Title
Interconnection Timelines and Costs for Distributed Energy Projects in the United States (2000-2025)

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Interconnection Timelines and Costs for Distributed Energy Projects in the United States (2000-2025)

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ENERGY TECHNOLOGIES AREA | ENERGY ANALYSIS DIVISION | ENERGY MARKETS & PLANNING

i2X INTERCONNECTION INNOVATION e-XCHANGE
U.S. DEPARTMENT OF ENERGY

These slides provide a summary visualization of empirical data on interconnection timelines and costs for distributed energy projects connected to U.S. utility distribution systems. Lawrence Berkeley National Laboratory (LBNL) collected the data from utilities, public utility commissions, state energy offices, and Interconnection.fyi. The slides do not comment on or recommend any specific regulations or policies. The LBNL/i2X Distributed Energy Projects Interconnection Dashboard provides direct access to aggregated data and visualizations used for this analysis.

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Contents

What is interconnection?

- Interconnection is the process of adding a distributed energy resource (DER) to a utility's distribution system.
  - The term may refer to the technical, procedural, and legal requirements of the interconnection process.
- Interconnection allows utility customers and third-party service providers to connect generation and storage projects (DERs) at customer premises and operate them in parallel with the utility system.

See Technical Appendix and Additional Figures here.

Interconnection Process Flow

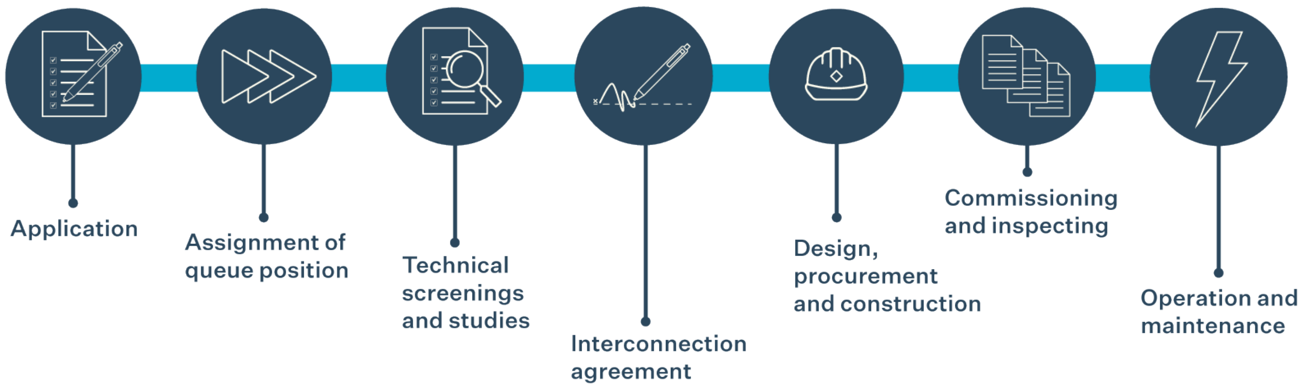

Image source: PGE

Acronyms

- DER - Distributed energy resource
- DOE - U.S. Department of Energy
- GW - Gigawatt
- i2X - Interconnection Innovation e-Xchange
- ISA - Interconnection service agreement
- kW - Kilowatt
- kWh - Kilowatt hour
- MW - Megawatt
- PTO - Permission to operate

What are distributed energy projects?

Generation and storage technologies sited close to customers can provide all or some of their immediate power needs. Also called distributed energy resources, these technologies can be used to provide supply or reduce demand to satisfy the energy, capacity, or ancillary service needs of the electricity system as well. Distributed energy projects can support electricity customer reliability, affordability, and choice.

Adapted from NARUC 2016

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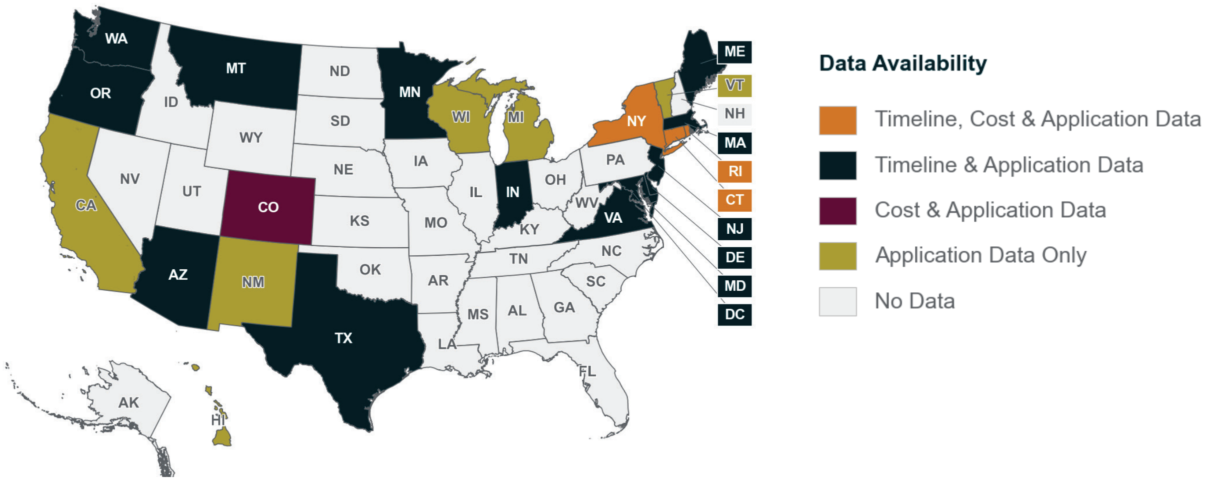
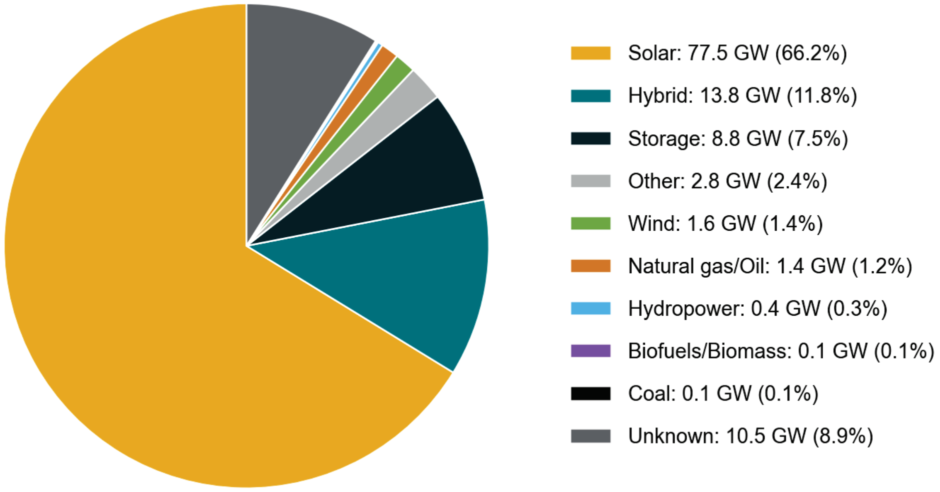
High Level Findings

First Nationwide DER Interconnection Data Collection Identifies Data Gaps and Opportunities for Insights

- Despite data gaps, LBNL's DER Interconnection dataset includes more than 2.7 million applications that were submitted 2000-2025.
- Applications are heavily represented by California, which makes up 65% of the data, followed by New York (11%), Arizona (10%), and New Jersey (9%), due to data availability and interconnection volume concentration.
- By project count, small systems (<30 kW), typically residential-scale, account for the vast majority of projects (97.3%).
- By capacity, solar represents two-thirds of projects (77.5 GW), followed by hybrid systems* (11.8%, 13.8 GW) and storage (7.5%, 8.8 GW).



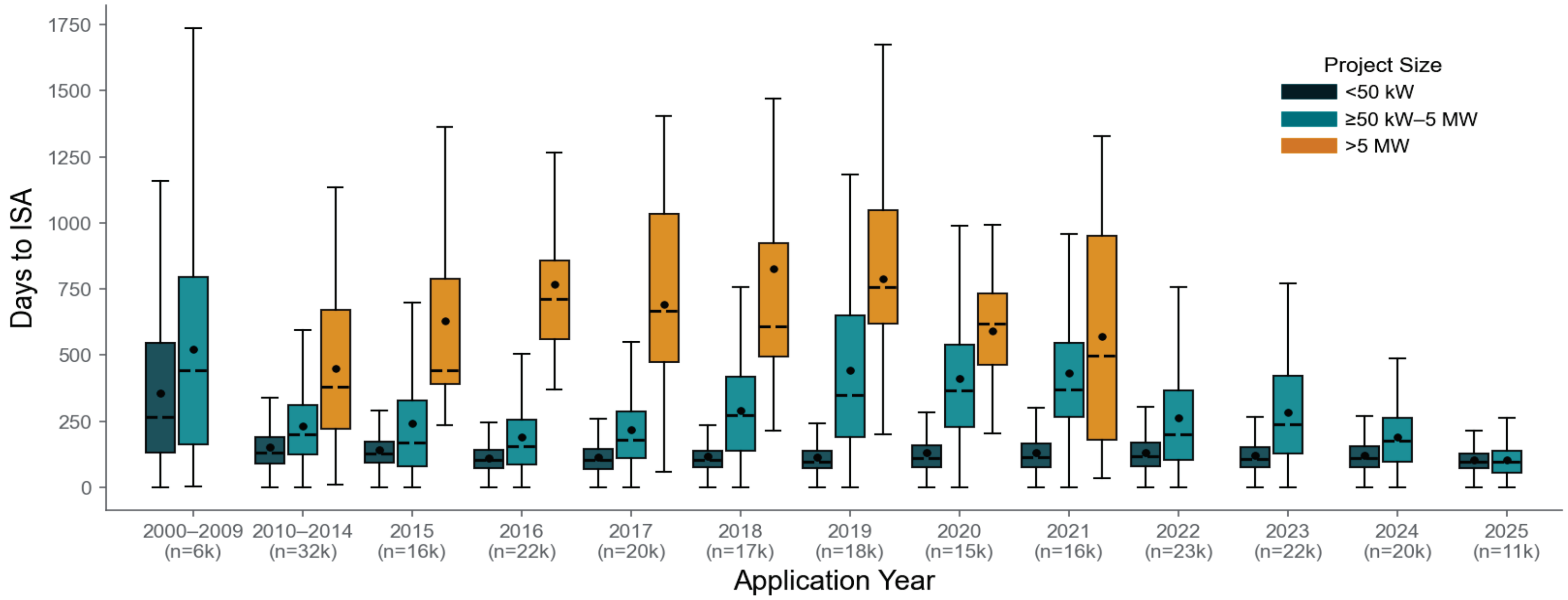


Technology Share by Capacity (2000-2025)

*Any project with more than one technology, including microgrids and combinations of biomass, coal, diesel, fuel cells, fuel oil, geothermal, hydropower, hydrogen, natural gas, wind, solar, and storage.

Timeline for Interconnection Agreement Depends on Project Size and Fluctuates Widely by Year for Larger Projects

- DOE's Interconnection Innovation Exchange (i2X) set 2030 success targets for simple, fast, and affordable DER interconnection. Targets include timelines related to the utility's Interconnection Service Agreement (ISA), which specifies technical operating requirements for the project.
  - *Median time from interconnection request to ISA* – The target for small systems is one day.
  - *Percent of applications that execute an ISA* – The target for small systems is 99%.
- ISA timelines vary by project size and over time.
- Timelines to ISA for projects up to 5 MW decreased since 2023.



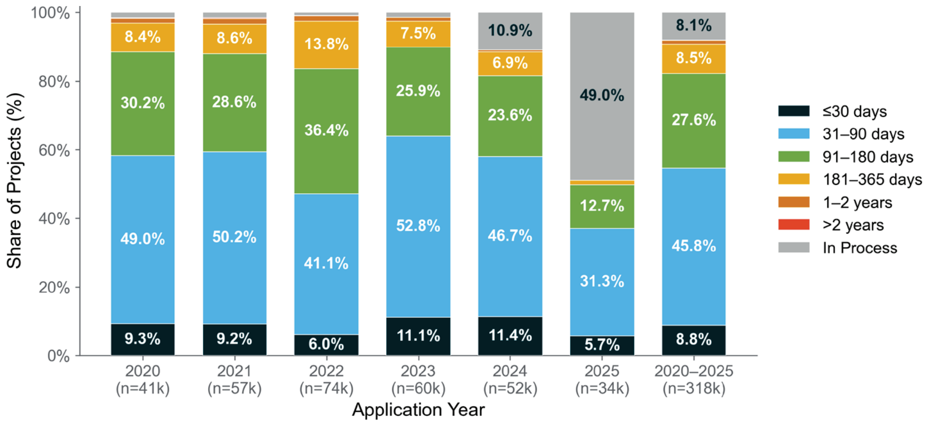
States represented: CT, DC, MA, ME, MN, NJ, RI, VA.
NJ projects represent 94% of the sample.
The figure excludes 2022-2025 results for projects >5 MW because of LBNL's small sample size.
CA data are excluded because pre-construction ISA is waived for small-scale projects.
Project size bins are based on the i2X 2030 success targets.

Timeline to Operation Also Increases With Project Size

- Permission to operate (PTO) is the utility’s approval to connect the project to the grid.
  - Time to PTO is calculated as the number of months between application submittal and PTO.
  - PTO includes time for construction and inspection.

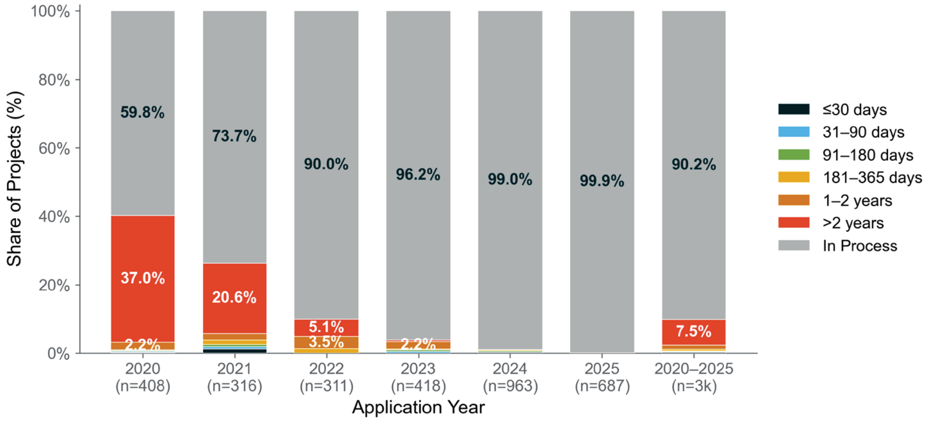
- The time it takes to achieve PTO generally increases with project size.
  - For example, more than half of projects <30 kW received the utility’s PTO in 90 *days* or less between 2020 and 2025. In contrast, just 2.4% of projects between 1 and 5 MW achieved PTO in 2 *years* or less during the same period.

Time to PTO by Application Year (<30 kW)*



States represented in the sample include AZ, CT, DC, IN, MA, ME, MN, NY, RI, TX, WA with majority of the data representing AZ (42%) and NY (39%) and RI (7%).

Time to PTO by Application Year (>1-5 MW)



States represented in the sample include AZ, CT, DC, DE, MA, MD, ME, MN, MT, NY, OR, RI, TX with majority of the data representing NY (55%) and MD (11%) and MA (11%).

