference in means (*p-value* >0.05) based on a paired t-test. Test statistics for differences in means can be found in Appendix C.

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1 Introduction

In the United States, installing a photovoltaic (PV) system and connecting it to the utility grid requires multiple approval and process steps spanning the local permitting jurisdiction, installer, and utility. Generally, a PV installer must obtain a building and electrical construction permit from the local jurisdiction in addition to an interconnection agreement from the utility (Figure 1). While the level of coordination between these parallel approval processes varies, local jurisdiction building permitting is separate from the utility interconnection process. In this report, we focus on the utility interconnection process, PV construction, and final building permitting inspection which consists of four distinct steps (Figure 2):

1. Applying for and receiving utility interconnection review and approval
2. Constructing the PV system
3. Passing a final local jurisdiction building permit inspection and submitting paperwork for permission to operate (PTO, the final authorization for system operation) to the utility
4. Receiving PTO from the utility.

We do not examine the timeline for receiving approval for PV construction, which is a stage of the local jurisdiction building permitting process that is often applied for concurrently with utility interconnection and early in PV project development. Figure 1 depicts this stage in gray.

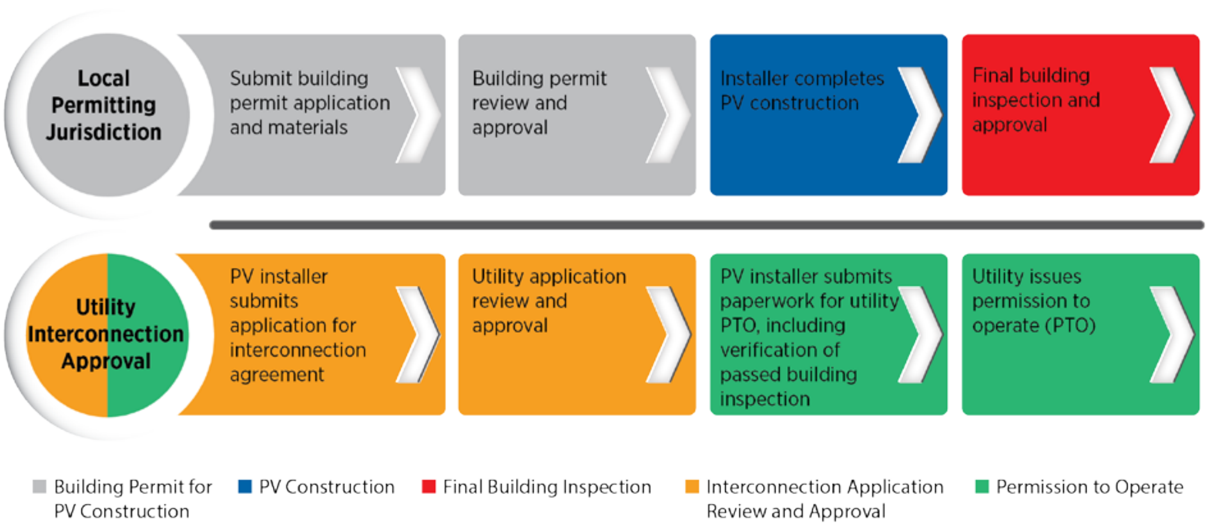

Figure 1. Process for PV building permitting and utility interconnection

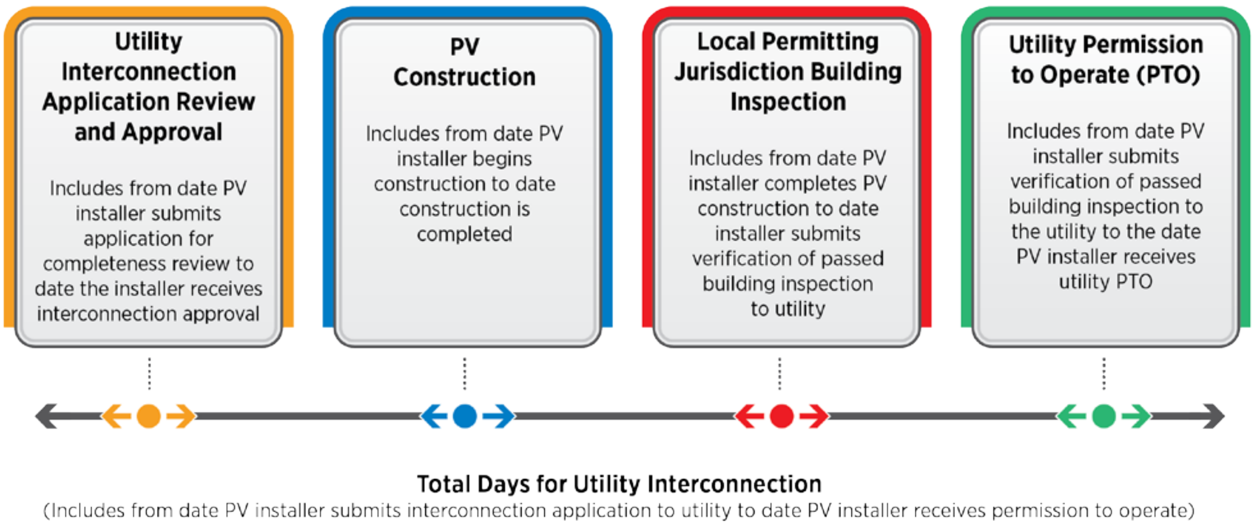

Figure 2. Timeline analysis metrics based on process for PV building permitting and utility interconnection

With more than 190 investor-owned utilities (IOUs), 2,000 publically owned utilities, and 870 cooperatives in the United States (APPA 2014), PV developers encounter wide variation in interconnection fees and requirements, which can increase the time and cost of project completion. The lack of standardization in building permitting and inspection processes across more than 18,000 authorities having jurisdiction (AHJ) can further slow PV deployment. Though a growing number[2] of states have adopted standard interconnection procedures, these procedures typically only apply to IOUs[3] and differ among states in terms of fees and requirements, such as the use of standard form agreements, capacity limits, specified timelines, insurance requirements, and other key considerations (DSIRE 2014).

For interconnection, most state and federal engineering and safety requirements are based on IEEE 1547 and UL 1741, but there is no equivalent set of requirements for consistent interconnection processes across states and utilities (DSIRE 2014). However, some efforts toward implementation of standard process requirements are being made. In May 2005, the Federal Energy Regulatory Commission (FERC) enacted the *pro forma* Small Generator Interconnection Procedures (SGIP) to standardize the interconnection process for projects up to 20 megawatts (MW). The FERC SGIP applies only to facilities subject to FERC jurisdiction, but it is increasingly being used as a model for state interconnection standards and includes provisions for three levels of interconnection[4]: (1) a simplified review for certified inverter-based

[2] As of July 2014, "More than 30 states plus D.C. and Puerto Rico have adopted comprehensive interconnection standards that apply to customer-sited systems (both large and small), regardless of whether the system is net-metered" (DSIRE 2014).
[3] In certain states, such as Colorado, interconnection requirements apply to publically owned utilities as well. Specifically, Colorado's interconnection procedures apply to IOUs with 40,000 or more customers, all electrical cooperatives, and municipal utilities with 5,000 or more customers.
[4] States that have adopted SGIP's three levels of review include, but are not limited to Colorado, Connecticut, Florida, Indiana, Maine, Michigan, Oregon, New Jersey, New Mexico, New York, North Carolina, Ohio, Utah, and Virginia (DSIRE 2014).

systems of less than 10 kW, (2) a “Fast Track Process” for eligible generators, and (3) a “Study Process” for all other systems of 20 MW or less (FERC 2005). On November 22, 2013, FERC issued a final rule that made numerous amendments to SGIP, including expanding fast track eligibility[5] and adding three technical screens to the supplemental review process. These amendments were made, in part, to respond to an increased volume of small generator interconnection requests while ensuring the safety and reliability of the electric grid (Coddington et al. 2012a).

Meanwhile, the number of distributed PV installations is growing rapidly in the United States, with approximately 2,000 MW installed in 2013—more than triple the annual capacity installed in 2010 (Klemun 2013). Residential and non-residential distributed installations are projected to exhibit the strongest growth through 2017 (Klemun 2013), resulting in an ever-increasing volume of applications for PV systems to be grid-connected behind the meter. However, longer completion times for the distributed-PV interconnection process can increase costs borne by local permitting authorities, PV developers, and electric utilities. Thus, a detailed understanding of the time required for interconnection and project completion can facilitate planning for the anticipated increase in grid-connected, distributed PV systems.

This report examines the timeframes for completing various steps in the PV interconnection process. Section 2 reviews the existing literature on interconnection processes and costs. Section 3 describes our data, metrics, and methods. Section 4 provides detailed results of the analysis. Section 5 summarizes the results, draws conclusions, and outlines areas for potential future work.

2 Literature Review

To date, research on distributed PV interconnection has largely focused on technical and procedural aspects, including potential grid impacts of distributed generation, mitigation measures, and model interconnection procedures (CCSE 2013, Coddington et al. 2012a, IREC 2013a, Coddington et al. 2012b). The Solar Electric Power Association (SEPA) recently completed a survey with responses from 64 utilities that identified differences in utility interconnection processes. The SEPA study finds that utilities confront common challenges as they move toward more streamlined interconnection application processing, including keeping customers up-to-date on application status (status transparency), ensuring application accuracy and completeness, communicating with customers, and reporting (Makhyoun et al. 2014). In addition, Tweedie and Doris (2011) identify key differences between the interconnection processes in California and Germany, while the Interstate Renewable Energy Council (IREC) uses a case study approach to identify areas for improved coordination between the PV processes for utility interconnection, local permitting, and incentive applications (IREC 2013b). Meanwhile, a small body of work has addressed the cost of interconnection directly (Sena et al. 2014, Navigant Consulting 2013). Finally, the National Renewable Energy Laboratory has produced several reports analyzing PV non-hardware balance-of -system (“soft”) costs, including the average labor hours required to complete the permitting, inspection, and interconnection process (Ardani et al. 2013, Friedman et al. 2013, Ardani et al. 2012).While these studies

[5] The Fast Track process eligibility criteria for inverter-based facilities was increased from 2 MW to 5 MW, assuming the proposed point of interconnection is on a line with voltage between 30 and 69 kV.

identify the interconnection process as a challenging aspect of project development and an important area for future research, they do not provide a data-driven, system-level examination of interconnection timelines across U.S. states. Our present analysis fills this gap in the literature by quantifying interconnection timelines for residential and small commercial PV systems installed across the United States between 2012 and 2014.

3 Data, Metrics, and Methods

We collected data for more than 30,000 distributed PV systems installed between 2012 and 2014 across 87 utilities in 16 states. The data were primarily sourced from the internal project tracking systems of high-volume PV installers. We also collected supplemental data via in-depth interviews with members of the Distributed Generation Interconnection Collaborative (DGIC),[6] including nine utilities and 14 PV industry experts (developers and installers, representatives of public utilities commissions, and researchers).