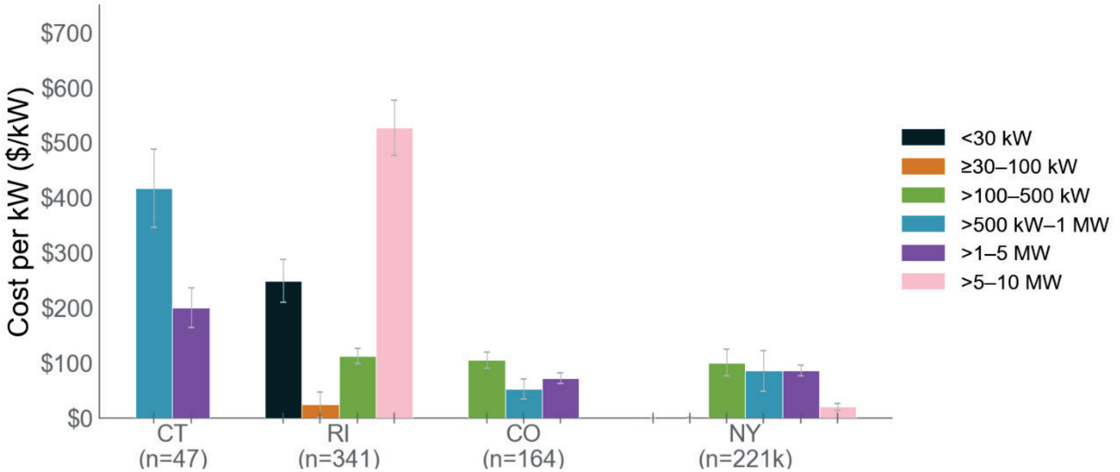
*"Application year” is the year a DER interconnection application was submitted to the utility. A project achieving PTO within 365 days did not necessarily achieve PTO in the same year as the application year; that depends on the specific application date.

Data for <30 kW figure heavily represent NY (39%) and AZ (42%). NY accounts for 55% of data for the >1-5 MW figure. LBNL’s sample size for each year impacts the bar totals.

Data on Grid Upgrade Costs Are Extremely Limited and Vary Significantly by State, Project Size, and Technology

- Data represent costs that interconnection customers pay for distribution system upgrades required to accommodate new DERs—e.g., new transformer, protective devices—as determined by the utility during the interconnection process.
- Available cost data are limited to four states.
  - New York accounts for >99% of the data.
- Variation in upgrade costs by state are due in large part to cost-sharing practices—e.g., NY customers paid no upgrade costs for 99% of projects.
- Average upgrade costs were highest for solar projects >5-10 MW ($383/kW) and lowest for solar projects <30 kW ($0/kW).

Median Cost per kW by State and Project Size (2015-2025)



Average and Median Upgrade Cost per kW				
Technology Type	**Size Segment**	**Mean**	**Median**	**Count**
Solar	<30 kW	$ 0	$ 0	211354
	≥30–100 kW	$ 17	$ 0	1413
	>100–500 kW	$ 163	$ 108	336
	>500 kW–1 MW	$ 238	$ 142	112
	>1–5 MW	$ 142	$ 85	643
	>5–10 MW	$ 383	$ 403	12
	>10 MW			2
	Overall	$ 1	$ 0	213872
Storage	<30 kW	$ 1	$ 0	1123
	≥30–100 kW	$ 10	$ 0	16
	>100–500 kW			3
	>500 kW–1 MW			6
	>1–5 MW	$ 162	$ 115	84
	>5–10 MW			1
	>10 MW			4
	Overall	$ 13	$ 0	1237
Hybrid	<30 kW	$ 2	$ 0	5367
	≥30–100 kW	$ 2	$ 0	670
	>100–500 kW			3
	>500 kW–1 MW			3
	>1–5 MW	$ 182	$ 122	57
	>5–10 MW	$ 34	$ 20	20
	>10 MW			1
	Overall	$ 4	$ 0	6121
Natural gas/Oil	<30 kW			5
	≥30–100 kW	$ 18	$ 0	18
	>100–500 kW	$ 21	$ 20	10
	>500 kW–1 MW			2
	>1–5 MW			6
	>5–10 MW			0
	>10 MW			0
	Overall	$ 16	$ 6	41

Figure and table include only projects that are in process or in service, and exclude withdrawn or cancelled projects. Gray cells indicate cohorts with <10 projects.

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Background, Scope, and Data

Data Support Efficient Interconnection Processes

- As adoption increases for all kinds of distributed generation and storage, so have interconnection application volumes, timelines,* and costs.
- Publicly available data on interconnection:
  - Enable tracking, benchmarking, and review of process improvements over time
    - Application data, such as queue volume, application status, and project size and type
    - Timelines for various interconnection phases
    - Costs by project size and type
  - Support efficient application processing
    - Lack of quality data hinders project siting decisions and can lead to interconnection delays and high upgrade costs

Source: Base Power

*See Cruce et al. 2025; Fekete et al. 2022, O'Shaughnessy et al. 2020

Data Sharing Practices

- Data sharing practices on interconnection applications, timelines, and costs vary significantly across the United States.
  - Detailed public interconnection data are not widely available across the country (Cadmus 2024).
  - Even when utilities provide data, many data fields are missing—e.g., costs, status, capacity, and technology type.
  - Types of data and frequency of data sharing are not standardized (NARUC 2023; Ingram et al. 2021).
  - Publicly available data are typically the result of state requirements for data sharing.

- Challenges for data sharing include:
  - Labor and resources needed to collect, aggregate, clean and standardize the data,
  - Computing requirements for data collection and sharing, and
  - Privacy and security of the data (Ingram et al. 2021).

Scope of Data Review

- Research to date on interconnection data for energy projects has primarily focused on transmission (Beams 2025; Gorman et al. 2025, Rand et al. 2025).
- This is the first national analysis of interconnection timelines and costs for interconnection of distributed generation and storage connected to U.S. utility distribution systems.
- The analysis assesses performance metrics that measure progress toward simple, fast, and affordable interconnection — specifically:
  - How do metrics vary across states, project sizes, technology types, and over time?
- The analysis also identifies gaps in data availability.
- The research covers the period 2000 to 2025* and spans the following:
  - Distributed biomass/biofuels, small coal and hydropower, natural gas/oil, solar, storage, wind, hybrid, and other DER technologies^
  - All metering configurations—offsite/virtual, behind the meter, paired, islanding-capable
  - Distribution- and sub-transmission-level up to 50 MW†

*The dataset does not represent comprehensive data for 2025. LBNL acquired some datasets prior to the end of 2025.
^"Hybrid" represents microgrids and any other project that includes more than one type of technology. Other technologies include steam turbines, fuel cells, hydrogen, combined heat and power, and bidirectional electric vehicle chargers.
† The dataset comprises generation and storage technologies; load is out of scope for this analysis.

Analyses Conducted

- Application data across states, technology types, project sizes, and time
- Average and median timelines, with standard error and box plots to calculate the interquartile range (IQR)
- Average and median upgrade costs to interconnection customers, with standard error and box plots to calculate the IQR, normalized by size of systems ($/kW)
- Relationship between interconnection application volumes and timelines
- Project sizes by capacity bins, based on common categories for residential and nonresidential systems and to differentiate among DER systems more likely to have similar timelines and costs:
  - <30 kW, ≥30-100 kW, >100-500 kW, >500 kW-1 MW, >1-5 MW, >5-10 MW, >10 MW

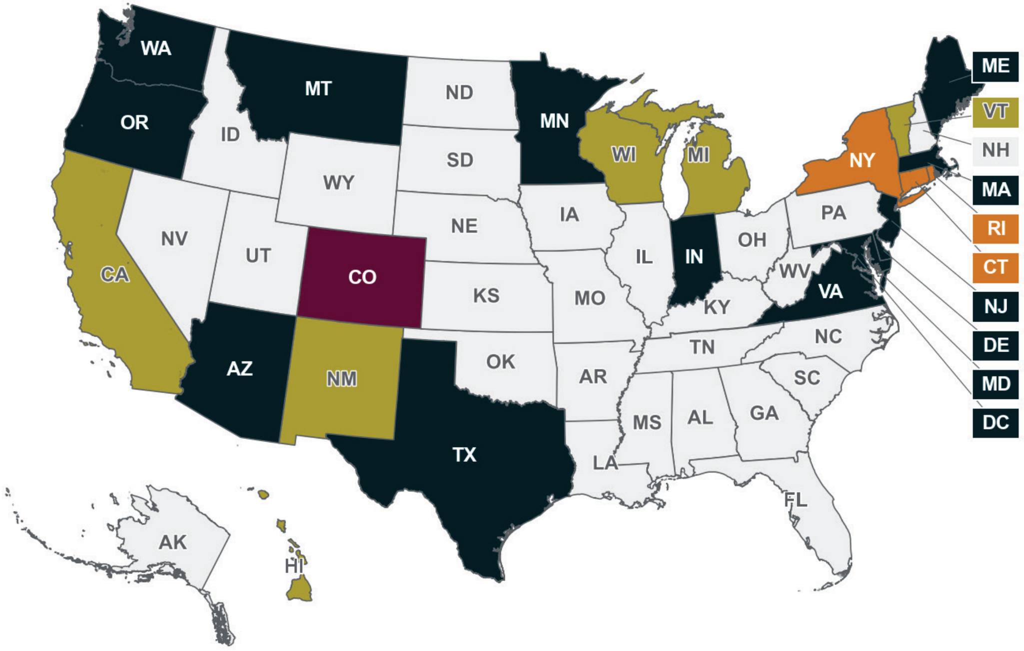
See Technical Appendix for how to read mean, median, standard error, and box and whisker plots.

Data Sources and Limitations

- Sources
  - *Public websites* hosted by utilities, public utility commissions, and state energy offices – LBNL collected this data in summer 2025.
  - *Data from Interconnection.fyi*, through a non-disclosure agreement (NDA) – LBNL used this data, as of February 2026, when it was more detailed than information from public websites.
  - *Data collected directly from state agencies and utilities*, including some data under NDAs with utilities (November 2025–January 2026).

- Limitations
  - Each state/utility has different standards for sharing data publicly, including the type of data shared and cadence.
  - The data fields in interconnection reports filed by regulated utilities are not standardized—for example:
    - Most utility datasets did not include information on the cost of required distribution system upgrades.
    - Not all datasets include the same timeline metrics, which makes it challenging to analyze timelines.
  - The datasets LBNL collected required extensive standardization across technology types, interconnection statuses, dates, and types of costs, among other data fields.
  - Variation in interconnection application volume in LBNL's dataset is in part due to available data.

Dataset Overview



Data Availability

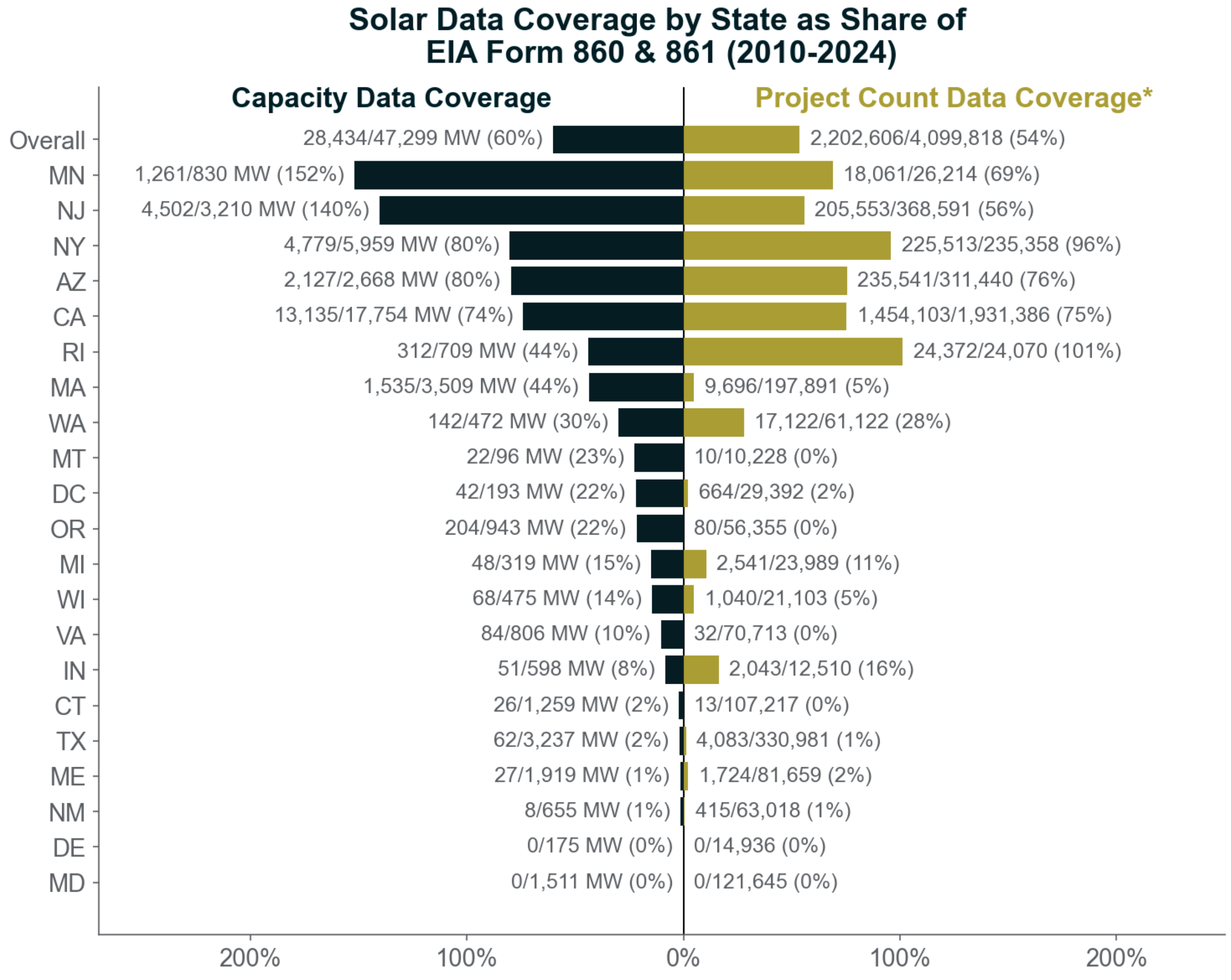
- Timeline, Cost & Application Data
- Timeline & Application Data
- Cost & Application Data
- Application Data Only
- No Data

Data Availability and Count of Projects by Metric

	Interconnection Application Data	Timeline to ISA	Timeline to PTO	Upgrade Costs
States	24	8*	15**	4^
Utilities	188	36	28	10
Total Projects	2.73M	237k	574k	226k

*States with timeline data on application to ISA: CT, DC, MA, ME, MN, NJ, RI, VA
**States with timeline data on application to PTO: AZ, CT, DC, DE, IN, MA, MD, ME, MN, MT, NY, OR, RI, TX, WA
^States with distribution upgrade cost data: CO, CT, NY, RI

Sample Representativeness



*EIA Form 861 non-NEM data does not report installation counts; counts were estimated based on share of solar capacity.

- As a proxy for determining whether LBNL's dataset for interconnection *applications* is representative of actual *installations* in the U.S., LBNL compared its data to DER installations reported by utilities to the Energy Information Administration (EIA) on Form 860 (Electric Generator Report) and Form 861 (Electric Power Industry Report).
  - In order to produce a comparable sample for this particular analysis, LBNL used only solar data and made additional adjustments.*
- The results indicate that LBNL's data are highly representative for several states.
  - Including four states comprising the majority of projects in LBNL's sample: AZ, CA, NY, and NJ
- Nevertheless, data diverges significantly between the LBNL and EIA datasets for some states. In addition to sample size, the mismatch may be due in part to:
  - Share of small vs. large projects
  - More data from municipal and rural electric cooperative utilities in LBNL's dataset for some states

Chart is filtered so states with highest coverage by capacity display at the top, starting under "Overall".
*See the Technical Appendix for details.

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Data Analysis: Interconnection Applications

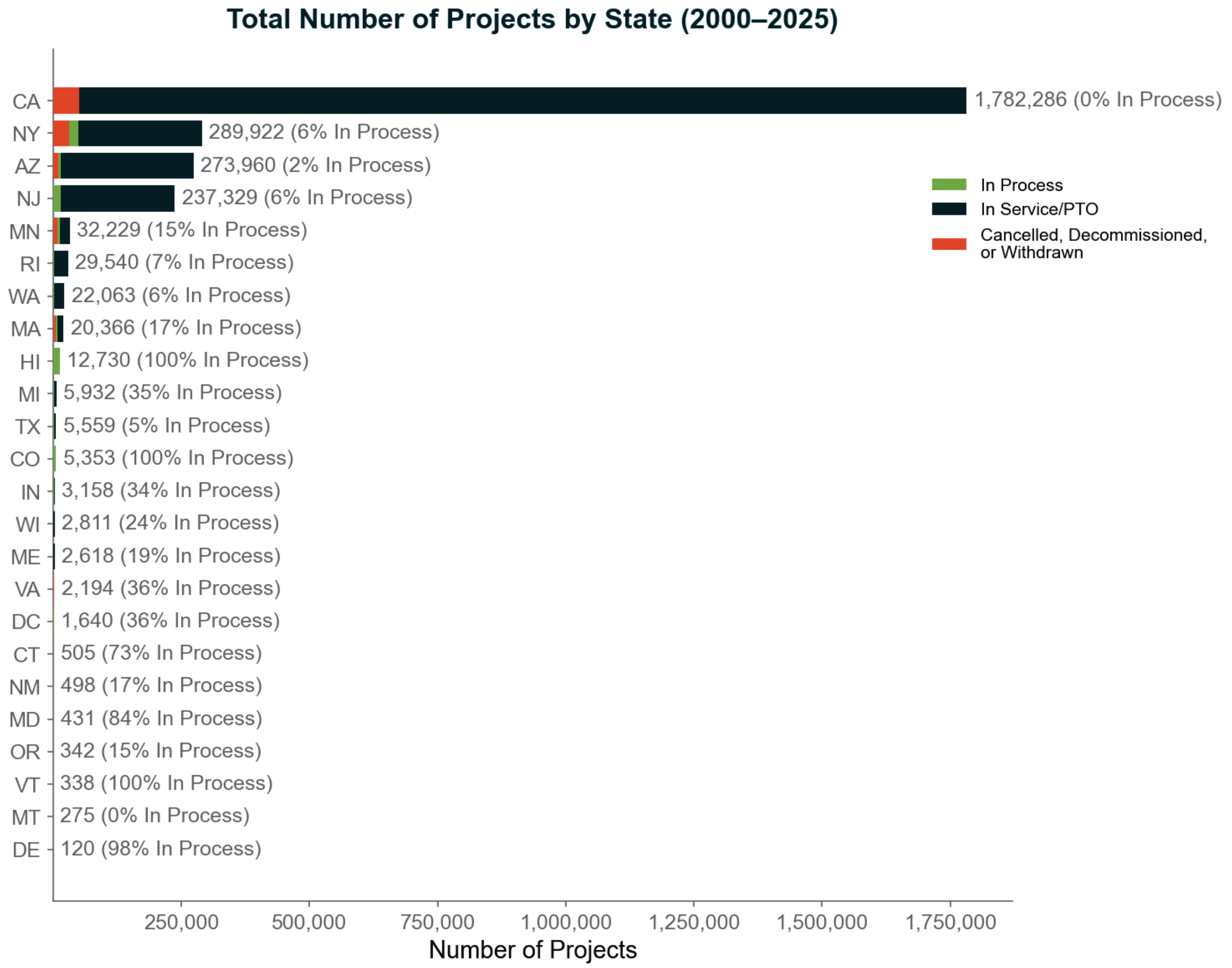
Application Status

Application Status	Description
Application	Interconnection application has been received by utility
Interconnection Service Agreement (ISA)	Interconnection service agreement has been executed or is under review
Under Study/Review	Project is undergoing a technical review or study
Design and Construction	Project interconnection design or construction is underway
Finalization	Project is undergoing witness test, commissioning, or other final steps directly prior to being placed in service
Permission to Operate (PTO)	Utility provided permission to operate, or the project is in service
On Hold	Project is on hold in the interconnection process
Cancelled/Decommissioned/Withdrawn	Project is either cancelled, decommissioned, or withdrawn

Application Data: By State

- Interconnection application data in LBNL's sample—e.g., project count, size, type, application status—are heavily represented by California, which makes up 65% of the data, followed by New York (11%), Arizona (10%), and New Jersey (9%).

- The vast majority of projects (92.2%) in LBNL's dataset are in service and operating (achieved PTO status).

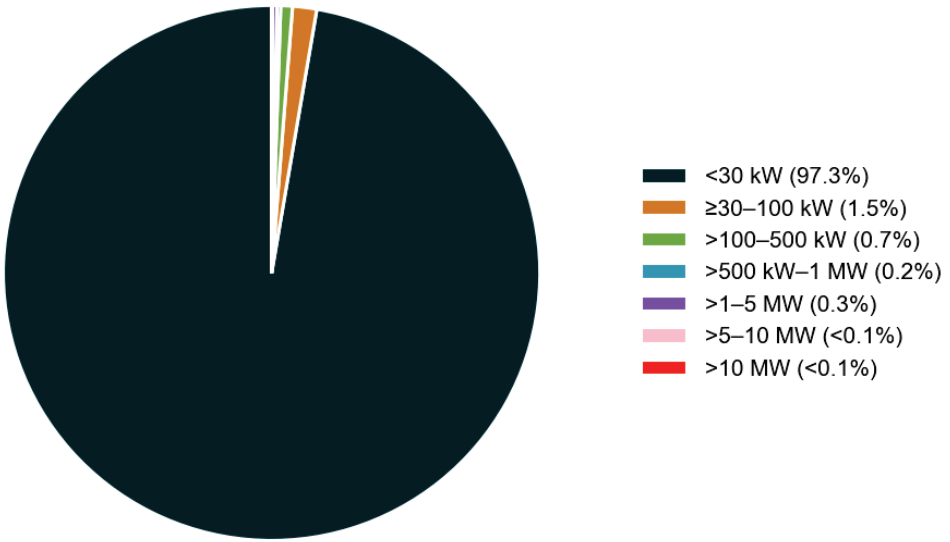


The chart excludes states with fewer than 100 projects in LBNL's sample.
Data collected for CA only includes in service/PTO or decommissioned projects.
See the Technical Appendix for full sample details.

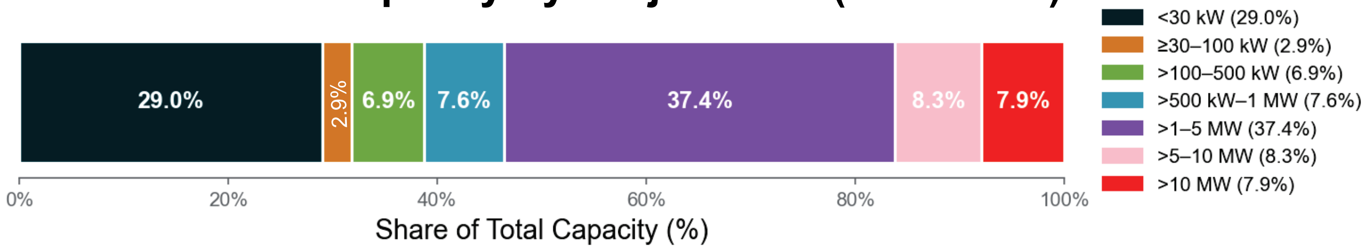
Application Data: Project Count and Capacity by Project Size

- By project count, small systems (<30 kW), typically residential-scale, make up the vast majority of projects in LBNL's dataset (97.3%).
  - The second largest subset of projects, ≥30-100 kW, represents only 1.5% of the data.
- Projects >1-5 MW represent the most capacity in the dataset (37.4%).
  - Small systems (<30 kW) account for the second highest share of capacity in the dataset (29.0%).

Share of Project Count by Project Size (2000-2025)

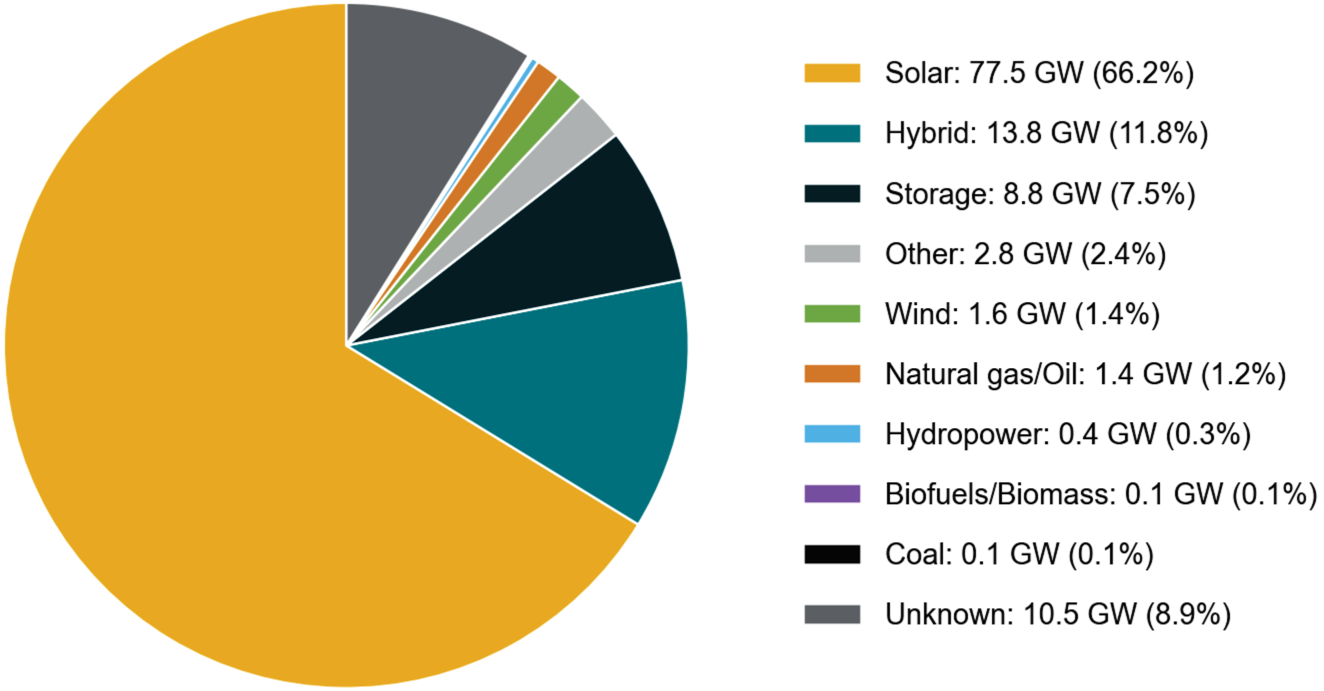


Share of Total Capacity by Project Size (2000-2025)



The figures exclude projects that are cancelled, decommissioned or withdrawn. See Technical Appendix for full sample details.

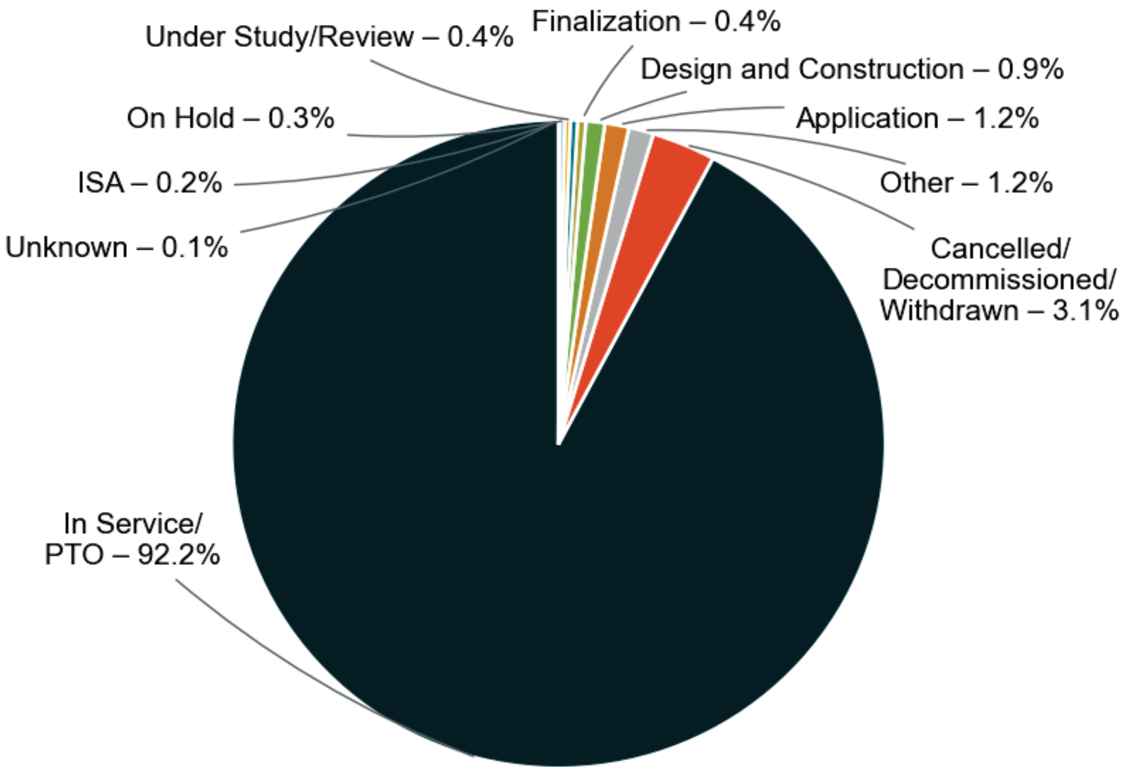
Application Data: Technology Share by Capacity (2000-2025)



- Solar represents two-thirds of the projects by capacity (77.5 GW).
- Hybrid systems are the second largest share of the sample, at 11.8% (13.8 GW).
- Standalone storage systems account for 7.5% of the sample (8.8 GW).
- The sample includes many other technologies, such as gas and oil generators.

Hybrid systems are any project with more than one technology, including microgrids and combinations of biomass, coal, diesel, fuel cells, fuel oil, geothermal, hydropower, hydrogen, natural gas, wind, solar, and storage.
"Other" includes steam turbines, fuel cells, hydrogen, combined heat and power, and bidirectional vehicle chargers.
Unknown technologies are for projects that did not specify the technology type.
See the Technical Appendix for full sample details.

Application Data: Share of Projects by Status (2020-2025)



- The vast majority (92.2%) of projects that applied for interconnection between 2020 and 2025 are in service and operating (achieved PTO).
- Projects that are cancelled, decommissioned or withdrawn represent only 3.1% of the total.
- The share of all other project statuses in the sample is 4.7%.

See the Technical Appendix for full sample details.

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Data Analysis: Timelines

Context for Timeline Data

- The availability of timeline data varies across utilities, both in terms of the first year that interconnection applications are reported and the particular interconnection statuses covered.
- LBNL's analyses focus on the time between: (1) interconnection application submittal and execution of the interconnection service agreement (ISA) with the utility and (2) application submittal and permission to operate (PTO) or the in-service date.
  - Some states provide both types of data; other states provide data on only one of these metrics.
- Data for timelines to ISA are heavily represented by New Jersey (94%), while data for timelines to PTO are heavily represented by Arizona (45%) and New York (42%).
- There likely is a bias in the timeline to PTO analysis for 2024 and 2025 for larger projects, which typically have timelines longer than 12 months.
  - Projects with a 2024 or 2025 application year that achieve PTO by 2025 may bias the sample towards a shorter timeline compared to prior years.
- LBNL's data samples for timeline to ISA represent all interconnection statuses. The data samples for timelines to PTO exclude cancelled, decommissioned, and withdrawn projects.

See the Technical Appendix for full sample details.

Timeline Calculations Across Metrics

- LBNL analyzed interconnection metrics over time by application year, timelines calculated as either days to ISA or months to PTO, and timeline duration.