To evaluate PV interconnection timelines, we used system-level data that recorded the number of business days required to complete the following processes: (a) applying for and receiving utility interconnection review and approval, (b) constructing the PV system, (c) passing a final local jurisdiction building permit inspection and submitting paperwork for PTO to the utility, and (d) receiving PTO from the utility, as well as (e) the complete utility interconnection process from start to finish (Figure 2).

These metrics are defined as follows:

- **(a) Utility Interconnection Application Review and Approval**: The number of business days from the date a PV installer submits an interconnection application to the utility to the date the installer receives interconnection approval and/or a formal interconnection agreement, whichever comes sooner.[7] This timeframe combines utility reviews for application completeness and compliance with technical requirements,[8] each of which have separate state-level timeframe mandates, where enacted.
- **(b) PV Construction:** The number of business days from the date a PV installer begins construction to the date when construction is complete, including all racking, mounting, electrical work, and installation of other balance-of-system components. At this stage, the PV system has building approval from the local permitting jurisdiction (not examined in this analysis), but it has not yet received the utility's PTO.
- **(c) Final Building Permit Inspection and Paperwork Submittal to Utility**: The number of business days from the date a PV installer completes construction to the date the installer submits final paperwork for PTO to the utility. This timeframe

[6] The DGIC is a stakeholder consortium of more than 100 members focused on identifying replicable innovation for the interconnection process. For more information see http://www.nrel.gov/tech_deployment/dgic.html.
[7] In some cases, the utility may notify the applicant of interconnection approval prior to issuing a formal interconnection agreement.
[8] Depending on the specific utility process, PV system size, and complexity of proposed interconnection, utility review for compliance with technical requirements includes initial review screens and then any required supplemental review and detailed study.

typically includes the PV installer scheduling any required local jurisdiction building inspections, undergoing the inspections, and submitting all final paperwork for the utility's PTO, such as verification of passed AHJ building inspection. This AHJ permitting inspection is separate from any utility-required inspections.

(d) **Utility PTO**: The number of business days from the date a PV installer submits all final paperwork to the utility to the date the installer receives final utility authorization for system operation. Final paperwork typically includes documentation that the completed installation has passed the local jurisdiction building permit inspection, but it may also include the interconnection application in utility territories that allow the PV installer to submit the application and PTO paperwork together following construction and inspection (see Section 4.2 for additional discussion of this process).

(e) **Total Days for Utility Interconnection**: The number of business days from the date a PV installer submits an interconnection application to the utility to the date the installer receives the utility's PTO. This period was only calculated for systems for which the installer submitted an application for interconnection separately from the final paperwork for PTO. Note that, because there may be additional process steps or overlap in the process steps included here, the total days do not necessarily equal the sum of the four individual project timeframe components examined in this analysis.

To present results, we segment our full U.S. sample into two PV system-size categories: residential (up to 10 kW) and small commercial (10 to 50 kW). Data for system sizes larger than 50 kW are much more limited, reducing the ability to draw robust conclusions; statistics for these larger systems are included in Appendix A. We compare the full U.S. sample to individual samples for five states with active solar markets: Arizona, California, New Jersey, New York, and Colorado. First, we provide results for the total number of days for the utility interconnection process. Then we present results for each discrete deployment stage in general sequential order. Specifically, we plot the ranges of days required for each stage using box-and-whiskers diagrams, where the box represents the interquartile range (between the 25th and 75th percentiles), the line within the box represents the median, and the whiskers represent the maximum and minimum values, excluding extreme outliers.

For each of the two utility-specific authorizations analyzed in this report, interconnection application review and approval and PTO, we assess the portion of projects that required 20 business days (approximately 1 month) or more. The threshold of 20 business days may indicate a project or process delay, because interconnection timeframe requirements typically mandate that each application and PTO process be completed within 15–20 business days (unless that application requires supplemental review or a detailed impact study). For Arizona, we compare the timeframes for utility approvals against the assumed threshold of 20 business days, because the state has no timeframe mandates for PV interconnection in place. Then—for California, New Jersey, New York, and Colorado—we compare actual timelines to state-level timeframe requirements. All projects sampled meet the system-size eligibility criteria for simplified or fast-track review in these states. However, we cannot conclude from the data whether a system received utility authorization for simplified or fast-track processing, thus precluding an assessment of which projects required detailed study.

For total days and the stage of final building permit inspection and paperwork submittal to the utility, we exclude PV systems for installers who indicated that the timelines for those particular systems were altered or extended because of arranging and finalizing financing. Owing to the exclusion of these projects and variation in system-level tracking across data providers, the amount of data differs by stage in various states. Given the large range in the data, we report median values for business days throughout.

4 Results

The following subsections present results for the total days required for the utility interconnection process as well as the time required for each stage in the process. Each shows results for our full U.S. sample and our five specific states of interest. Unless otherwise noted, any stated difference between samples (e.g. "the typical process timeframe for residential systems is longer/shorter than small commercial systems") assumes a significant difference in means with a p-value >0.05 based on a paired t-test. Test statistics for differences in means can be found in Appendix C.

4.1 Total Days for Utility Interconnection

For the residential sample of U.S. projects (up to 10 kW), the median number of total days from interconnection application submittal to utility PTO is 52 (Table 1). Generally, larger projects require additional time for utility studies and approvals as well as more time for construction. This is reflected in our data, which show a median period of 62 total days for small commercial installations (10–50 kW). Across all system sizes, the median is 53 total days.[9] Of the five states examined, California projects demonstrate the lowest median number of total days (50), followed by Arizona with 54, Colorado with 63, New York with 68, and New Jersey with 90 (Figure 3).

Table 1. Total Days for Utility Interconnection for Full U.S. Sample, by Project Size

System Size	Mean	Median	Std. Dev	Sample Size
Residential (up to 10 kW)	60	52	39	7,489
Small Commercial (10–50 kW)	74	62	44	740
Full Sample (up to 50 kW)	63	53	41	8,229

[9] For the full U.S. sample, the contribution of California PV systems is disproportionately large relative to the U.S. market. For example, in the first half of 2014, California accounted for 259,136 of the 488,353 total residential PV installations completed in the United States (53%) and 12,487 of the 41,803 total commercial PV installations (29%) (Greentech Media Research 2014).

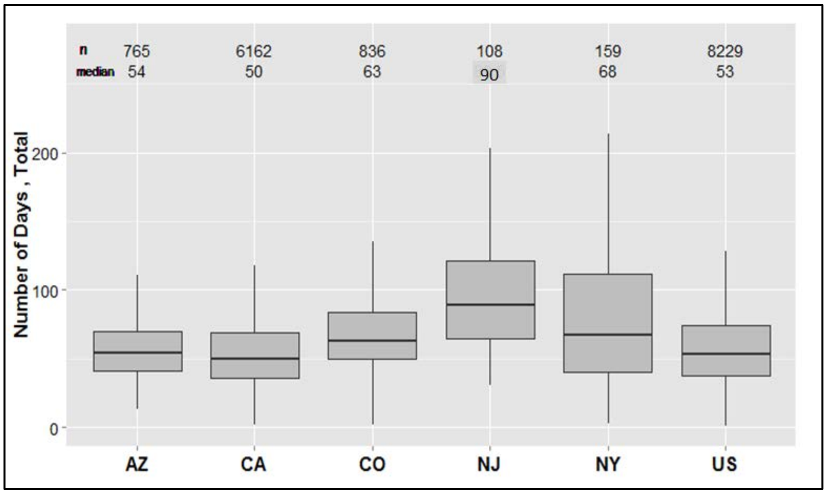

Figure 3. Total days for utility interconnection for five states and full U.S. sample (up to 50 kW)

4.2 Application Review and Approval

For states with interconnection application timeframe requirements in place, provisions vary across states and by system size. However, in states that follow FERC's SGIP, utilities must notify the applicant whether or not the application is complete within 10 business days of receiving the application. Then, for complete applications, utilities have an additional 15 business days to conduct any initial review screens (fast-track screens). If, following initial review, the utility determines that supplemental review is required, supplemental review must be completed within 20 business days. Lastly, detailed impact studies are to be completed in less than 120 calendar days.

Interviewees indicated that detailed studies are most common for PV projects of 1 MW and larger; because of the PV size range analyzed in this report (up to 50 kW), it is unlikely that a high percentage of projects sampled required detailed study. Interviewees also indicated that PV installers often downsize or alter projects to avoid the detailed study process, because its long duration and high costs can render a project economically unfeasible. In light of these challenges, amendments to the FERC SGIP supplemental review process, which were included in a final rule issued in November 2013, were partly intended to decrease the frequency of detailed studies while ensuring grid safety and reliability. Although significant differences in the interconnection application process, practices, and tools exist across utilities, Figure 4 provides a simplified overview of the FERC SGIP increasingly being adopted by U.S. states.

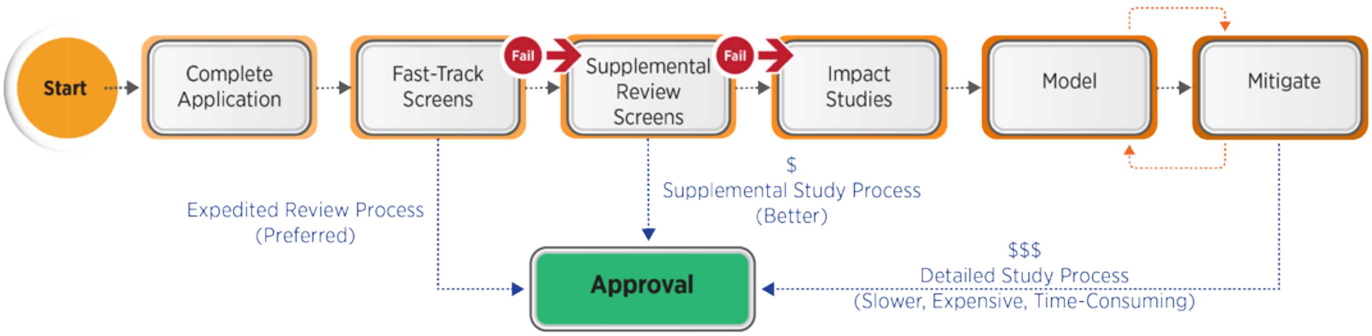

Figure 4. Overview of interconnection process used by FERC SGIP and several states, from Coddington and Mather (2014)

While utilities commonly prefer that PV installers submit an application for interconnection early in project development (i.e., prior to construction), some utilities make an exception for small PV projects. For example, in the territories of California's three largest IOUs,[10] PV installers have a utility-designated option of submitting the application for interconnection and PTO paperwork together, upon completing PV construction and passing all applicable AHJ building inspections. In doing so, these utilities essentially combine the application and PTO paperwork into a single, final step, thus streamlining the interconnection process for residential and small commercial systems that are not likely to cause an adverse grid impact. For example, more than half of the projects interconnected under Pacific Gas and Electric's (PG&E's) standard net energy metering (NEM) program (up to 30 kW) in 2014 did so without any pre-construction utility application reviews or approvals. For projects larger than 30 kW, PG&E advises installers to complete an interconnection application before construction to identify any potential adverse impacts early on and to avoid costly, at-risk construction. For our California sample, 30% of residential and 39% of small commercial projects completed separate interconnection application and PTO paperwork, compared to more than 90% of all projects sampled in Colorado, New York, and New Jersey.