Application Year	Timeline to ISA	Timeline to PTO	Timeline Duration
• "Application year" is the year a DER interconnection application was submitted to a utility. • Application years are used for all analyses.	• Calculated as the number of days between application submittal and ISA	• Calculated as the number of months between application submittal and PTO	• Calculated as the share of projects that achieve PTO within a certain number of days/years and the share of projects that remain in process

Timeline Duration Analysis by Application Year and Project Size

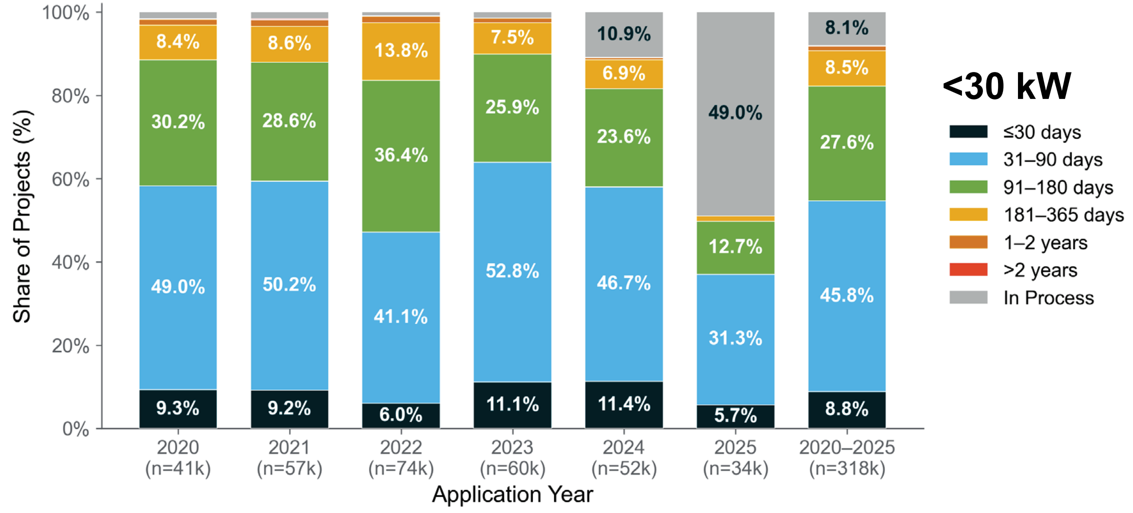
- The following slides analyze how long a project spends in the interconnection process, by application year and by project size.
  - Each bar in the chart represents an application (mint) year.
  - Colors represent how long it took for projects to achieve PTO from their application date (“Project Duration”).
  - “In process” indicates that a project is still under review in the utility’s interconnection process and has not yet achieved PTO.
- The time it takes to get the utility’s PTO generally increases with project size.
  - For example, 46% of projects <30 kW received the utility’s PTO in 31-90 days between 2020-2025; <1% of projects >100 kW–10 MW received PTO status in 31-90 days during the same period.
  - About 8% of projects <100 kW remained in process between 2020-2025, compared to 89% of larger projects (>500 kW–5 MW).
  - The majority (76%) of larger projects (>100 kW) remained in process during the period 2020-2025.

Project Duration

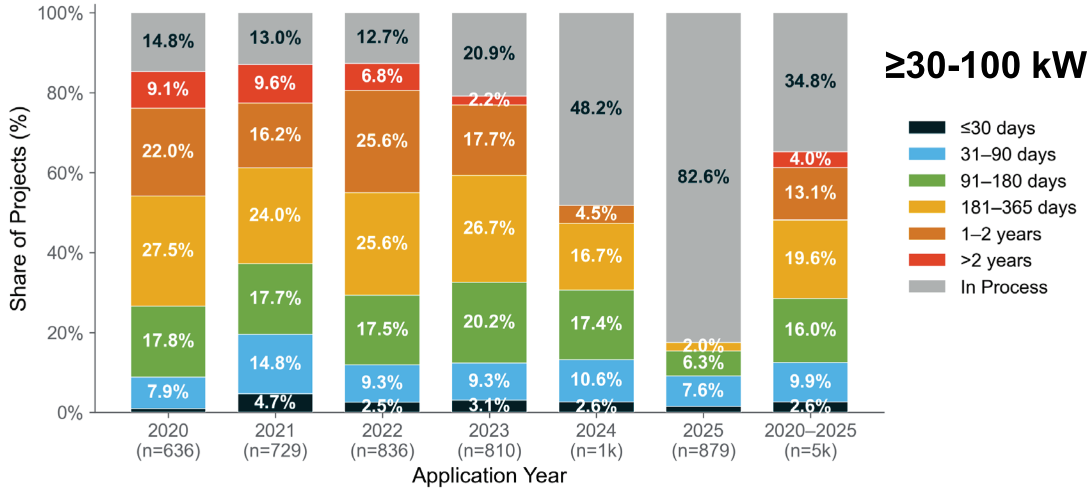
- ≤30 days
- 31–90 days
- 91–180 days
- 181–365 days
- 1–2 years
- >2 years
- In Process

The sample size represents the number of projects for a particular size and year(s) and excludes cancelled or withdrawn projects. See Technical Appendix for full sample details.

Timeline Duration to PTO by Application Year (1)



States represented in the sample include AZ, CT, DC, IN, MA, ME, MN, NY, RI, TX, WA with majority of the data representing AZ (42%) and NY (39%) and RI (7%).



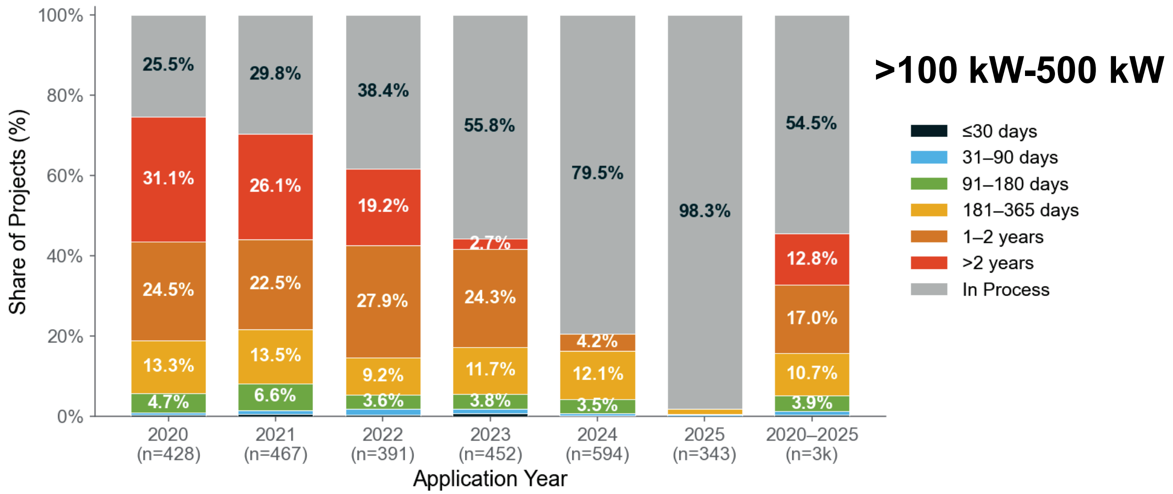
States represented in the sample include AZ, CT, DC, IN, MA, ME, MN, NY, OR, RI, TX, WA with majority of the data representing NY (41%) and AZ (20%) and MA (13%).

Project Size	Application to PTO Duration	Share of Projects						
		2020	2021	2022	2023	2024	2025	2020-2025
<30 kW	≤30 days	9.3%	9.2%	6.0%	11.1%	11.4%	5.7%	8.8%
	31-90 days	49.0%	50.2%	41.1%	52.8%	46.7%	31.3%	45.8%
	91-180 days	30.2%	28.6%	36.4%	25.9%	23.6%	12.7%	27.6%
	181-365 days	8.4%	8.6%	13.8%	7.5%	6.9%	1.3%	8.5%
	1-2 years	1.3%	1.6%	1.6%	1.1%	0.6%	0.0%	1.1%
	>2 years	0.2%	0.3%	0.1%	0.0%	0.0%	0.0%	0.1%
	In Process	1.6%	1.6%	0.9%	1.5%	10.9%	49.0%	8.1%

Project Size	Application to PTO Duration	Share of Projects						
		2020	2021	2022	2023	2024	2025	2020-2025
≥30-100 kW	≤30 days	0.9%	4.7%	2.5%	3.1%	2.6%	1.5%	2.6%
	31-90 days	7.9%	14.8%	9.3%	9.3%	10.6%	7.6%	9.9%
	91-180 days	17.8%	17.7%	17.5%	20.2%	17.4%	6.3%	16.0%
	181-365 days	27.5%	24.0%	25.6%	26.7%	16.7%	2.0%	19.6%
	1-2 years	22.0%	16.2%	25.6%	17.7%	4.5%	0.0%	13.1%
	>2 years	9.1%	9.6%	6.8%	2.2%	0.0%	0.0%	4.0%
	In Process	14.8%	13.0%	12.7%	20.9%	48.2%	82.6%	34.8%

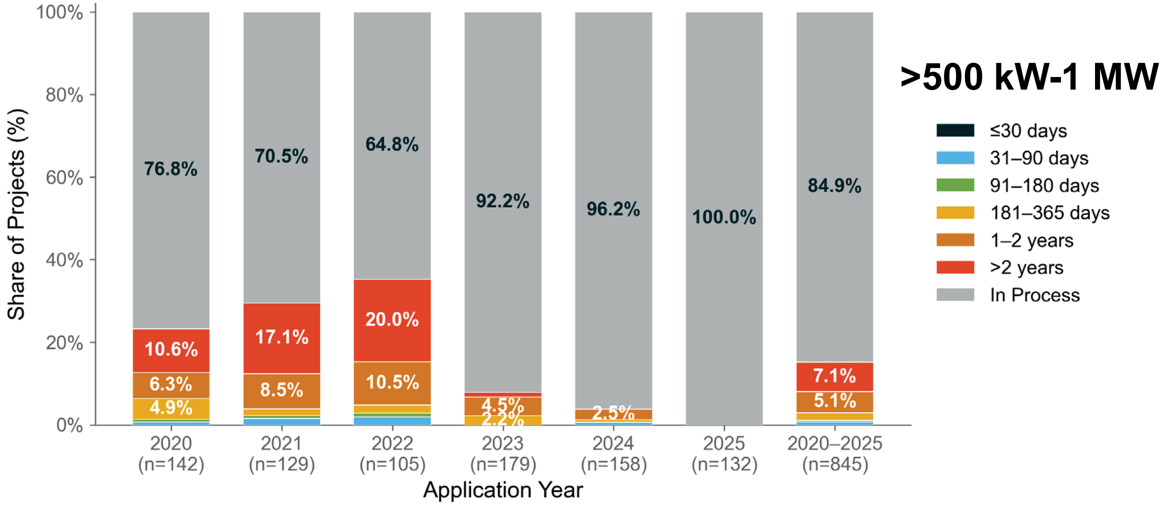
Sample size for the last bar in the charts above rounded up to the nearest 1K.
See Technical Appendix for full sample details.

Timeline Duration to PTO by Application Year (2)



States represented in the sample include AZ, CT, DC, DE, IN, MA, MD, ME, MN, NY, OR, RI, TX with majority of the data representing NY (36%) and MA (31%) and AZ (14%).

Sample size for the last bar rounded up to the nearest 1K.

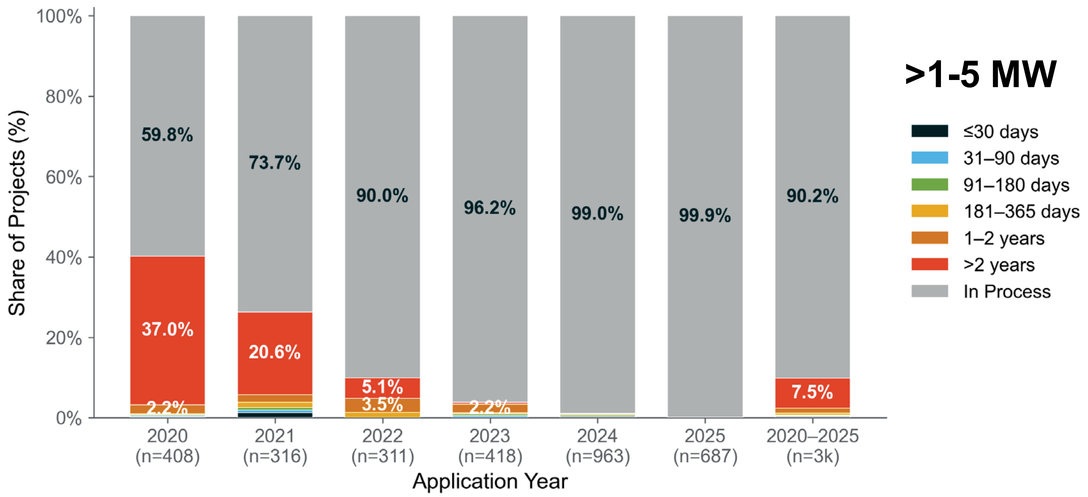


States represented in the sample include AZ, CT, DC, DE, IN, MA, MD, ME, MN, MT, NY, OR, RI, TX with majority of the data representing MN (31%) and NY (18%) and MA (14%).

Project Size	Application to PTO Duration	Share of Projects						
		2020	2021	2022	2023	2024	2025	2020-2025
>100-500 kW	≤30 days	0.2%	0.4%	0.3%	0.7%	0.2%	0.0%	0.3%
	31–90 days	0.7%	1.1%	1.5%	1.1%	0.5%	0.3%	0.9%
	91–180 days	4.7%	6.6%	3.6%	3.8%	3.5%	0.3%	3.9%
	181–365 days	13.3%	13.5%	9.2%	11.7%	12.1%	1.2%	10.7%
	1–2 years	24.5%	22.5%	27.9%	24.3%	4.2%	0.0%	17.0%
	>2 years	31.1%	26.1%	19.2%	2.7%	0.0%	0.0%	12.8%
	In Process	25.5%	29.8%	38.4%	55.8%	79.5%	98.3%	54.5%

Project Size	Application to PTO Duration	Share of Projects						
		2020	2021	2022	2023	2024	2025	2020-2025
>500 kW-1 MW	≤30 days	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	31-90 days	0.7%	1.6%	1.9%	0.0%	0.6%	0.0%	0.7%
	91-180 days	0.7%	0.8%	1.0%	0.0%	0.0%	0.0%	0.4%
	181-365 days	4.9%	1.6%	1.9%	2.2%	0.6%	0.0%	1.9%
	1-2 years	6.3%	8.5%	10.5%	4.5%	2.5%	0.0%	5.1%
	>2 years	10.6%	17.1%	20.0%	1.1%	0.0%	0.0%	7.1%
	In Process	76.8%	70.5%	64.8%	92.2%	96.2%	100.0%	84.9%

Timeline Duration to PTO by Application Year (3)



States represented in the sample include AZ, CT, DC, DE, MA, MD, ME, MN, MT, NY, OR, RI, TX with majority of the data representing NY (55%) and MD (11%) and MA (11%).

Sample size for the last bar rounded up to the nearest 1K.