However, as grid-connected PV capacity grows, submitting applications earlier in the PV development process may become increasingly necessary even for smaller systems, to identify grid impacts resulting from higher interconnection volumes. This has been an issue in Hawaii, where PV has grown rapidly. Tension between residential PV installers and utilities has arisen when installers have built PV systems before utility application reviews, only to learn that the utility will require a detailed impact study, costing up to $25,000, prior to issuing PTO.[11]

4.2.1 Results for Full U.S. Sample

Application review and approval requires the most time of any stage analyzed in this report. The medians are 18 days for residential and 17 days for small commercial installations, but this difference is not statistically significant (Table 2). Across all system sizes, the median is 18 days.

[10] San Diego Gas and Electric, Pacific Gas and Electric, and Southern California Edison.
[11] From personal communication with interviewees.

Approximately 44% of residential and 50% of small commercial projects sampled took 20 days or more; for this subset of installations, the median time to complete the application process was 38 days for the residential sector and 39 days for the small commercial sector. While the cause of longer application approval timeframes cannot be identified from the data, they could be attributed to PV installers submitting incomplete or incorrect applications that required rework and resubmittal, lengthy utility reviews due to application backlog or internal processes, utility-required supplemental reviews or impact studies beyond initial screens, or a combination of all three. While further investigation into the cause of application approval delays is needed to inform the implementation of time-saving measures, potential solutions include clarifying and simplifying application requirements, using standard interconnection forms and paperwork across utilities, and streamlining the utility review process with electronic and automated tracking.

Table 2. Application Review and Approval Days for Full U.S. Sample, by Project Size

System Size	Mean	Median	Std. Dev	Sample Size
Residential (up to 10 kW)	27	18	33	12,462
Small Commercial (10 – 50 kW)	28	17	36	1,198
Full Sample (up to 50 kW)	27	18	33	13,660

4.2.2 Comparison of Five States

In comparing actual timelines for application review and approval to state timeframe requirements in California, Colorado, New Jersey, and New York, we consider the timeframe requirements for utility application completeness review and initial screening in each state. We do not include additional time allowances for supplemental review and detailed study, because these are highly project dependent. In addition, from our data, we cannot account for the numerous permutations of project-specific exceptions, utility-applicant interactions, and paperwork exchanges typical of review and study processes beyond initial screening. However, all projects sampled meet the system-size eligibility criteria for simplified or fast-track review in these states.

For each state, we consider the unique system-size criteria for interconnection and corresponding timeframe requirements. For example, under California's Rule 21, all projects up to 2 MW in size are eligible for fast-track processing.[12] In contrast, for systems up to 2 MW, Colorado and New Jersey both allow for two tracks based on system size and complexity: Level 1 for systems up to 10 kW and Level 2 for systems up to 2 MW (New Jersey Office of Administrative Law 2014). New York also has two procedures, but with different size thresholds: an expedited process for systems up to 50 kW and a separate process for systems up to 2 MW. For Arizona, we compare application review and approval timeframes to an ideal threshold of 20 business days (approximately 1 month), because there are no state-level requirements in place. Interconnection process flow diagrams are included in Appendix B for states with timeframe

[12] Structured after FERC's SGIP, state-level fast-track procedures typically apply to systems up to 2 MW. In a final rule issued on November 22, 2013, the system-size eligibility for SGIP's fast track application process was raised from 2 MW to 5 MW. As of October 1, 2014, the key states examined still had size thresholds of 2 MW in place.

regulations for both application review and approval and PTO (New York, New Jersey, and Colorado).

IREC and Vote Solar's annual *Freeing the Grid* report examines the differences in interconnection standards across states and awards each state a score based on the degree of consistency with FERC's SGIP (IREC 2013c). Table 3 shows the FERC SGIP interconnection timeline requirements and the corresponding *Freeing the Grid* scoring criteria. Table 4 shows the state-level application timeframe requirements and total interconnection timeline score for each of the states analyzed, except Arizona. The total maximum interconnection timeline score possible is 5. However, the highest score awarded to any state in 2013 was 4.

Table 3. FERC SGIP Interconnection Timeline Requirements with *Freeing the Grid* Scoring Criteria

Points Possible	FERC SGIP Interconnection Timeline Requirements
+1	Application completeness reviewed in up to 10 business days
+1	Initial review screens, if any, applied in up to 15 business days
+1	Supplemental review, if any, applied in up to 20 business days
+1	Timeframe for utility completion of study process is less than 120 calendar days
+1	Timeframe specified for utility to provide interconnection agreement

Table 4. State Timeframe Requirements for Application Review and Approval with *Freeing the Grid* Score

State	*Freeing the Grid* Timeframe Requirement Score *(out of 5)*	System Size Eligibility	Days for Completeness Review	Days for Application Review (initial screens)	Total Days for Application Review and Approval
CA	4	up to 2 MW	10	15	25
NY	3	up to 50 kW	5	10	15
		up to 2 MW	5	15	20
NJ	3	up to 10 kW	3	10	13
		up to 2 MW	3	15	18
CO	4	up to 10 kW	10	15	25
		up to 2 MW	10	15	30[13]
AZ	N/A. As of the writing of this report, Arizona has no standard timeframe requirements in place.				

[13] In Colorado, for systems of 10 kW to 2 MW, 30 days includes an extra 5 days for interconnection agreement execution (CCR 2014), though it is not uncommon for utilities to notify the applicant that the proposed generation has been approved in advance of an interconnection agreement being issued. In addition, 30 days assumes no supplemental review required. If required, the total days prescribed for application review and approval doubles to 60.

Of the five individual states examined, New York demonstrates the lowest median number of days for PV system application review and approval (10 days for residential and small commercial), followed by New Jersey (14 days for residential, 15 for small commercial), California (20 for residential, 23 for small commercial), Arizona (22 for residential and small commercial), and Colorado (32 for residential, 25 for small commercial) (Figures 5 and 6). The 22-day difference between a typical (median) residential project in New York and Colorado may indicate the effectiveness of state-level regulations; for systems up to 2 MW, New York utilities are required to complete application review and approval in 10 fewer days than are Colorado utilities[14] (see Table 4). However, many projects in both states exceed the prescribed timeframes, as shown in Figure 5 (for residential) and Figure 6 (for small commercial) where the state timeframe requirements are represented as red lines.

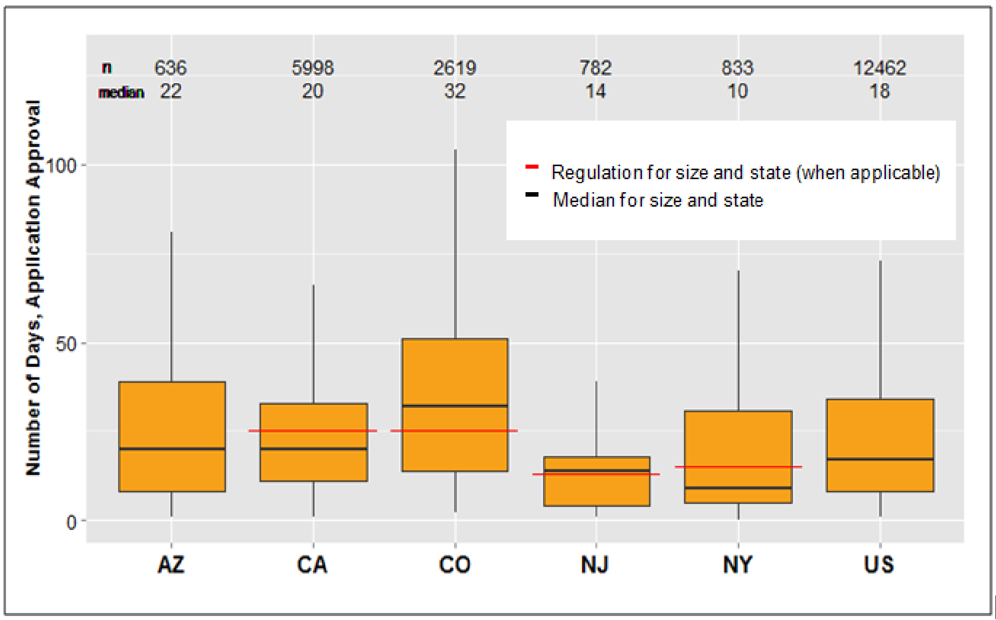

Figure 5. Application review and approval days for five states and full U.S. sample (10 kW and under)

[14] In New York, regulated utilities are allowed 15 business days for application review and approval for systems up to 50 kW, and they are allowed 20 days for systems of 50 kW to 2 MW (New York Standard Interconnection Requirements (SIR)). In Colorado, utilities are allowed 25 business days for systems up to 10 kW, and they are allowed 30 days for systems of 10 kW to 2 MW (CCR 2014).