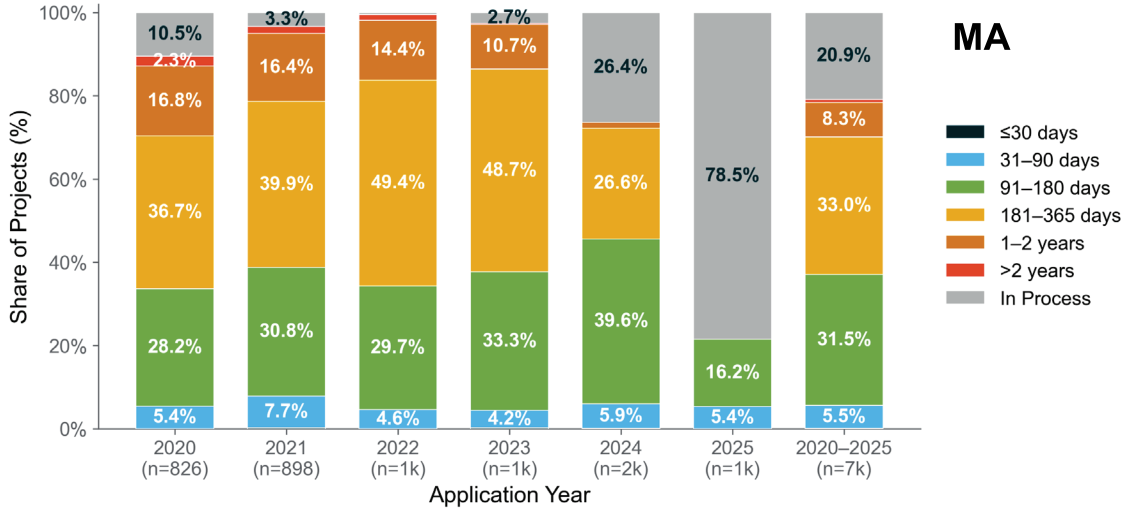
Project Size	Application to PTO Duration	Share of Projects						
		2020	2021	2022	2023	2024	2025	2020-2025
>1-5 MW	≤30 days	0.2%	1.3%	0.0%	0.0%	0.3%	0.0%	0.3%
	31-90 days	0.2%	0.6%	0.0%	0.5%	0.0%	0.1%	0.2%
	91-180 days	0.2%	0.6%	0.0%	0.5%	0.3%	0.0%	0.3%
	181-365 days	0.5%	1.3%	1.3%	0.2%	0.3%	0.0%	0.4%
	1-2 years	2.2%	1.9%	3.5%	2.2%	0.1%	0.0%	1.2%
	>2 years	37.0%	20.6%	5.1%	0.5%	0.0%	0.0%	7.5%
	In Process	59.8%	73.7%	90.0%	96.2%	99.0%	99.9%	90.2%

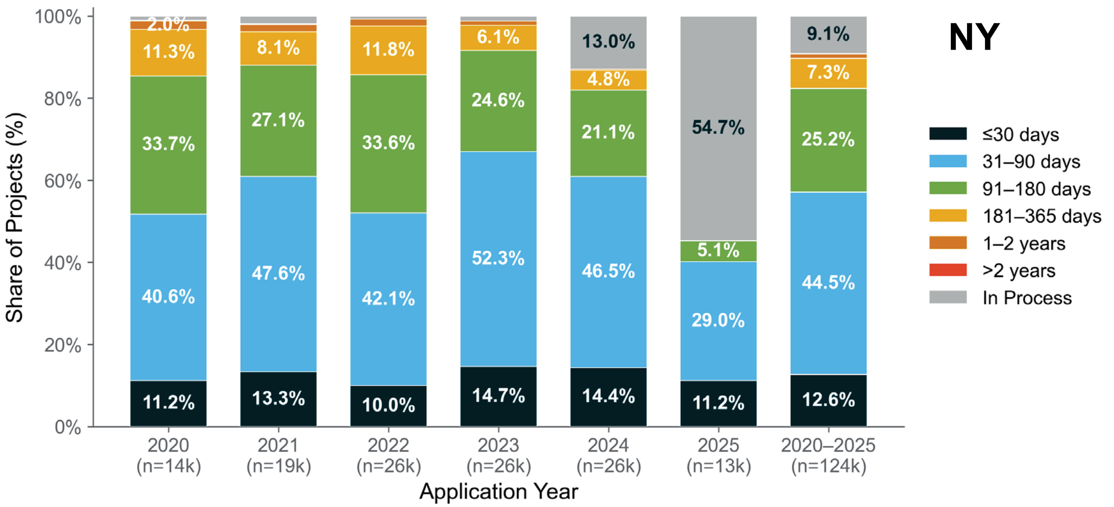
See Technical Appendix for full sample details.

Timeline Duration to PTO by Application Year – State to State Comparison

- The following slides compare the timeline duration for two project sizes in two states to illustrate variation in different markets for the period 2020-2025.
- LBNL selected Massachusetts and New York for the comparison on the basis of market maturity and advanced DER interconnection rules.
- The figures show similar trends — timeline duration increases as DER project size increases.
  - In both states, a greater share of large DER projects (>1-5 MW) were still in process during the period (did not achieve PTO), compared to small DER projects (<30 kW).
- In New York, nearly all (~90%) projects <30 kW that applied for interconnection during the period were completed within a year. In Massachusetts, that figure is ~70%.
- In Massachusetts, nearly all projects >1-5 MW that applied for interconnection between 2020-2025 remained in process. The same is true for New York between 2022-2025.

Timeline Duration to PTO by Application Year in Massachusetts and New York (<30 kW)



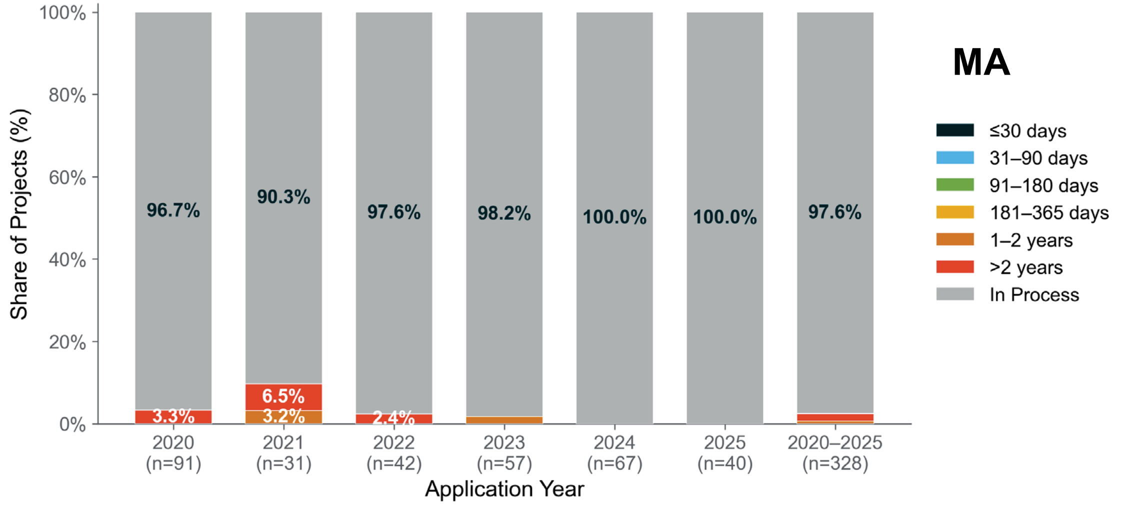


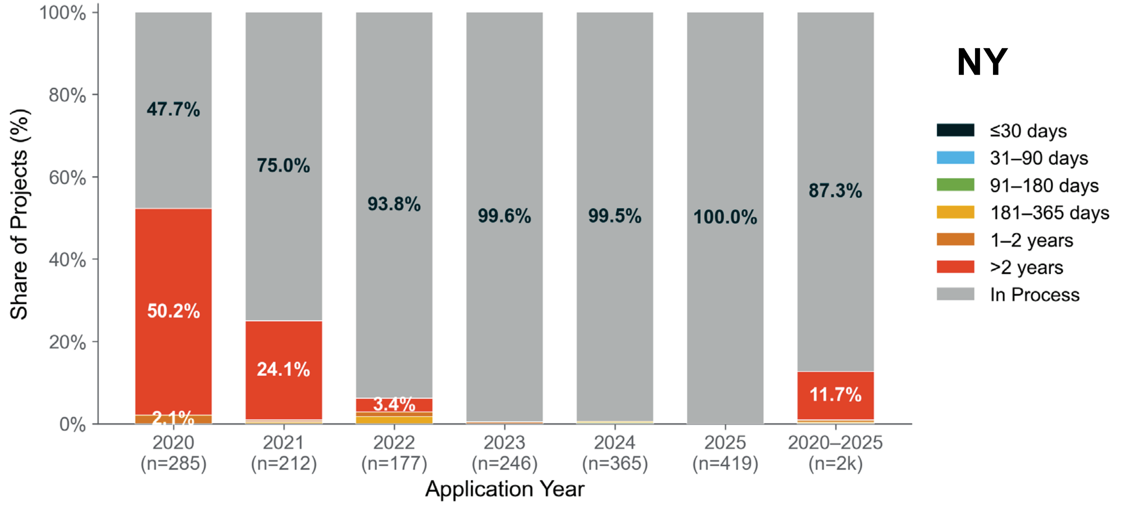
Project Size	Application to PTO Duration	Share of Projects in Massachusetts						
		2020	2021	2022	2023	2024	2025	2020-2025
<30 kW	≤30 days	0.0%	0.2%	0.0%	0.2%	0.1%	0.0%	0.1%
	31-90 days	5.4%	7.7%	4.6%	4.2%	5.9%	5.4%	5.5%
	91-180 days	28.2%	30.8%	29.7%	33.3%	39.6%	16.2%	31.5%
	181-365 days	36.7%	39.9%	49.4%	48.7%	26.6%	0.0%	33.0%
	1-2 years	16.8%	16.4%	14.4%	10.7%	1.4%	0.0%	8.3%
	>2 years	2.3%	1.7%	1.4%	0.2%	0.0%	0.0%	0.7%
	In Process	10.5%	3.3%	0.5%	2.7%	26.4%	78.5%	20.9%

Project Size	Application to PTO Duration	Share of Projects in New York						
		2020	2021	2022	2023	2024	2025	2020-2025
<30 kW	≤30 days	11.2%	13.3%	10.0%	14.7%	14.4%	11.2%	12.6%
	31-90 days	40.6%	47.6%	42.1%	52.3%	46.5%	29.0%	44.5%
	91-180 days	33.7%	27.1%	33.6%	24.6%	21.1%	5.1%	25.2%
	181-365 days	11.3%	8.1%	11.8%	6.1%	4.8%	0.0%	7.3%
	1-2 years	2.0%	1.7%	1.7%	1.1%	0.3%	0.0%	1.1%
	>2 years	0.2%	0.2%	0.1%	0.0%	0.0%	0.0%	0.1%
	In Process	1.0%	1.9%	0.7%	1.2%	13.0%	54.7%	9.1%

Sample size rounded up to the nearest 1K in the charts above.
See the Technical Appendix for full sample details.

Timeline Duration to PTO by Application Year in Massachusetts and New York (>1-5 MW)





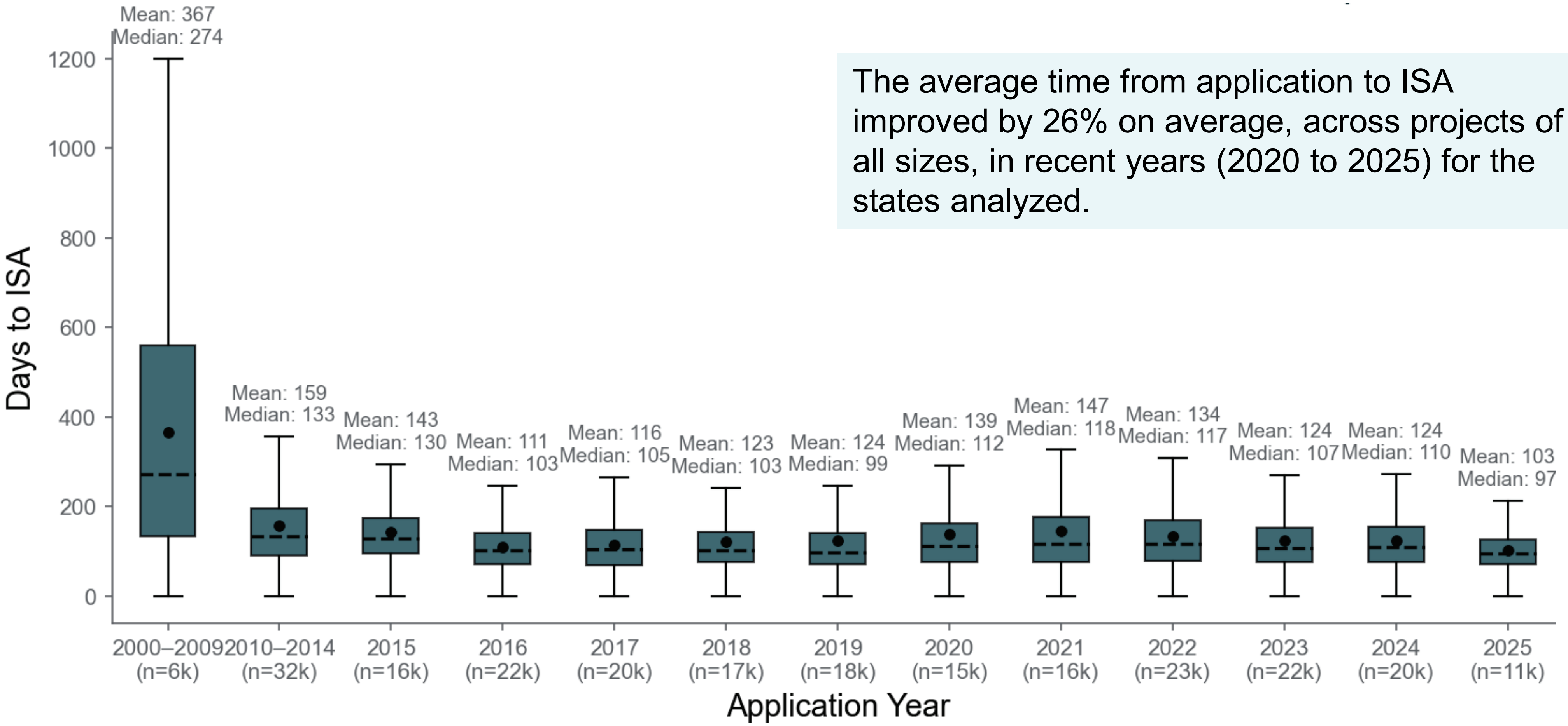
Sample size rounded up to the nearest 1K in the chart above.

Project Size	Application to PTO Duration	Share of Projects in Massachusetts						
		2020	2021	2022	2023	2024	2025	2020-2025
>1-5 MW	≤30 days	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	31-90 days	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	91-180 days	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	181-365 days	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	1-2 years	0.0%	3.2%	0.0%	1.8%	0.0%	0.0%	0.6%
	>2 years	3.3%	6.5%	2.4%	0.0%	0.0%	0.0%	1.8%
	In Process	96.7%	90.3%	97.6%	98.2%	100.0%	100.0%	97.6%

Project Size	Application to PTO Duration	Share of Projects in New York						
		2020	2021	2022	2023	2024	2025	2020-2025
>1-5 MW	≤30 days	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	31-90 days	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	91-180 days	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.1%
	181-365 days	0.0%	0.5%	1.7%	0.0%	0.3%	0.0%	0.3%
	1-2 years	2.1%	0.5%	1.1%	0.4%	0.0%	0.0%	0.6%
	>2 years	50.2%	24.1%	3.4%	0.0%	0.0%	0.0%	11.7%
	In Process	47.7%	75.0%	93.8%	99.6%	99.5%	100.0%	87.3%

See Technical Appendix for full sample details.

Timeline from Application to ISA (2000-2025)



The average time from application to ISA improved by 26% on average, across projects of all sizes, in recent years (2020 to 2025) for the states analyzed.

The chart includes all project sizes. States represented: CT, DC, MN, ME, MA, NJ, RI, VA. NJ projects represent 94% of the sample.
See the Technical Appendix for full sample details.