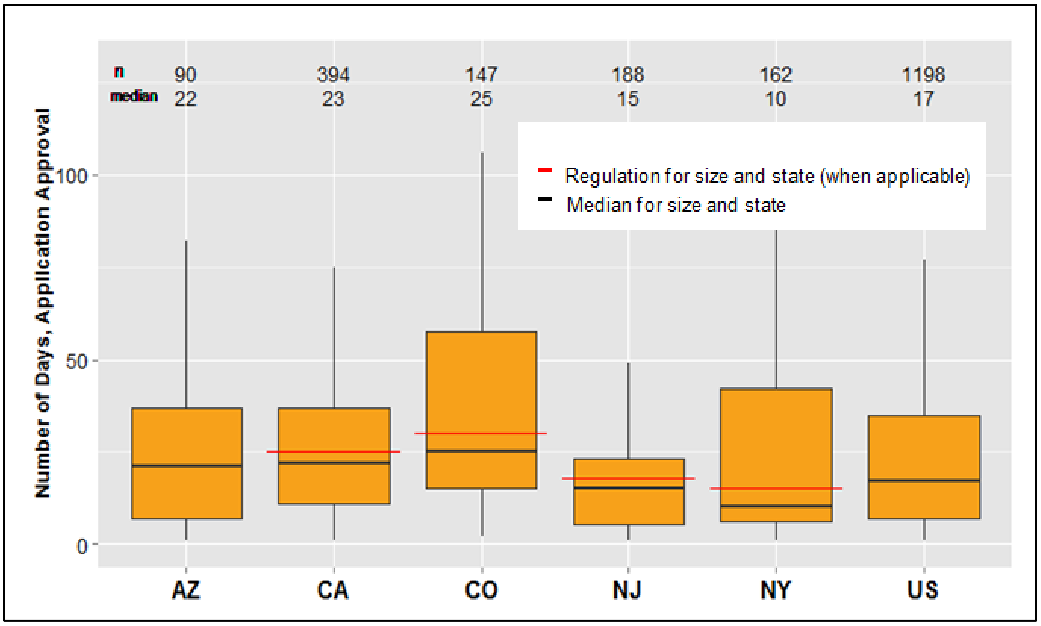

Figure 6. Application review and approval days for five states and full U.S. sample (10 to 50 kW)

Table 5 provides additional detail, giving the total time requirement for utility application completeness review and initial screens ("Time Req."), the percentage of applications that exceeded the time requirement, and the median application review and approval time for those projects that exceeded the requirement. In Colorado, 58% of residential and 45% of small commercial projects sampled exceeded the mandated timeframes of 25 days and 30 days, respectively. For this subset of installations, the median time to complete the application process was 50 days for the residential sector and 59 days for the small commercial sector. In New York, 38% of all projects sampled exceeded the prescribed timeframe of 15 days, and the median time to complete the application review and approval process for these projects was 49 days for residential and 60 days for small commercial. With the exception of California and Arizona, for projects that exceeded regulated timeframes, there are longer delays for small commercial projects compared to residential; a typical small commercial project was delayed by an additional 9–11 business days.

Table 5. PV Projects that Exceeded Application Review and Approval Time Requirement, by State and Size

	Residential (up to 10 kW)			Small Commercial (10–50 kW)		
State	Time Req. (business days)	Applications Exceeding Time Req. (%)	Median for Applications that Exceeded Time Req. (business days)	Time Req. (business days)	Applications Exceeding Time Req. (%)	Median for Applications that Exceeded Time Req. (business days)
CA	25	37%	38	25	47%	39
NY	15	38%	49	15	38%	60
NJ	13	52%	18	18	42%	27
CO	25	58%	50	30	45%	59
AZ	[20]*	53%	43	[20]*	54%	43

* 20-day threshold is assumed for analytic purposes, because Arizona has no interconnection timeframe requirements.

With respect to enforcement mechanisms for utility compliance with interconnection timeframe requirements, penalties and procedures vary across states. For example, in California, IOUs are required to submit quarterly reports of "delayed" systems to the California Public Utilities Commission (CPUC). Then, depending on the circumstances, the CPUC can levy penalties and mandate behavioral and process changes. Meanwhile, Massachusetts has taken one of the most comprehensive approaches to date. On July 31, 2014, the Massachusetts Department of Public Utilities issued Order DPU 11-75-F, approving a "Utility Timeline Enforcement Mechanism." Under this mechanism, utilities face a maximum penalty for noncompliance of twice the amount of interconnection fees collected in a year, up to a certain cap that is utility specific. The order also allows for a 5% dead band, with no penalties imposed for average processing times up to 105% of the regulated timeline, then a fixed 0.1% penalty by utility up to the maximum of 115% of the regulated timeline (DPU 2014).

4.3 Construction

Distributed PV system construction consists of positioning and attaching racking and mounting materials, installing and stringing modules, running conduit, and installing the inverter (unless the system has alternating-current modules with integral inverters). Average timeframes and cost for PV system construction have decreased in the United States due to the advent of streamlined balance-of-system components and the maturation of the solar industry workforce.

4.3.1 Results for Full U.S. Sample

For smaller residential systems (10 kW and under), installation can be completed in as little as one day (Morris et al. 2013), though construction time requirements increase with increasing system size (Goodrich et al. 2012). In our sample, the median number of construction days is 2 for residential systems and 4 for small commercial systems (Table 6). Across all system sizes, the median is 2 days.

Table 6. Construction Days for Full U.S. Sample, by Project Size

System Size	Mean	Median	Std. Dev	Sample Size
Residential (up to 10 kW)	4	2	8	24,401
Small Commercial (10–50 kW)	7	4	15	2,351
Full Sample (up to 50 kW)	4	2	9	26,752

4.3.2 Comparison of Five States

Figure 7 shows system construction days for our five states and the full U.S. sample. Variation in mean construction timeframes across the states examined is largely not statistically significant, with the exception of the differences between Arizona and California and between California and New York. These results may overestimate construction timeframes in terms of actual labor hours worked, because the level of data granularity captures the complete business cycle timeframe, from the date construction started to the date construction was completed. Half days worked and exact labor hours for construction are not captured.

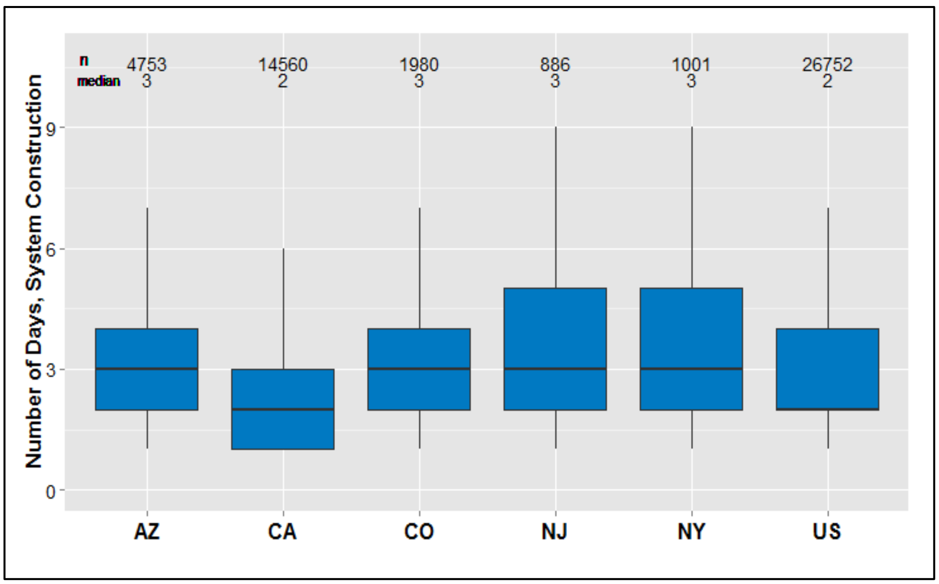

Figure 7. Construction days for five states and full U.S. sample (up to 50 kW)[15]

4.4 Final Building Inspection and Paperwork Submittal to Utility

For a PV installer to receive final interconnection authorization from the utility, it must first submit verification of passing final building inspection, which is often completed by the city, county, state, or city and county. In addition, for net-metered systems, it is common for the utility to require the AHJ to issue a meter clearance via letter, email, or fax before the utility will install and enable the meter. Building inspections are separate from any utility-required inspections or witness testing, and most AHJs require at least one inspection of the completed PV system before the permit is finalized. However, the exact number of building inspections can

[15] For the full U.S. sample, the median and 25th percentile both have values of 2 because of the relatively small spread in observations.

vary, with some AHJs preferring two inspections: a rough inspection prior to construction and a final inspection following construction. Also, in some jurisdictions, PV installers are required to complete separate building (structural), electrical, and fire inspections. It is important for the completed PV system to adhere to the original plans submitted to the local permitting authority, because alterations may require PV system changes and additional inspections.

For the purposes of this analysis, building inspection timeframes are from the date construction is completed to the date the PV installer submits all final paperwork for PTO to the utility, including verification of passed AHJ inspection. Thus, building inspection timeframes are for final inspection of fully installed PV systems and include the business days required to schedule the inspection, complete the inspection, and compile and send all the final documentation required for PTO to the utility. In some jurisdictions, the AHJ sends verification of passed building inspection directly to the utility, thereby eliminating the need for the installer to do so.

Typically, for approved systems, the actual final building inspection is completed in a single day, but the business days required for the full process from scheduling the inspection to finalizing and sending the proof of passed inspection to the utility varies. For example, inspection-related delays could occur when a customer or installer is not present for the final inspection and it must be rescheduled. This is common in states with a high percentage of seasonal residents, like Arizona, where it can be more difficult to coordinate inspection times with the homeowner, installer, and AHJ.

4.4.1 Results for Full U.S. Sample

While the median inspection timeframe for both residential and small commercial systems is 4 business days, on average, inspection takes longer for small commercial systems (Table 7).

Table 7. Building Inspection Days for Full U.S. Sample, by Project Size

System Size	Mean	Median	Std. Dev	Sample Size
Residential (up to 10 kW)	6	4	8	7,925
Small Commercial (10–50 kW)	7	4	8	575
Full Sample (up to 50 kW)	6	4	8	8,500

4.4.2 Comparison of Five States

Of the five individual states examined, for the full sample (up to 50kW) California has the lowest median number of days for inspection (3), followed by Arizona with 7, Colorado with 9, and New York and New Jersey with 10 (Figure 8). The results for New York are less robust because of the smaller number of observations there compared to the other states examined.[16]

[16] When comparing New York against the other samples, the difference in inspection days is only statistically significant between New York and California and between New York and the full U.S. sample.