Timeline from Application to ISA by Project Size (2000-2025)

Number of Days to ISA

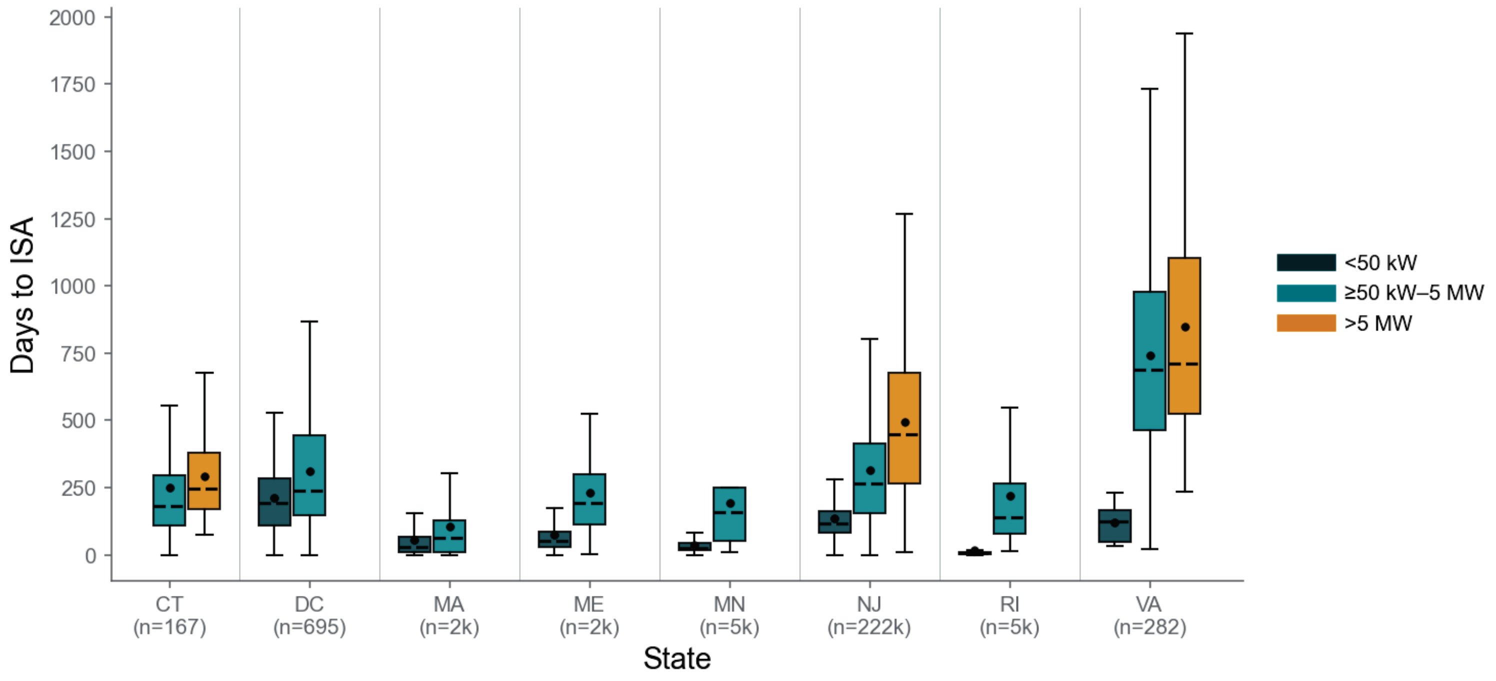
Project Size	Metric	2000– 2009	2010– 2014	2015– 2019	2020	2021	2022	2023	2024	2025
<50 kW	Mean	356	153	118	130	131	132	120	123	103
	Median	266	130	106	110	114	116	106	109	97
≥50 kW – 5 MW	Mean	522	232	281	411	433	270	290	194	105
	Median	442	201	223	366	372	207	243	178	97
>5 MW	Mean		448	729	591	570				
	Median		379	630	620	499				

- Timelines to ISA for projects <50 kW and ≥50 kW–5 MW decreased between 2020 and 2025.
- Timelines to ISA for projects >5 MW improved considerably from 2015 to 2021; the dataset for 2022-2025 includes fewer than 10 projects each year so these projects are excluded.
  - Variation in the relative change for mean and median values during different time periods is likely due to fluctuations in sample size and make-up from year to year.

States represented: CT, DC, MA, ME, MN, NJ, RI, VA. NJ projects represent 94% of the sample.
Gray cells indicate cohorts with <10 projects.
See Technical Appendix for full sample details.

Timeline to ISA Varies Considerably by State and Project Size

- Timeline data vary considerably by state and project size.
- As expected, median timelines to ISA were longest for large projects, particularly projects >5 MW in NJ and ≥50 kW in VA.



States represented: CT, DC, MA, ME, MN, NJ, RI, VA. NJ projects represent 94% of the sample.
The figure excludes cohorts with <10 projects. Gray cells in the table indicate cohorts with <10 projects.

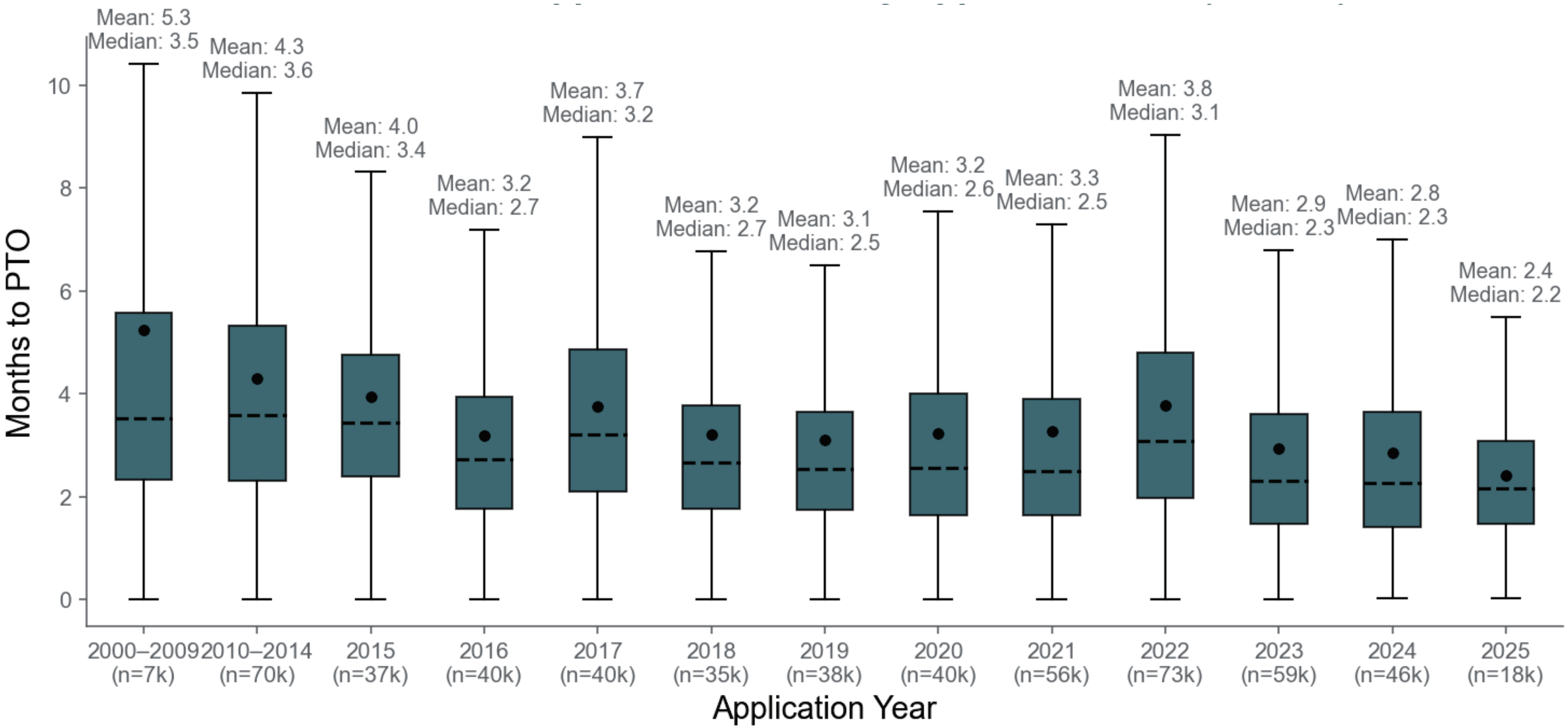
Days to ISA (2000-2025)				
State	Project Size	Mean	Median	Count
CT	<50 kW			0
CT	≥50 kW–5 MW	249	181	149
CT	>5 MW	291	247	18
DC	<50 kW	213	193	467
DC	≥50 kW–5 MW	310	240	228
DC	>5 MW			0
MA	<50 kW	56	29	1534
MA	≥50 kW–5 MW	104	62	755
MA	>5 MW			5
ME	<50 kW	73	52	1895
ME	≥50 kW–5 MW	232	194	56
ME	>5 MW			0
MN	<50 kW	37	26	4532
MN	≥50 kW–5 MW	194	157	17
MN	>5 MW			2
NJ	<50 kW	137	115	216893
NJ	≥50 kW–5 MW	316	265	5444
NJ	>5 MW	496	450	89
RI	<50 kW	17	5	4391
RI	≥50 kW–5 MW	220	140	235
RI	>5 MW			6
VA	<50 kW	119	123	15
VA	≥50 kW–5 MW	742	690	187
VA	>5 MW	849	713	80

Interconnection Timeline to PTO Analysis – Main Findings

- The median time from application to PTO* for projects <30 kW was 3.6 months or less between 2000 and 2025. The median time during the latter part of this period, from 2020 to 2025, was 3.1 months or less.
- The median timelines for DER projects >1-5 MW ranged from ~5–48 months between 2000 and 2024.
  - Median timelines more than doubled from 2000 to 2018
  - Median timelines for projects that achieved PTO declined between 2019 and 2023, from 42.2 months to 13.4 months; however, the majority of large DER projects sized >1-5 MW remained in process without achieving PTO by 2025.
    - This may indicate that projects that achieved PTO in a shorter timeframe skewed the median timeline results. The sample size for the median timeline analysis includes only projects in service; it excludes projects in process.
- Conclusions about timelines to PTO in 2024 and 2025 for DER projects 1–5 MW are difficult to make.
  - The cut-off date for data collection may bias the sample towards projects with shorter timelines, reducing the mean and median.
  - Sample size is insufficient.
  - The analysis does not determine whether timelines in recent years are decreasing. Insights on timelines for larger DER projects are better illustrated by the timeline duration analysis.

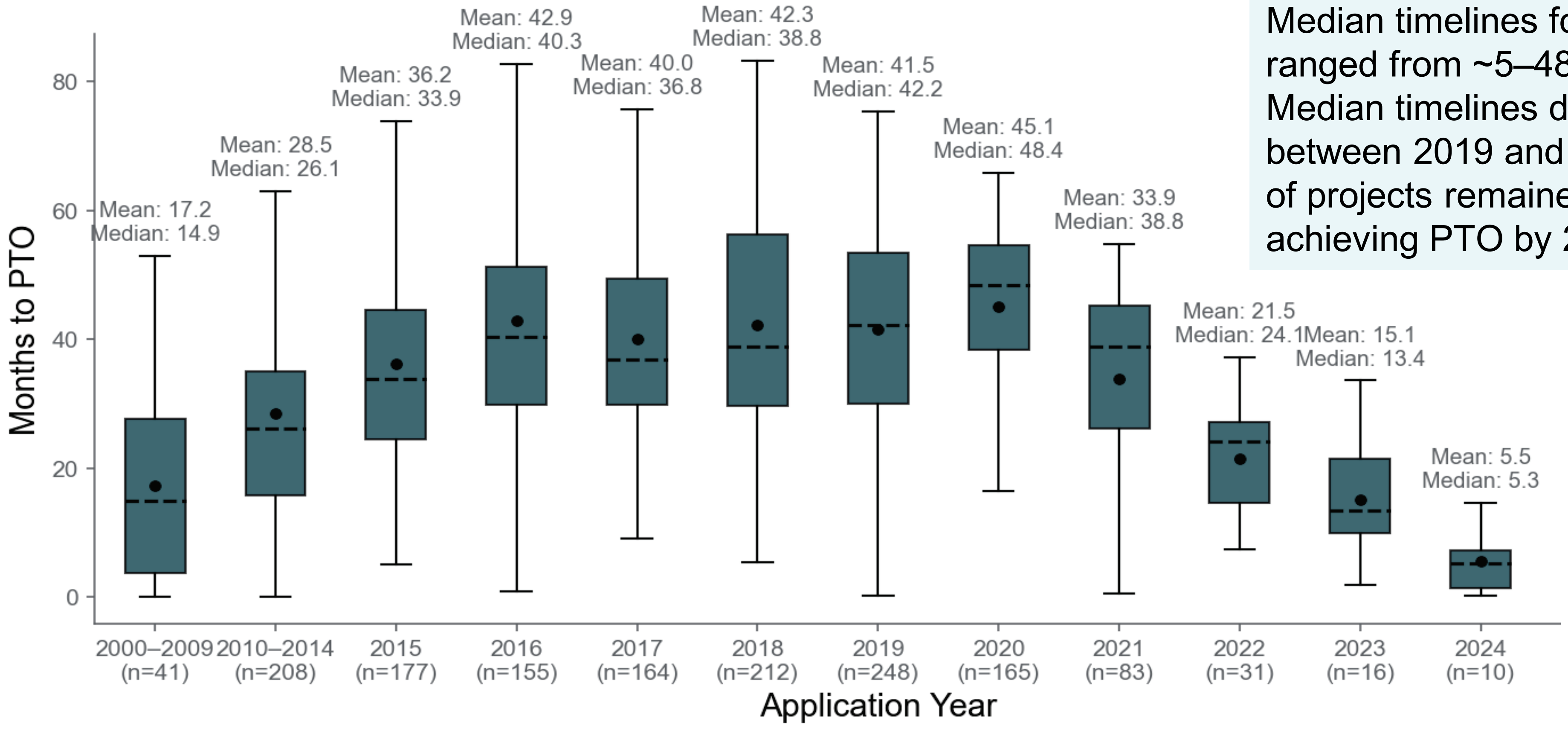
*Timeline to PTO includes construction and inspection.
See Additional Figures for timeline to PTO figures for projects 5-10 MW.

Months From Application to PTO for Projects <30 kW (2000-2025)



The sample includes only projects in process or in service; it excludes withdrawn or cancelled projects.
States represented include AZ, DC, IN, MA, ME, MN, NY, RI, TX, and WA. The majority of data is represented by AZ (46%) and NY (42%).
See Technical Appendix for full sample details.

Months From Application to PTO for Projects >1-5 MW (2000-2024)



Median timelines for projects >1-5 MW ranged from ~5–48 months by year. Median timelines declined significantly between 2019 and 2023, but the majority of projects remained in process without achieving PTO by 2024.

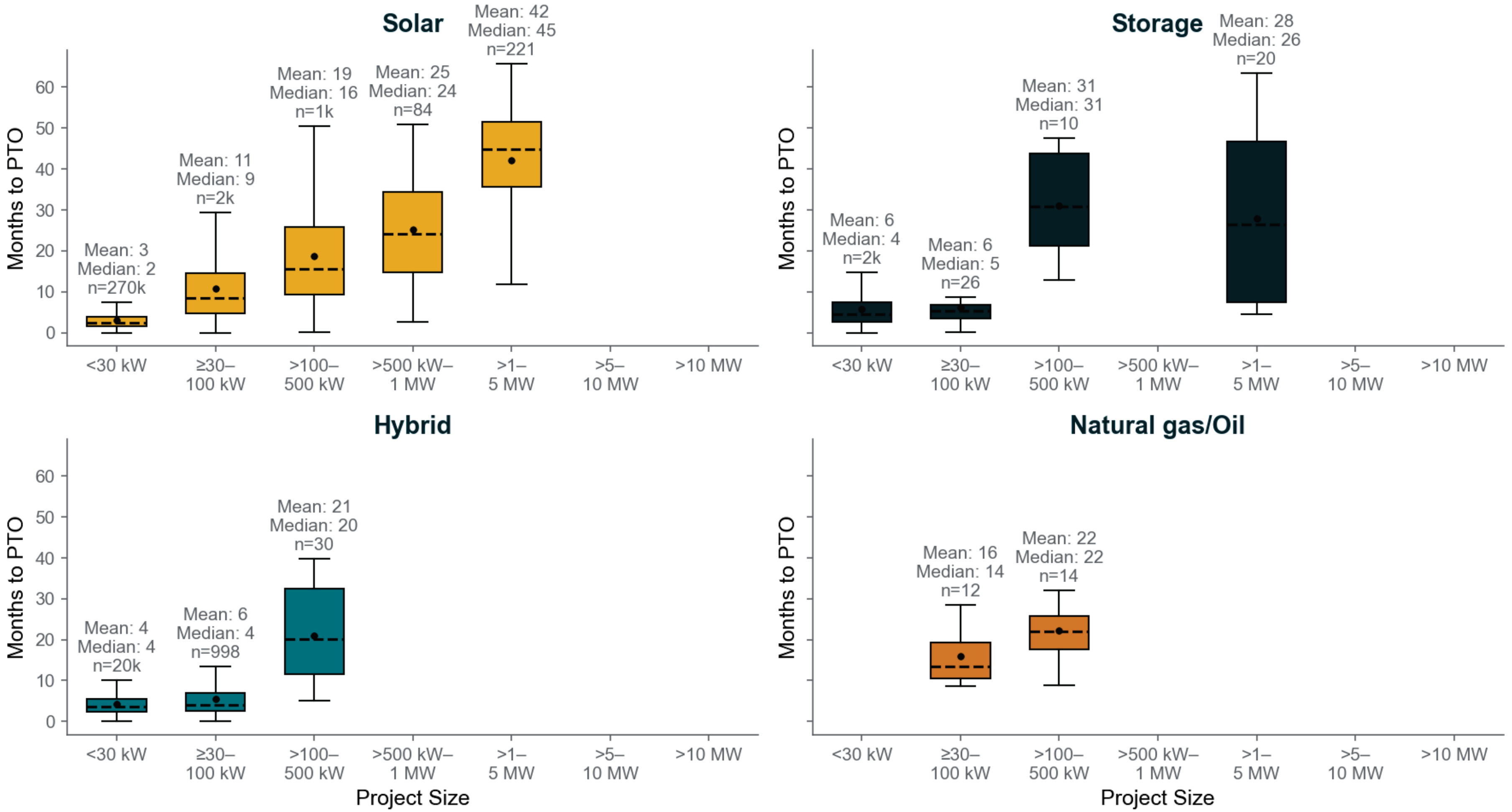
The cut-off date for sample collection biases timelines in 2021-2024, given the long interconnection process for large projects. In addition, the figure excludes 2025 data because LBNL's sample for that year includes only one project.

Includes only projects in process or in service; excludes withdrawn or cancelled projects.

States represented include: AZ, CT, DC, DE, MA, MD, ME, MN, MT, NY, OR, and RI. The majority of data is from NY (59%) and MA (27%).

See Technical Appendix for full sample details.

Months From Application to PTO by Technology & Project Size (2020-2025)



State shares represented in the sample — solar: AZ (43%), NY (40%); storage: NY (48%), AZ (30%); hybrid: AZ (57%), NY (24%); natural gas/oil: NY (45%), MA (34%).
See Technical Appendix for full sample details. The figure excludes cohorts with <10 projects.

Timeline to PTO by Technology (2020-2025)

- Solar technologies had both the shortest and longest median timelines to PTO—2 months for small projects (<30 kW) and 45 months for projects >1-5 MW.
- Overall, storage and hybrid technologies experienced relatively short median timelines to PTO at 5 months and 4 months, respectively.
  - However, the median timeline for large storage projects (>1-5 MW) was 26 months.
  - Projects >100 kW had substantially longer timelines than smaller projects.
- The overall median timeline to PTO for the 44 natural gas and oil projects was 16 months.

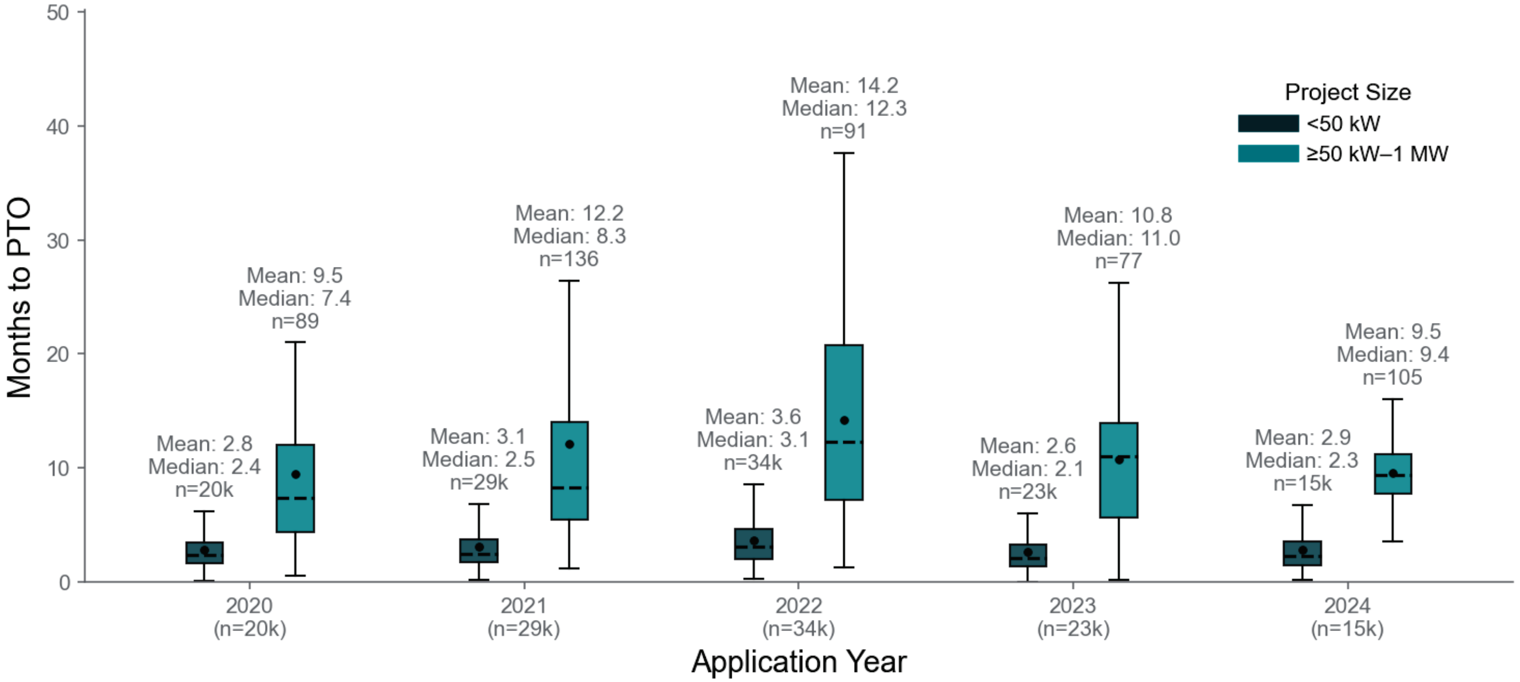
Months to PTO (2020-2025)				
Technology Type	Size Segment	Mean	Median	Count
Solar	<30 kW	3	2	269838
	≥30–100 kW	11	9	2283
	>100–500 kW	19	16	1131
	>500 kW–1 MW	25	24	84
	>1–5 MW	42	45	221
	>5–10 MW			4
	>10 MW			4
	Overall	3	2	273565
Storage	<30 kW	6	4	1589
	≥30–100 kW	6	5	26
	>100–500 kW	31	31	10
	>500 kW–1 MW			6
	>1–5 MW	28	26	20
	>5–10 MW			0
	>10 MW			0
	Overall	6	5	1651
Hybrid	<30 kW	4	4	20481
	≥30–100 kW	6	4	998
	>100–500 kW	21	20	30
	>500 kW–1 MW			4
	>1–5 MW			9
	>5–10 MW			2
	>10 MW			0
	Overall	4	4	21524
Natural gas/Oil	<30 kW			7
	≥30–100 kW	16	14	12
	>100–500 kW	22	22	14
	>500 kW–1 MW			4
	>1–5 MW			5
	>5–10 MW			0
	>10 MW			2
	Overall	20	16	44

Gray cells indicate cohorts with <10 projects.

Timeline to PTO by State and Project Size

- LBNL analyzed mean and median timelines to PTO, by project size and by state, for the five states with the largest samples: Arizona, New York, Rhode Island, Washington, Massachusetts.
- Across these states for the period from 2020 to 2024, median timelines for large projects (>1 MW) were substantially longer than for smaller projects.
  - Large projects took 31 months to reach PTO in Massachusetts and 45 months to reach PTO in New York.
- Mid-size DER projects (≥50 kW–1 MW) in Massachusetts, New York, and Rhode Island took over one year to reach PTO from 2020 to 2024, with median timelines at 18 months for Massachusetts, 16 months for New York, and 17 months for Rhode Island.
  - Median timelines to PTO were shorter in Arizona at 9 months.
- Median timelines for small projects (<50 kW) to reach PTO were 3.1 months or less between 2020 and 2024 in New York, Arizona, Rhode Island and Washington, but over 6 months in Massachusetts over the same period.

Timeline to PTO by State and Project Size: Arizona (2020-2024)



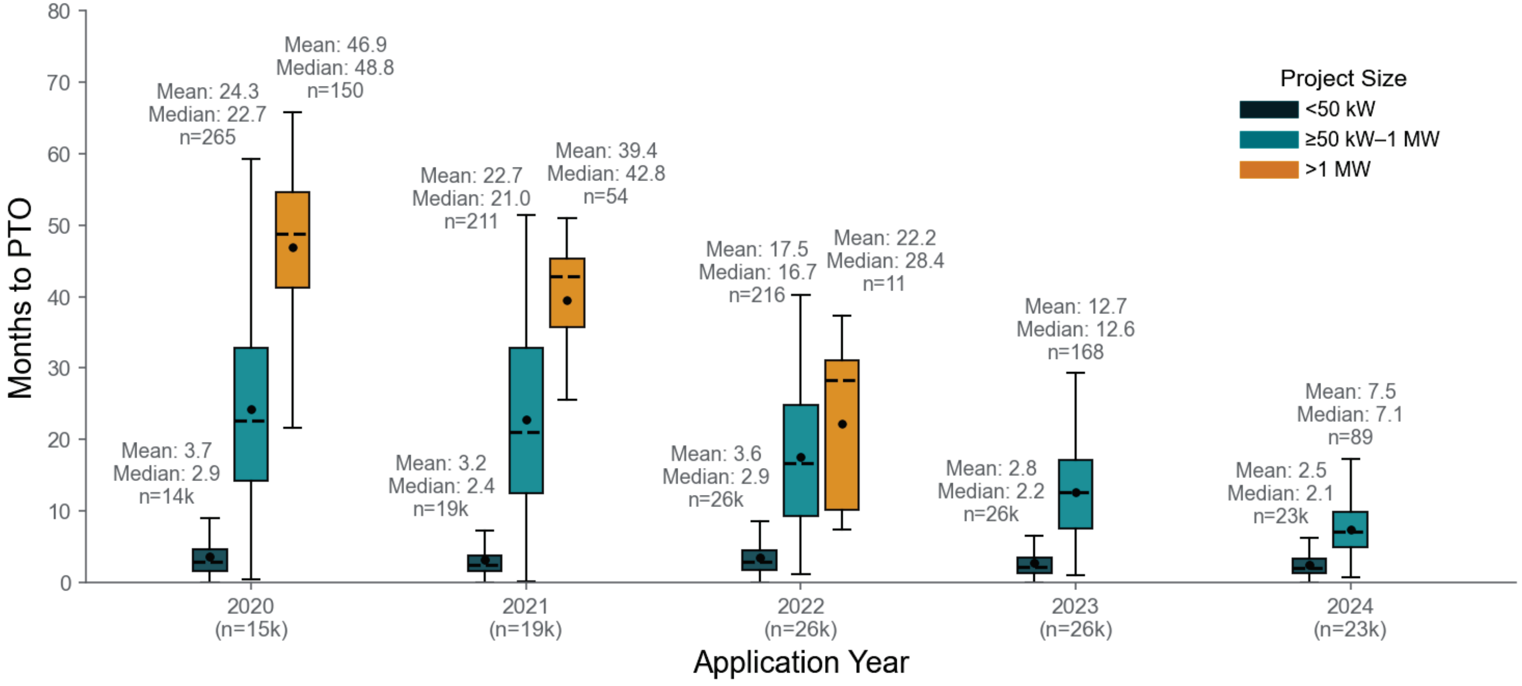
- Median timelines to achieve PTO in Arizona for projects of all sizes increased between 2020 and 2022 and decreased between 2022 and 2024.

Arizona Timeline to PTO (in Months) by Project Size

State	Project Size	Metric	2020	2021	2022	2023	2024	2020–2024
AZ	<50 kW	Mean	2.8	3.1	3.6	2.6	2.9	3.1
		Median	2.4	2.5	3.1	2.1	2.3	2.5
	≥50 kW–1 MW	Mean	9.5	12.2	14.2	10.8	9.5	11.3
		Median	7.4	8.3	12.3	11.0	9.4	9.4
	>1 MW	Mean						15.4
		Median						10.2

The figure excludes cohorts with <10 projects and grays out these cells in the table.

Timeline to PTO by State and Project Size: New York (2020-2024)



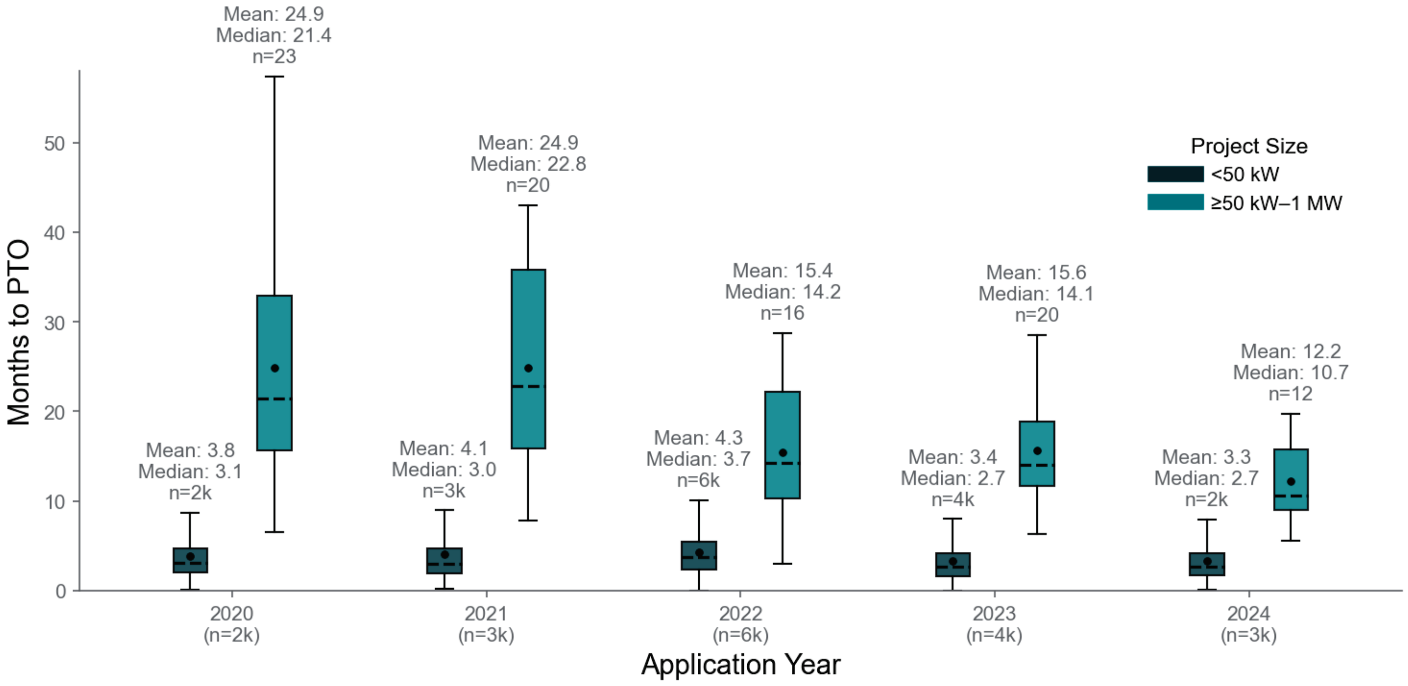
- The median timeline to achieve PTO in New York was 2.4 months for projects <50 kW and 16 months for projects ≥50 kW-1 MW for the period.
- The small sample for projects >1 MW in 2023 and 2024 may skew the results toward a longer median timeline. Only one project >1 MW in 2023, and two projects >1 MW in 2024, achieved PTO.