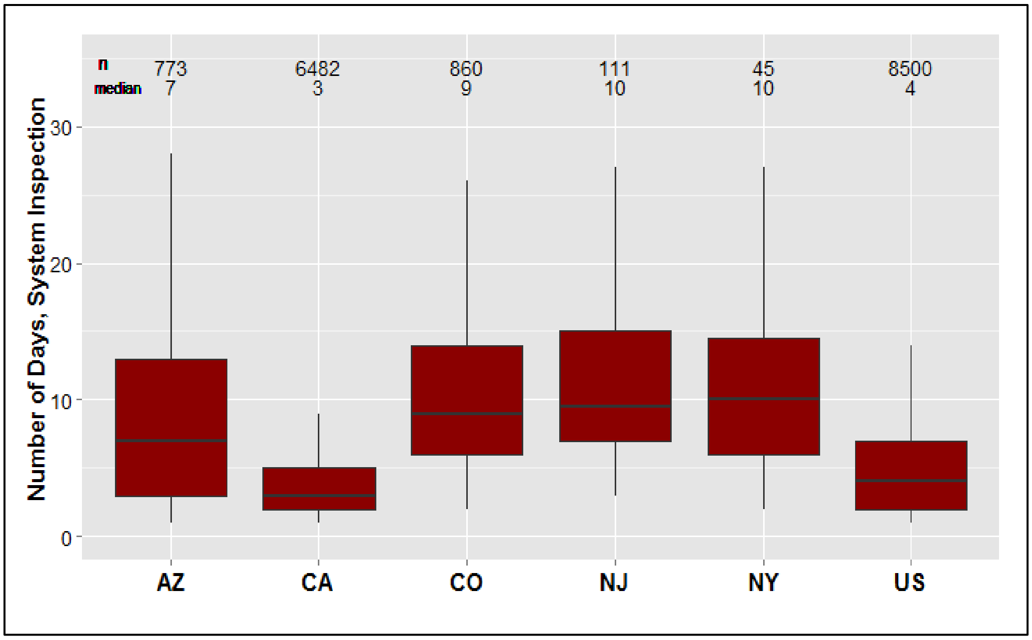

Figure 8. Building inspection days for five states and full U.S. sample (up to 50 kW)

4.5 Permission to Operate (Final Authorization)

Once PV construction and final AHJ building permit inspections are completed, the installer submits all paperwork required for PTO to the utility. This paperwork includes verification of passed building inspection, but it may also include the interconnection application in utility territories that allow the PV installer to submit the application and PTO paperwork together, following construction and AHJ building permit inspection (see Section 4.2). Upon review and approval of all the paperwork required for final authorization, the utility is likely to install a net meter (for net-metered systems) and issue a PTO letter. Only upon receipt of the PTO letter is the installer authorized to energize the system. Many state-level requirements mandate specific timeframes for the utility to issue PTO once all required paperwork is received. These timeframe requirements vary by system size and interconnection complexity, but they typically range from 5 to 10 days for residential and small commercial systems and as high as 40 days, or longer, for large commercial systems or projects requiring additional witness testing by the utility.

While this analysis does not examine the timeline for utility-required inspections, these inspections can extend the total time for PV interconnection. Certain utilities, such as Arizona Public Service (APS), have streamlined the final authorization process by waiving any pre-PTO inspections for residential PV installations. Specifically, APS allows PV installers to "self-certify" eligible residential projects, thereby acknowledging that all applicable AHJ permitting and utility interconnection requirements have been met.[17] Enactment by APS of self-certification for residential PV was largely in response to a rapid increase in interconnection applications, from 325 residential applications received in 2006 to 9,000 received in 2013 (APS 2014). As a result, only about 10% of residential PV projects installed in APS territory in 2013 required any pre-PTO inspections.

[17] Project eligibility for self-certification in APS territory includes residential PV with up to three inverters, no battery storage, and typically up to 12 kW.

4.5.1 Results for Full U.S. Sample

The median number of days for PTO among the projects sampled is 10 for residential systems and 12 for small commercial systems (Table 8). Across all system sizes, the median is 10 days. Approximately 17% of residential and 25% of small commercial projects sampled took 20 days or more. For this subset of installations, the median time to complete the final authorization process was 28 days for the residential sector and 29 days for the small commercial sector.

We find no material difference when comparing PTO timelines for projects in which the interconnection application and PTO paperwork were submitted separately per the typical interconnection process, versus those in which the application and PTO paperwork were submitted together following construction and AHJ inspection. This indicates that submittal of the application in conjunction with PTO paperwork, as permitted by the three main California IOUs (see Section 4.2), does not slow the PTO process.[18]

Table 8. PTO Days for Full U.S. Sample, by Project Size

System Size	Mean	Median	Std. Dev	Sample Size
Residential (up to 10 kW)	13	10	13	31,685
Small Commercial (10–50 kW)	16	12	16	2,740
Full Sample (up to 50 kW)	14	10	14	34,425

4.5.2 Comparison of Five States

Here we compare actual timelines to state-level requirements for PTO in Colorado, New Jersey, and New York. Similar to application review and approval, all projects sampled meet the system-size eligibility criteria for simplified or fast-track review in these states. For Arizona, a state with no PTO timeframe requirements, we use a comparative limit of 20 days to assess PTO delays. Like Arizona, California does not have a specific PTO timeline requirement. However, California does have a statutory requirement (Public Utilities Code sections 2827 and 2827.8) that, for all net-metered PV systems (up to 30 kW), the utility must issue PTO within 30 days of *receipt* of a complete interconnection application (Legislative Counsel of California 2014).[19] On account of the data collected, we evaluate the portion of projects in California that took longer than 30 days to receive PTO from the date the application was *approved*. This approach likely underestimates the portion of projects that exceeded the 30-day requirement, because it does not account for the period from when a complete application was *received* to when it was *approved*.

Generally, regulations for PTO timeframes are flexible to allow for additional utility witness testing and inspection prior to authorizing an installer to energize a completed PV system. For example, New Jersey utilities must issue a PTO letter within 5 days if utility inspection is waived, but they are allowed up to 20 days if witness testing and/or additional inspections are

[18] The mean PTO time for projects in which the application and PTO paperwork were submitted together is 13.8 business days, compared to 14.2 business days for projects in which the application and PTO paperwork were submitted separately. The difference in means is statistically significant (*p-value* = 0.03), but it is not materially different owing to rounding. For both project types, the median PTO time is 10 business days.
[19] Faster application processing and approval timeframes have been attributed to this legislated mandate (according to a personal communication with an interviewee).

required for systems up to 10 kW. These timeframes increase by 5 days for systems up to 2 MW. Colorado has the same regulations for all systems up to 2 MW: 5 days if utility inspection is waived and 10 days if witness testing and/or additional inspections are required. Table 9 compares state-level requirements for PTO, by system size and interconnection track.

Table 9. State Timeframe Requirements for PTO, by System Size and Interconnection Track

State	System-Size Eligibility	Days for PTO (if inspection, witness test waived)	Days for PTO (if inspection, witness test NOT waived)
CA	All net-metered PV systems must receive PTO within 30 days of receipt of a complete application.		
NY	up to 50 kW	5	5
	up to 2 MW	10	40
NJ	up to 10 kW	5	20
	up to 2 MW	10	25
CO	up to 10 kW	5	10
	up to 2 MW	5	10
AZ	N/A. As of the writing of this report, Arizona has no standard timeframe requirements in place.		

For the purposes of assessing the portion of projects that exceeded regulated PTO timeframes, we use the higher of the two cut-offs to account for any potential, but allowed, final utility inspections (Table 10). Table 10 lists for all five states the time requirement for utility PTO ("Time Req."), the percentage of projects that exceeded the time requirement, and the median PTO time for those projects that exceeded the requirement.

Table 10. PV Projects that Exceeded PTO Time Requirements, by State and Size

	Residential (up to 10 kW)			Small Commercial (10–50 kW)		
State	Time Req. (business days)	Applications Exceeding Time Req. (%)	Median for Applications that Exceeded Time Req. (business days)	Time Req. (business days)	Applications Exceeding Time Req. (%)	Median for Applications that Exceeded Time Req. (business days)
CA	[30]*	38%	44	[30]*	49%	50
NY	5	53%	11	5	58%	11
NJ	20**	23%	28	25**	9%	29
CO	10**	10%	38	10**	51%	19
AZ	[20]***	22%	28	[20]***	24%	28

* While California does not have a specific PTO timeline requirement, it has a statutory requirement that all net-metered PV systems (up to 30 kW) be issued PTO within 30 days of application.
** We use the requirement upper limit for projects, which assumes the utility inspection and/or witness test are not waived.
*** A 20-day threshold is assumed for analytic purposes, because Arizona has no interconnection timeframe requirements.

Figure 9 and Figure 10 graphically depict the differences between actual PTO days and state time requirements (red lines, for Colorado, New York, and New Jersey). As shown in these figures, New York has the lowest median number of days for PTO (6 for residential and small commercial) among the five states examined, just as it had the shortest application review and approval timeline (Figure 5 and Figure 6). It is followed by Colorado (10 days for residential, 11 for small commercial), California (10 for residential, 12 for small commercial), New Jersey (11 for residential and small commercial),[20] and Arizona (12 for residential, 13 for small commercial). Compared to Arizona, a state with no timeframe requirements for PTO, median completion times in New York are faster. However, the differences in PTO time frames between Arizona and the other two states with PTO regulations (Colorado and New Jersey) are minimal and not statistically significant.[21] This indicates that, while the adoption of state-level timeframe requirements may lead to overall lower median processing times, other factors must be considered when identifying causes of variation between states. These factors could include differences in utility processing platforms and tools, witness-testing requirements, and utility customer-satisfaction goal setting and tracking.

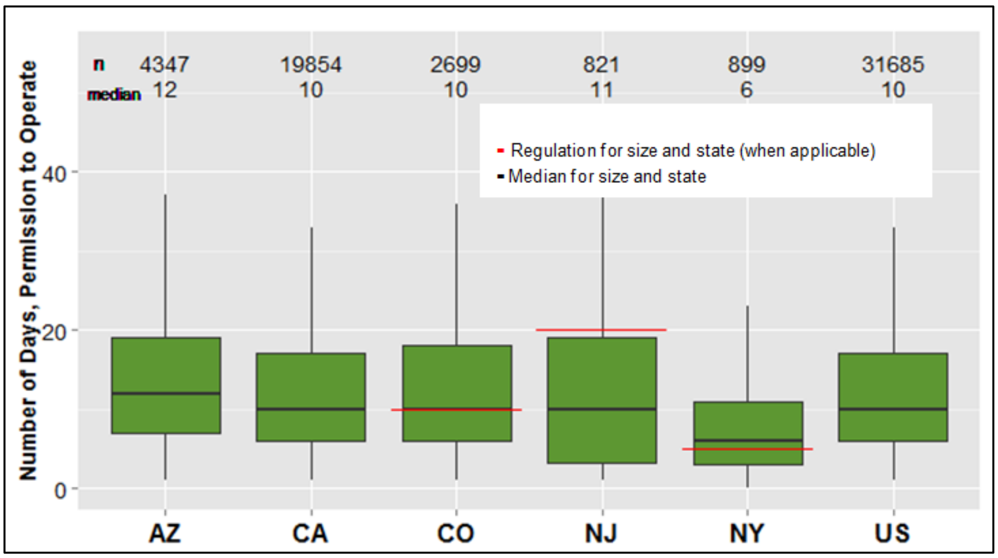

Figure 9. PTO days for five states and full U.S. sample (10 kW and under)

[20] New Jersey's median PTO timelines for residential and small commercial systems are not statistically different than any other state's timelines, with the exception of New York's.

[21] Includes residential and small commercial samples.

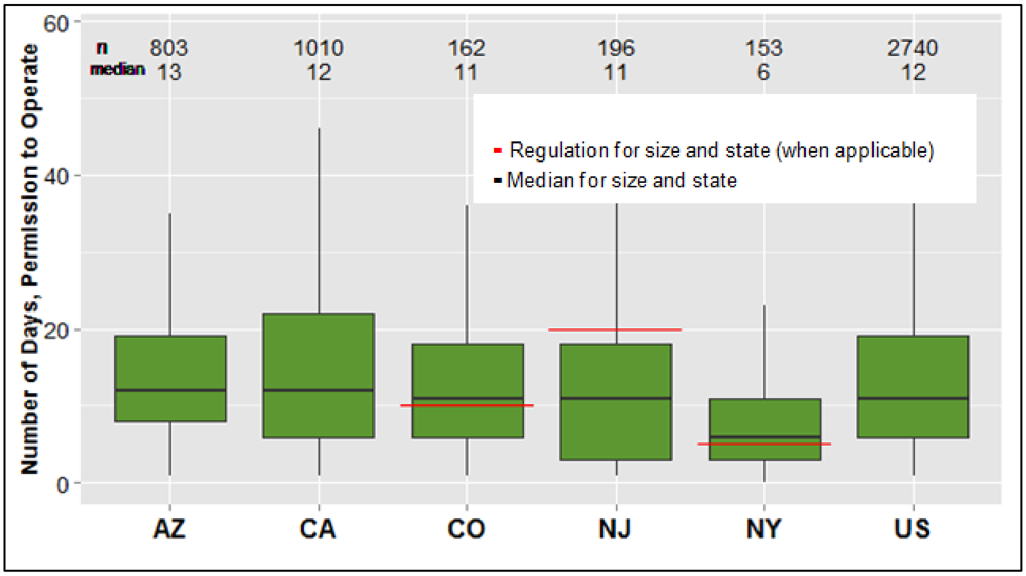

Figure 10. PTO days for five states and full U.S. sample (10 to 50 kW)

Furthermore, most systems are smaller than 10 kW in all states. Thus, the lower median completion time in New York suggests that the lack of a specialized interconnection track for projects 10 kW and under is not a notable source of PTO delay for residential projects, relative to the other states examined. However, even in New York many eligible systems do not receive PTO approval within the timeframe requirement of 5 days. Specifically, 53% of residential and 58% of small commercial projects sampled in New York exceeded the mandated PTO timeframe. For these installations, the median time required to complete the PTO process was 11 days for both the residential and small commercial sectors.

5 Summary Results and Conclusions

Our analysis quantifies the substantial time required for distributed PV interconnection processes and deployment in the United States. Based on our national sample across 87 utilities in 16 states, the median total project length for distributed PV systems installed between 2012 and 2014 was 53 business days (40–70 days between the 25th and 75th percentiles). Figure 11 shows the range in values across our full U.S. samples for the specific project timeframes analyzed. Of these, application review and approval was the most time consuming, requiring a median of 18 days (about 3.5 weeks), followed by PTO, requiring a median of 10 days (2 weeks). System construction and building inspection required significantly less time, with median timeframes of 2 and 4 days, respectively.

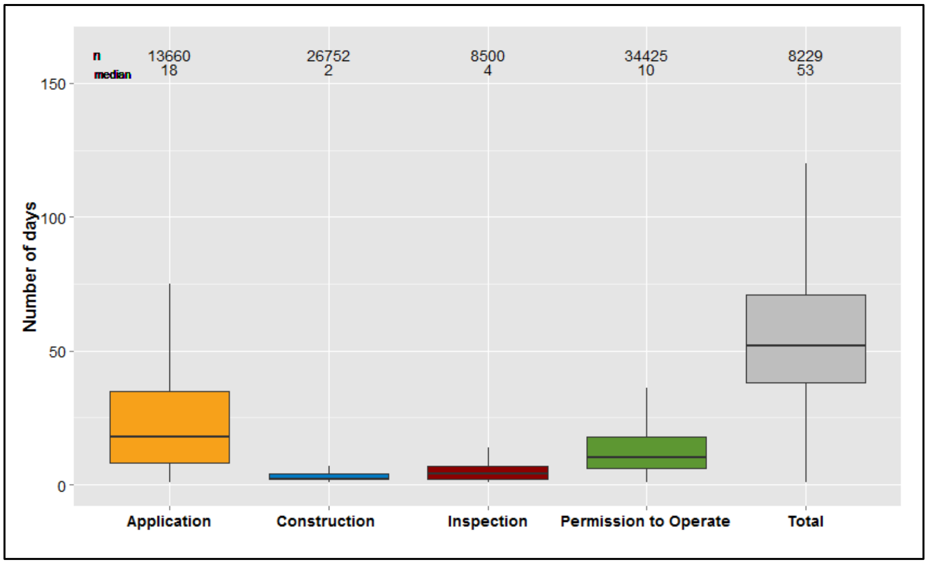

Figure 11. Days for each interconnection stage, full U.S. sample (up to 50 kW)

We also compared results by system size, analyzing residential (up to 10 kW) and small commercial (10–50 kW) systems. As expected, larger systems generally required more total process and project completion time (Table 1). Across our full U.S. sample, the median time required for construction was 2 days for residential systems and 4 days for small commercial systems. The mean inspection time is slightly longer for small commercial systems than for residential systems, though both have a median of 4 days. Application review and approval timelines do not differ statistically for residential and small commercial systems. Approximately 44% of residential and 50% of small commercial projects sampled took 20 days or more. For these installations, completing the application process took a median of 38 days for the residential sector and 39 days for the small commercial sector. This indicates that projects fall into one of two categories: (a) projects that move through the process well below the typical regulated timeframes (15–20 business days), or (b) projects with very significant delays (i.e., 2–3 weeks beyond the typical regulated timeframe). Obtaining PTO required a median of 10 days for residential systems and 12 days for small commercial systems. Approximately 17% of residential and 25% of small commercial projects sampled took 20 days or more. For these installations, completing the final authorization process took a median of 28 days for the residential sector and 29 days for the small commercial sector.

Finally, we examined project completion timeframes in five key PV states: Arizona, California, Colorado, New Jersey, and New York. Our results suggest considerable variation in time requirements among states. By creating uncertainty, such variation can make installers' workflow planning more difficult and generally reduce the efficiency of their business processes. Our state-by-state analysis does suggest that more stringent regulations limiting the timeframe for application approval and PTO might reduce project length, as in New York. This same analysis, however, also suggests that such regulations do not limit process timeframes to the targets specified. Even when limiting the analysis to projects eligible for expedited or fast-track review and to systems sizes of 50 kW and under, we find that interconnection process delays are common and can range from days to several weeks.

Our study is a first step toward filling a significant gap in the literature on distributed PV interconnection costs and time requirements. Further research, for example via in-depth interviews with installers and utilities, could help to identify the exact sources of delays in various processes and inform the development of policies and practices that minimize the amount of time required of utilities and installers for PV deployment. Also, follow-on analysis informed by additional data sources—such as internal utility project tracking systems, regulatory databases,[22] and further data from PV installers—would enable the comparison of interconnection times more broadly.

[22] There is an emerging focus on data transparency for interconnection timelines and queues. States such as California, Massachusetts, and New York require utilities to provide varying levels of information related to application processing times and volume. Some data are made publically available, often quarterly, to support data access and transparency in the interconnection process.

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Appendix A: Interconnection Process Times for Large Commercial and Industrial Samples

Data for system sizes greater than 50 kW are much more limited, reducing the ability to draw robust conclusions. As a result, these statistics are included here rather than in the main body of the report. Overall, application and PTO timeframes are greater for the industrial sample (250 kW to 2 MW) compared to the large commercial sample (50 to 250 kW). Median application timeframes are 51 business days for the the industrial sample and 15 days for the large commercial sample. For PTO, median timeframes are 18 days for the industrial sample and 10 days for the large commercial sample. While these results are statistically different from the residential and small commercial samples, they are not statistically different from each other (i.e., between the industrial and large commercial categories). As in the the residential and small commercial samples, the range of values for application review and approval is larger than the range for PTO, indicating that, across all system sizes, there is a greater variance in application completion timeframes compared to PTO timeframes.

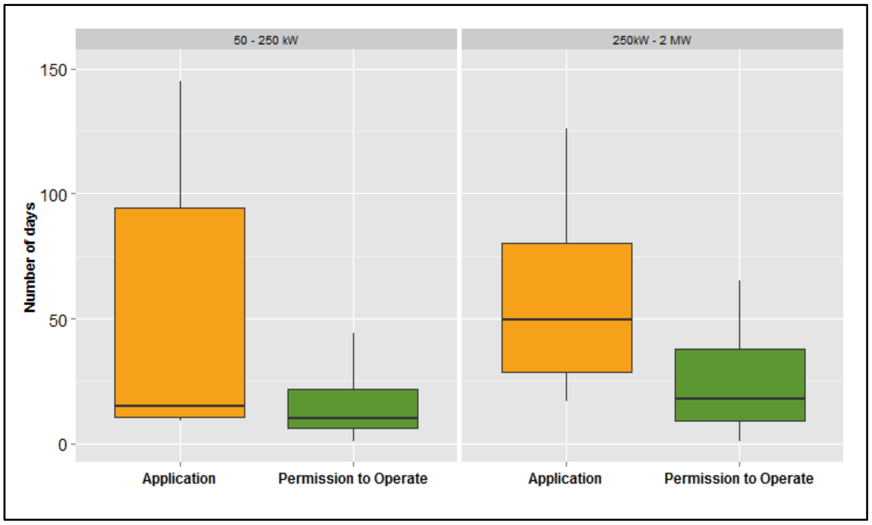
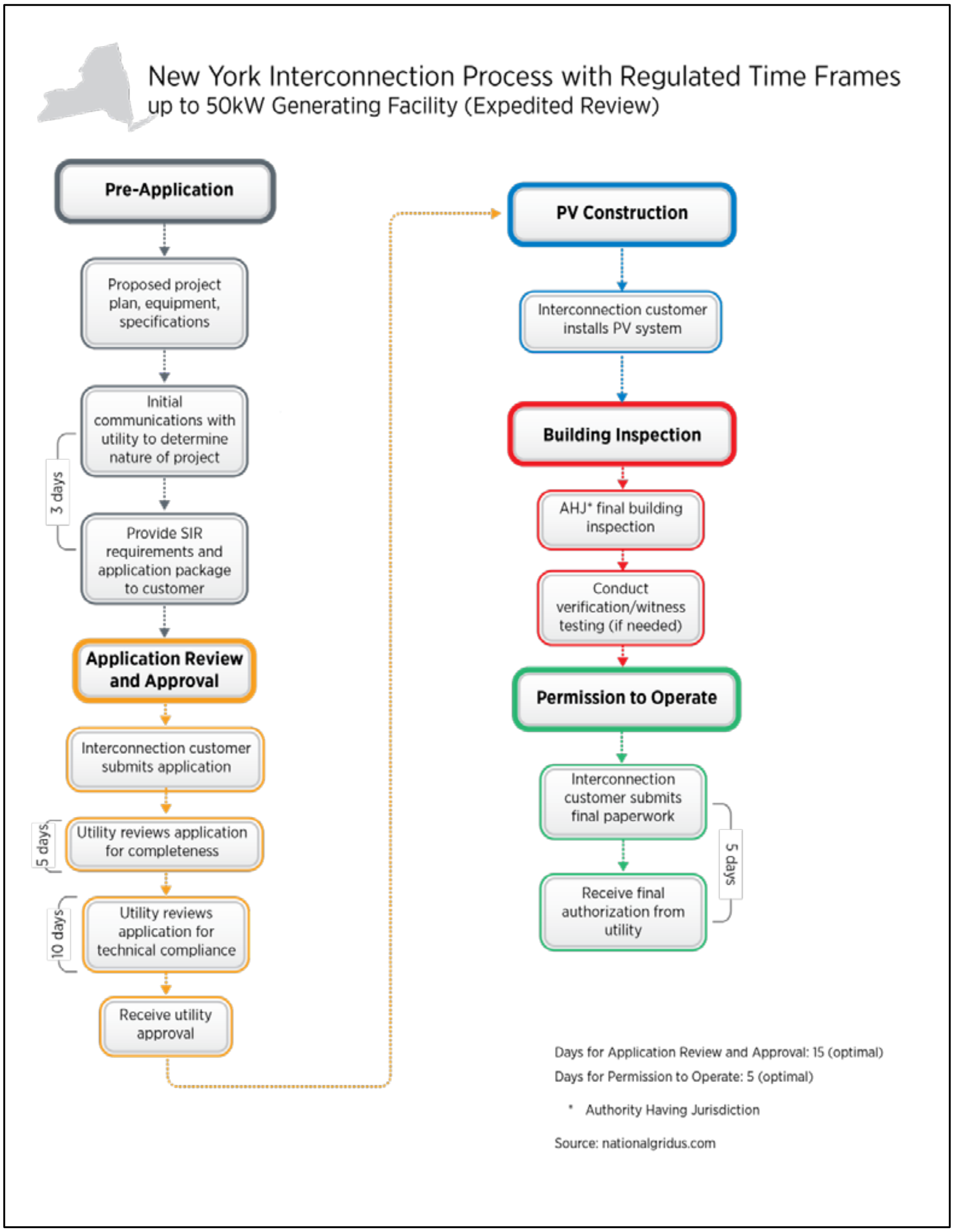


Figure 12. Days for application review and approval and PTO, full U.S. samples of large commercial (50 to 250 kW) and industrial (250 kW to 2 MW) systems

Application Review and Approval				
System Size	**Mean**	**Median**	**Std. Dev**	**Sample Size**
Large Commercial (50 to 250 kW)	57	15	56	11
Industrial (250 kW to 2 MW)	66	51	55	23

Permission to Operate				
System Size	**Mean**	**Median**	**Std. Dev**	**Sample Size**
Large Commercial (50 to 250 kW)	18	10	23	41
Industrial (250 kW to 2 MW)	24	18	20	58

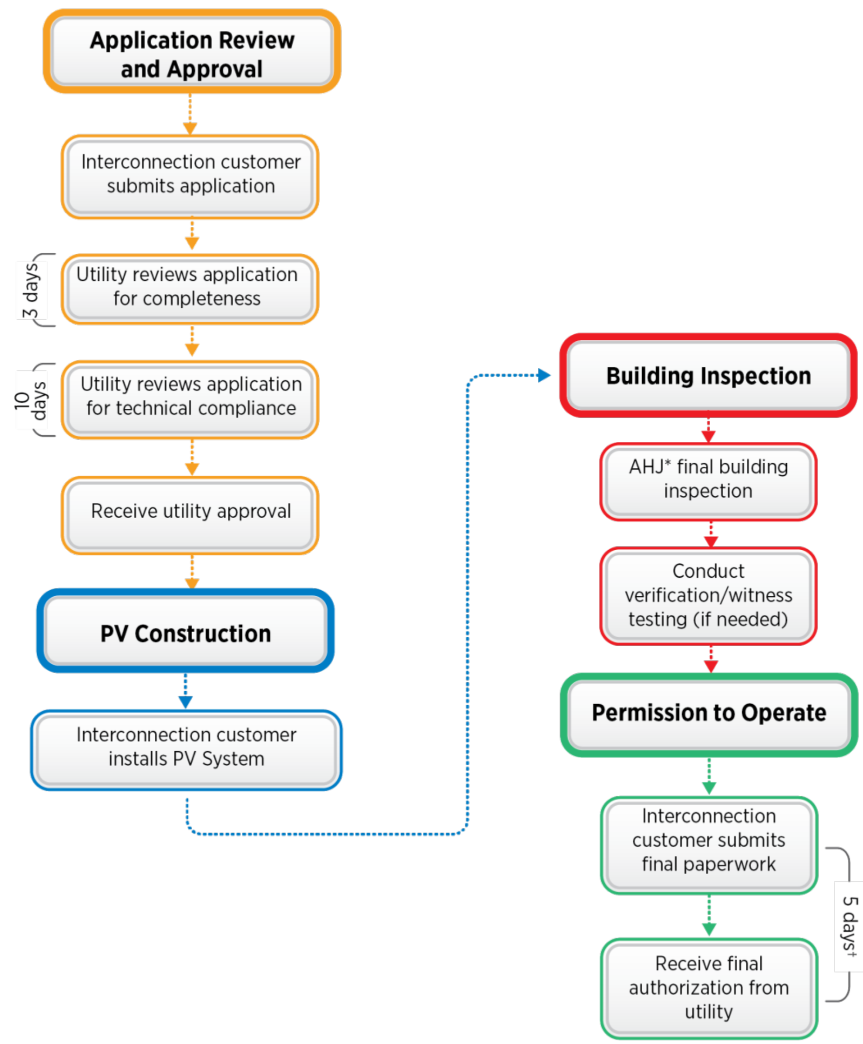
Appendix B: Interconnection Process Diagrams for Analyzed States with Timeframe Regulations for both Application Review and Approval and PTO (New York, New Jersey, and Colorado)[23]



[23] Additional interconnection tracks exist in each state; only expedited or fast-track reviews are shown here.

New Jersey Interconnection Process with Regulated Time Frames

10kW and Under Generating Facility



Days for Application Review and Approval: 13 (optimal)

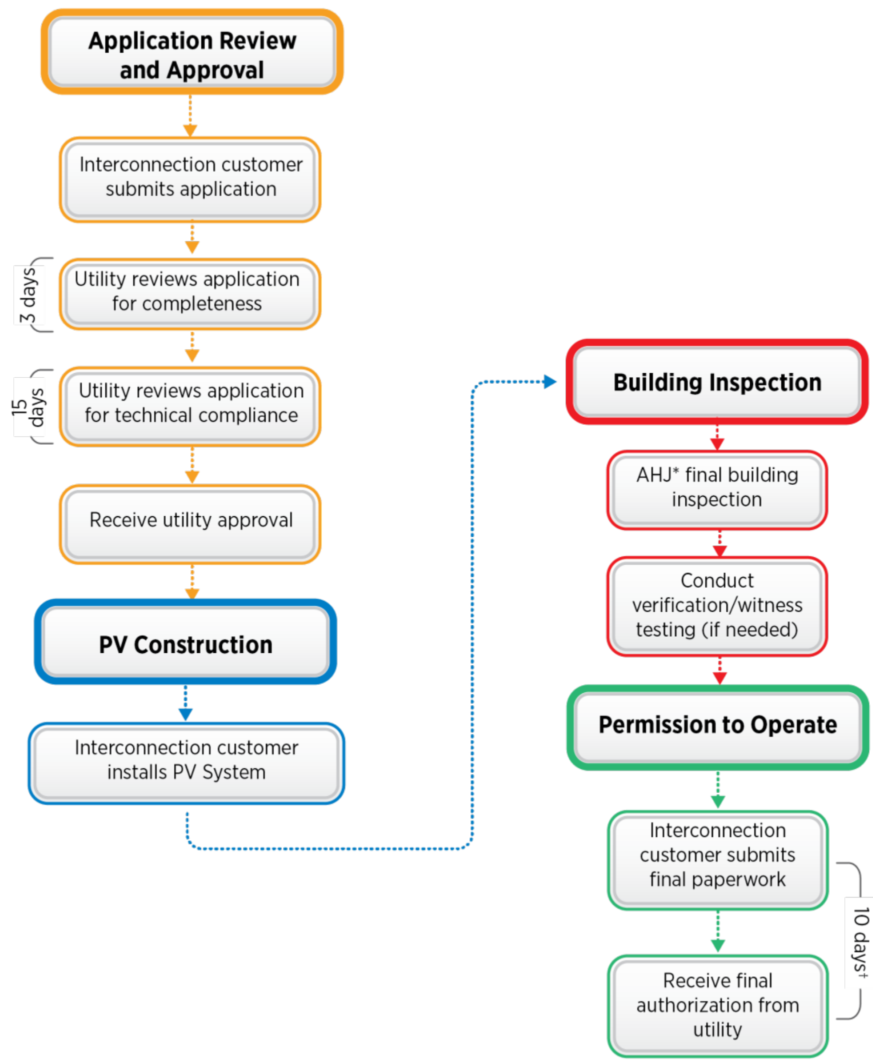
Days for Permission to Operate: 5 (optimal); 20 (maximum with exceptions)
† 5 days, if utility inspection waved, maximum 20 days if utility inspection not waived

* Authority Having Jurisdiction

Source: New Jersey Administrative Code

New Jersey Interconnection Process with Regulated Time Frames

>10kW to 2MW Generating Facility



Days for Application Review and Approval: 18 (optimal)

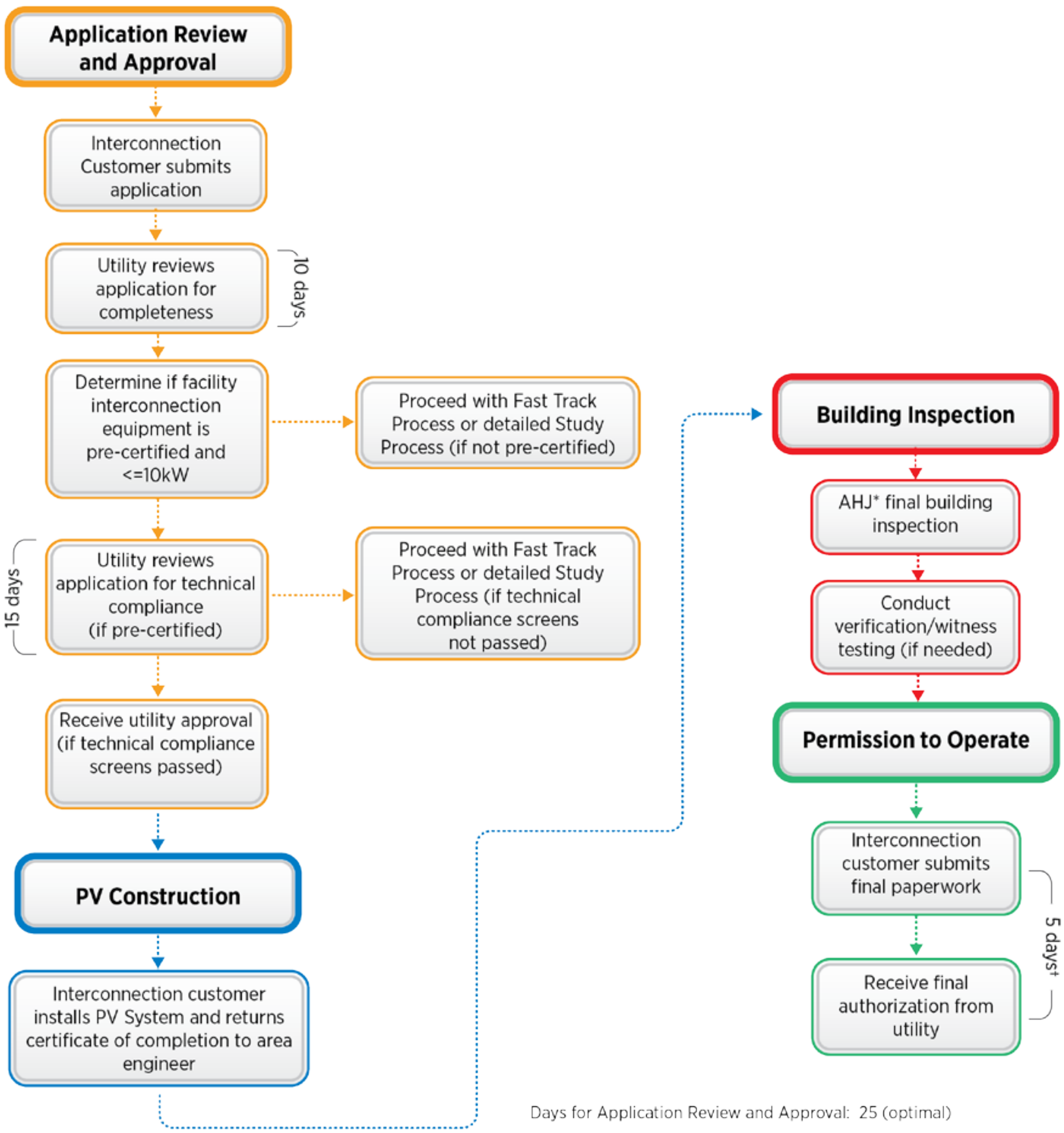
Days for Permission to Operate: 10 (optimal); 25 (maximum with exceptions)
† 10 days, if utility inspection waved, maximum 25 days if utility inspection not waived

* Authority Having Jurisdiction

Source: New Jersey Administrative Code

Colorado Interconnection Process with Regulated Time Frames

10kW and under Generating Facility

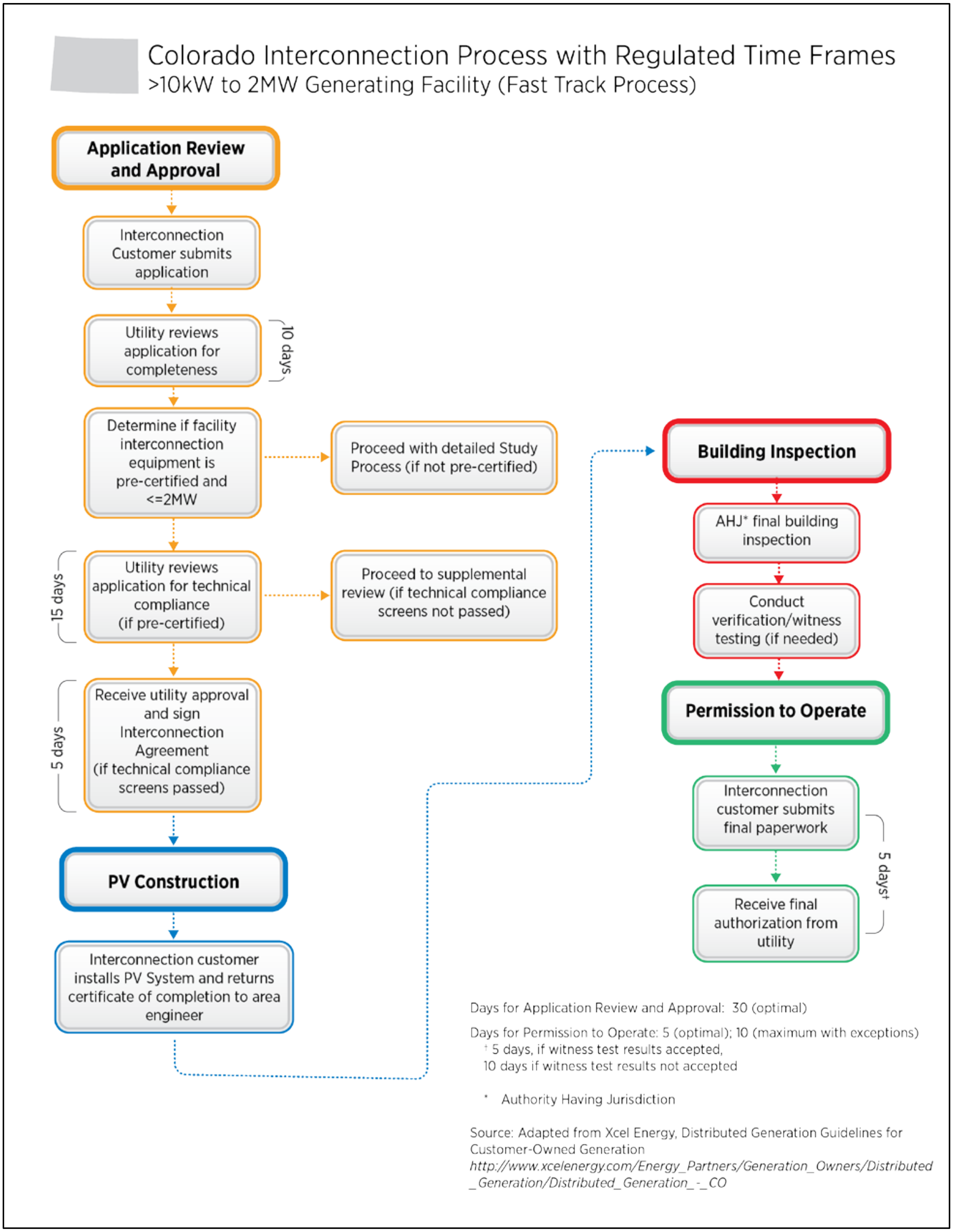


Days for Application Review and Approval: 25 (optimal)

Days for Permission to Operate: 5 (optimal); 10 (maximum with exceptions)
† 5 days, if witness test results accepted,
10 days if witness test results not accepted

* Authority Having Jurisdiction

Source: Adapted from Xcel Energy, Distributed Generation Guidelines for Customer-Owned Generation
http://www.xcelenergy.com/Energy_Partners/Generation_Owners/Distributed_Generation/Distributed_Generation_-_CO


Colorado Interconnection Process with Regulated Time Frames
>10kW to 2MW Generating Facility (Fast Track Process)
Application Review and Approval
Interconnection Customer submits application
Utility reviews application for completeness
10 days
Determine if facility interconnection equipment is pre-certified and <=2MW
Proceed with detailed Study Process (if not pre-certified)
15 days
Utility reviews application for technical compliance (if pre-certified)
Proceed to supplemental review (if technical compliance screens not passed)
5 days
Receive utility approval and sign Interconnection Agreement (if technical compliance screens passed)
PV Construction
Interconnection customer installs PV System and returns certificate of completion to area engineer
Building Inspection
AHJ* final building inspection
Conduct verification/witness testing (if needed)
Permission to Operate
Interconnection customer submits final paperwork
5 days†
Receive final authorization from utility
Days for Application Review and Approval: 30 (optimal)
Days for Permission to Operate: 5 (optimal); 10 (maximum with exceptions)
† 5 days, if witness test results accepted,
10 days if witness test results not accepted
* Authority Having Jurisdiction
Source: Adapted from Xcel Energy, Distributed Generation Guidelines for Customer-Owned Generation
http://www.xcelenergy.com/Energy_Partners/Generation_Owners/Distributed_Generation/Distributed_Generation_-_CO

Appendix C: Statistical Difference in Means between States and Sizes for Different Interconnection Processes for the Full Sample of Systems (0–50 kW)

Application Days

	AZ	CA	CO	NJ	NY
CA	0.00	-	-	-	-
CO	0.00	0.00	-	-	-
NJ	0.00	0.00	0.00	-	-
NY	0.00	0.42	0.00	0.00	-
US	0.00	0.00	0.00	0.00	0.86

Construction Days

	AZ	CA	CO	NJ	NY
CA	0.00	-	-	-	-
CO	1.00	0.08	-	-	-
NJ	1.00	0.75	1.00	-	-
NY	0.65	0.00	0.16	0.20	-
US	0.01	0.00	1.00	1.00	0.01

Inspection Days

	AZ	CA	CO	NJ	NY
CA	0.00	-	-	-	-
CO	0.00	0.00	-	-	-
NJ	0.01	0.00	0.65	-	-
NY	0.06	0.00	1.00	1.00	-
US	0.00	0.00	0.00	0.00	0.00

PTO Days

	AZ	CA	CO	NJ	NY
CA	0.00	-	-	-	-
CO	0.18	0.01	-	-	-
NJ	0.45	0.18	0.98	-	-
NY	0.00	0.00	0.00	0.00	-
US	0.00	0.96	0.01	0.21	0.00

Total Project Days

	AZ	CA	CO	NJ	NY
CA	0.07	-	-	-	-
CO	0.00	0.00	-	-	-
NJ	0.00	0.00	0.00	-	-
NY	0.58	0.16	0.00	0.00	-
US	0.00	0.00	0.00	0.00	0.00

Size category	*0-10 kW*	*10-50 kW*	*50-250kW*
	p-value		
Application Days			
10-50 kW	0.53	-	-
50-250kW	0.01	0.01	-
250 - 2MW	0.00	0.00	0.53
Construction Days			
10-50 kW	0.00		
Inspection Days			
10-50 kW	0.01		
PTO Days			
10-50 kW	0.00	-	-
50-250kW	0.04	0.20	-
250 - 2MW	0.00	0.00	0.15
Total Project Days			
10-50 kW	0.00		

● = difference in means significant at less than 5%
● = difference in means significant between 5 and 10%
● = difference in means not significant