New York Timeline to PTO (in Months)

State	Project Size	Metric	2020	2021	2022	2023	2024	2020–2024
NY	<50 kW	Mean	3.7	3.2	3.6	2.8	2.5	3.1
		Median	2.9	2.4	2.9	2.2	2.1	2.4
	≥50 kW–1 MW	Mean	24.3	22.7	17.5	12.7	7.5	18.8
		Median	22.7	21.0	16.7	12.6	7.1	16.0
	>1 MW	Mean	46.9	39.4	22.2			43.3
		Median	48.8	42.8	28.4			45.3

The figure excludes cohorts with <10 projects and grays out these cells in the table.

Timeline to PTO by State and Project Size: Rhode Island (2020-2024)



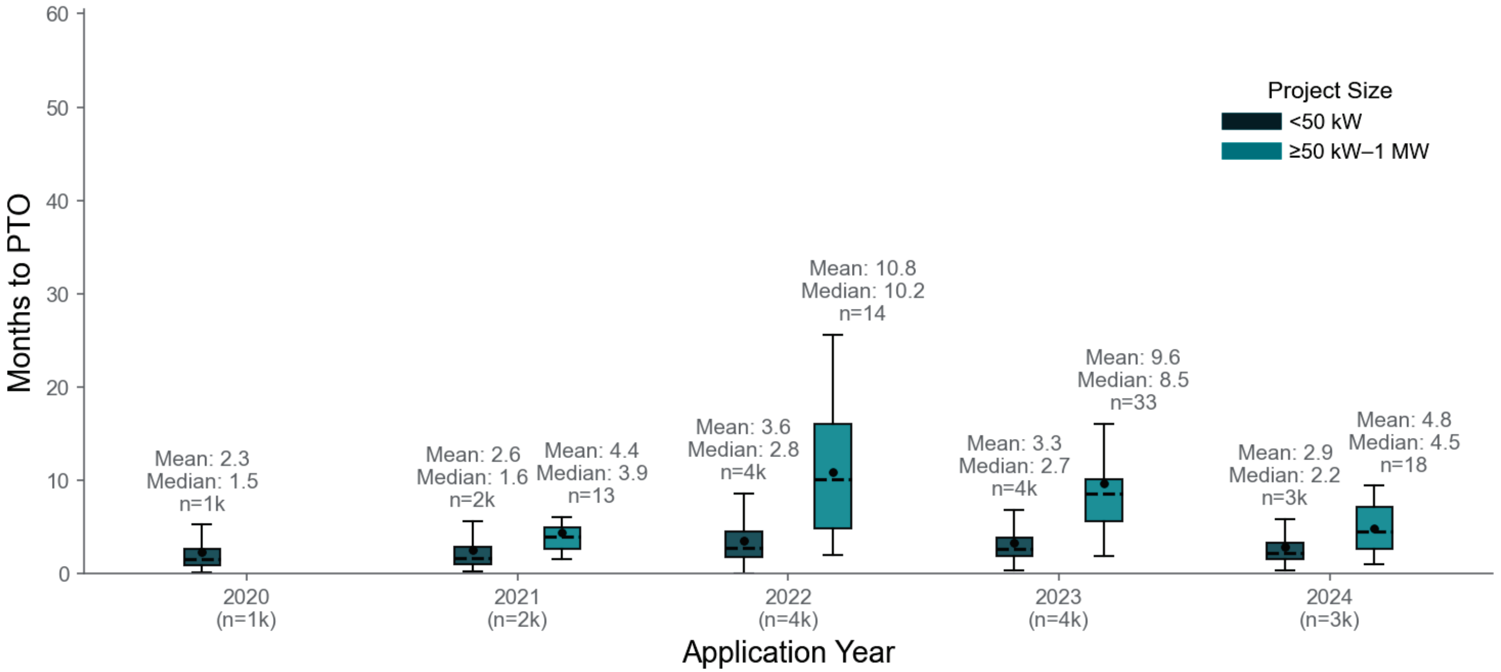
- The median timeline to achieve PTO for projects in Rhode Island was 3.1 months for projects <50 kW and 16.8 months for projects ≥50 kW–1 MW.
- Median timelines to PTO have decreased over time.

Rhode Island Timeline to PTO (in Months)

State	Project Size	Metric	2020	2021	2022	2023	2024	2020–2024
RI	<50 kW	Mean	3.8	4.1	4.3	3.4	3.3	3.9
		Median	3.1	3.0	3.7	2.7	2.7	3.1
	≥50 kW–1 MW	Mean	24.9	24.9	15.4	15.6	12.2	19.5
		Median	21.4	22.8	14.2	14.1	10.7	16.8
	>1 MW	Mean						7.1
		Median						7.1

The figure excludes cohorts with <10 projects and grays out these cells in the table.

Timeline to PTO by State and Project Size: Washington State (2020-2024)



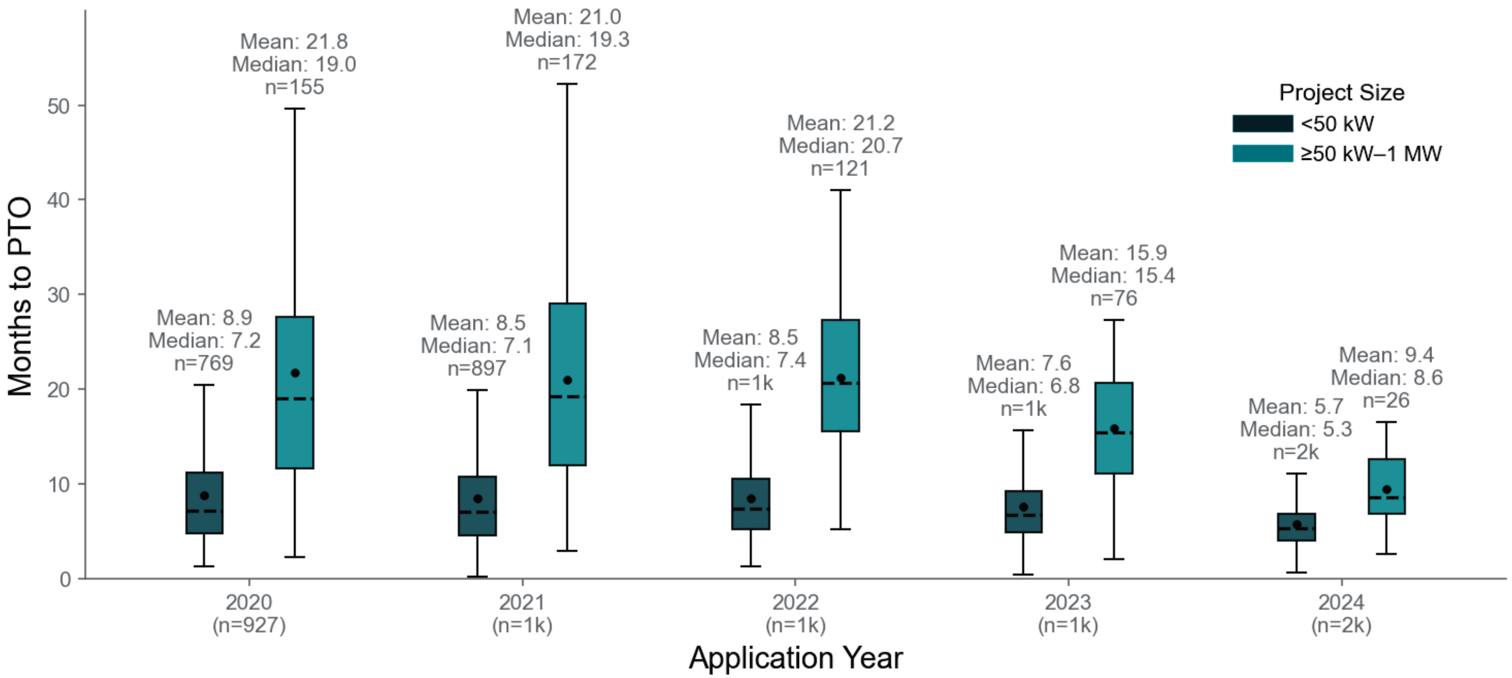
- The median timeline to achieve PTO in Washington was 2.3 months for projects <50 kW and 6 months for projects ≥50 kW to 1 MW for the period.
- Median timelines to PTO declined between 2022-2024.

Washington Timeline to PTO (in Months)

State	Project Size	Metric	2020	2021	2022	2023	2024	2020–2024
WA	<50 kW	Mean	2.3	2.6	3.6	3.3	2.9	3.1
		Median	1.5	1.6	2.8	2.7	2.2	2.3
	≥50 kW–1 MW	Mean		4.4	10.8	9.6	4.8	7.8
		Median		3.9	10.2	8.5	4.5	6.0
	>1 MW	Mean						
		Median						

The Washington sample was limited to projects ≤1 MW.
The figure excludes cohorts with <10 projects and grays out these cells in the table.

Timeline to PTO by State and Project Size: Massachusetts (2020-2024)



- The median timeline to achieve PTO in Massachusetts was 6.4 months for projects <50 kW and 18.1 months for projects ≥50 kW-1 MW.

Massachusetts Timeline to PTO (in Months)

State	Project Size	Metric	2020	2021	2022	2023	2024	2020–2024
MA	<50 kW	Mean	8.9	8.5	8.5	7.6	5.7	7.5
		Median	7.2	7.1	7.4	6.8	5.3	6.4
	≥50 kW–1 MW	Mean	21.8	21.0	21.2	15.9	9.4	20.0
		Median	19.0	19.3	20.7	15.4	8.6	18.1
	>1 MW	Mean						31.7
		Median						31.5

The figure excludes cohorts with <10 projects and grays out these cells in the table.
Annual results for projects >1 MW are not included because only one project >1 MW achieved PTO each year in 2022 and 2023, and no projects this size achieved PTO in 2024.

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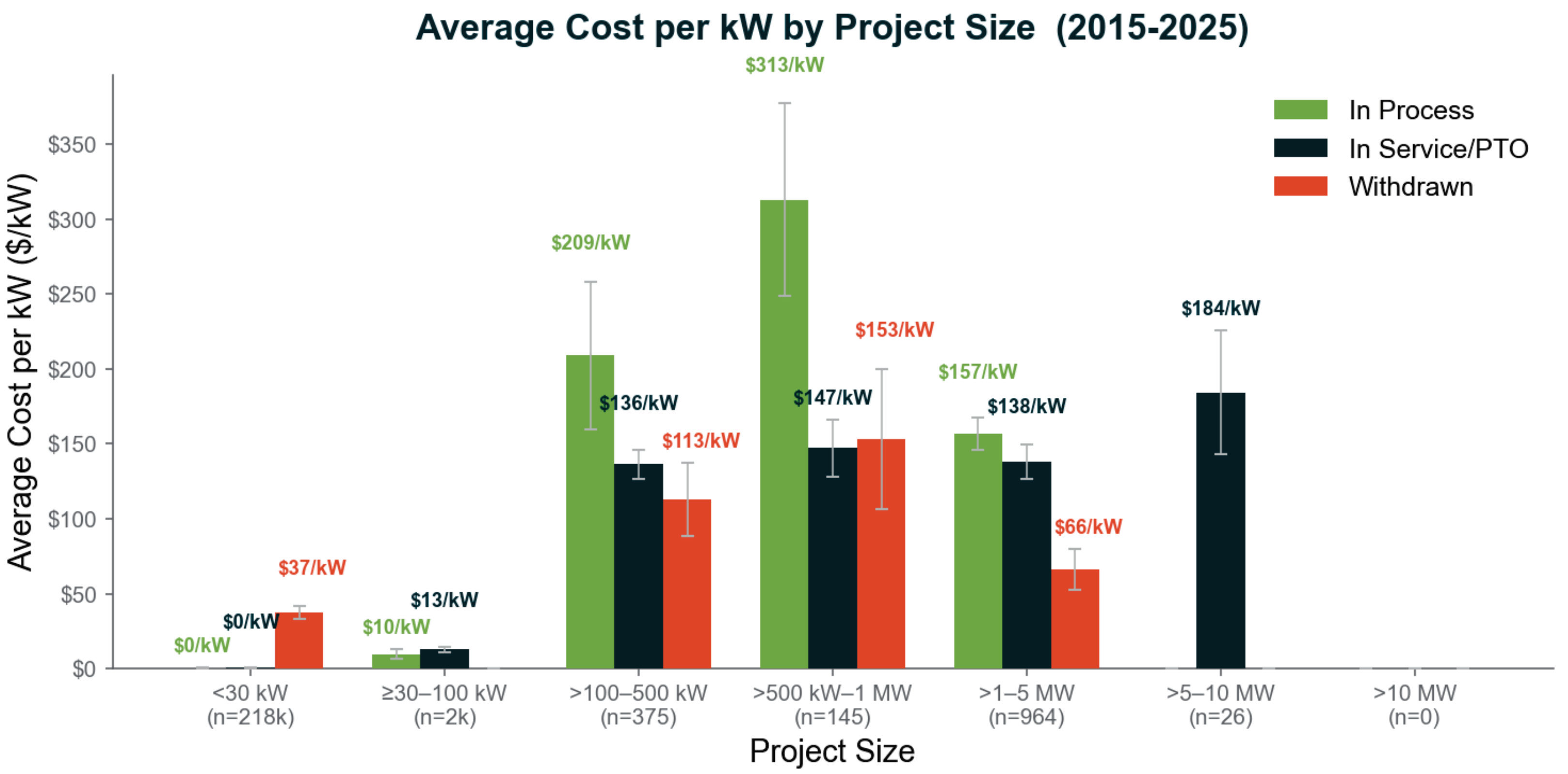
Data Analysis: Costs

Context for Cost Analysis

- The cost analysis addresses distribution system upgrade costs paid by DER interconnection customers.
- The cost dataset is limited to four states with publicly reported upgrade costs: Colorado, Connecticut, New York, and Rhode Island.
  - Small DER systems (<30 kW) represent 98% of the cost data.
  - New York data are heavily represented in the sample (>99% of the total). The state has significantly lower costs compared to other states
    - 99% of the cost data for the state is zero; 100% of projects <30 kW paid no upgrade costs.
    - LBNL removed New York projects >50 kW for the analysis if costs are listed at $0. Projects exceeding that size are likely to pay for distribution system upgrades.*
- The cost analysis is limited to 2015–2025 due to lack of earlier data.
- Changes in reported costs over time depend in part on the cost allocation mechanism (e.g., cost-causer pays, cost-sharing) in place during different periods of time.
  - Smaller DER systems may not be required to pay upgrade costs.
    - The dataset includes these projects at zero cost.
- Some of the data LBNL collected may list some projects at zero cost if the utility has not yet provided upgrade costs.

*LBNL made this decision following consultation with industry stakeholders based on expected interconnection costs for New York.

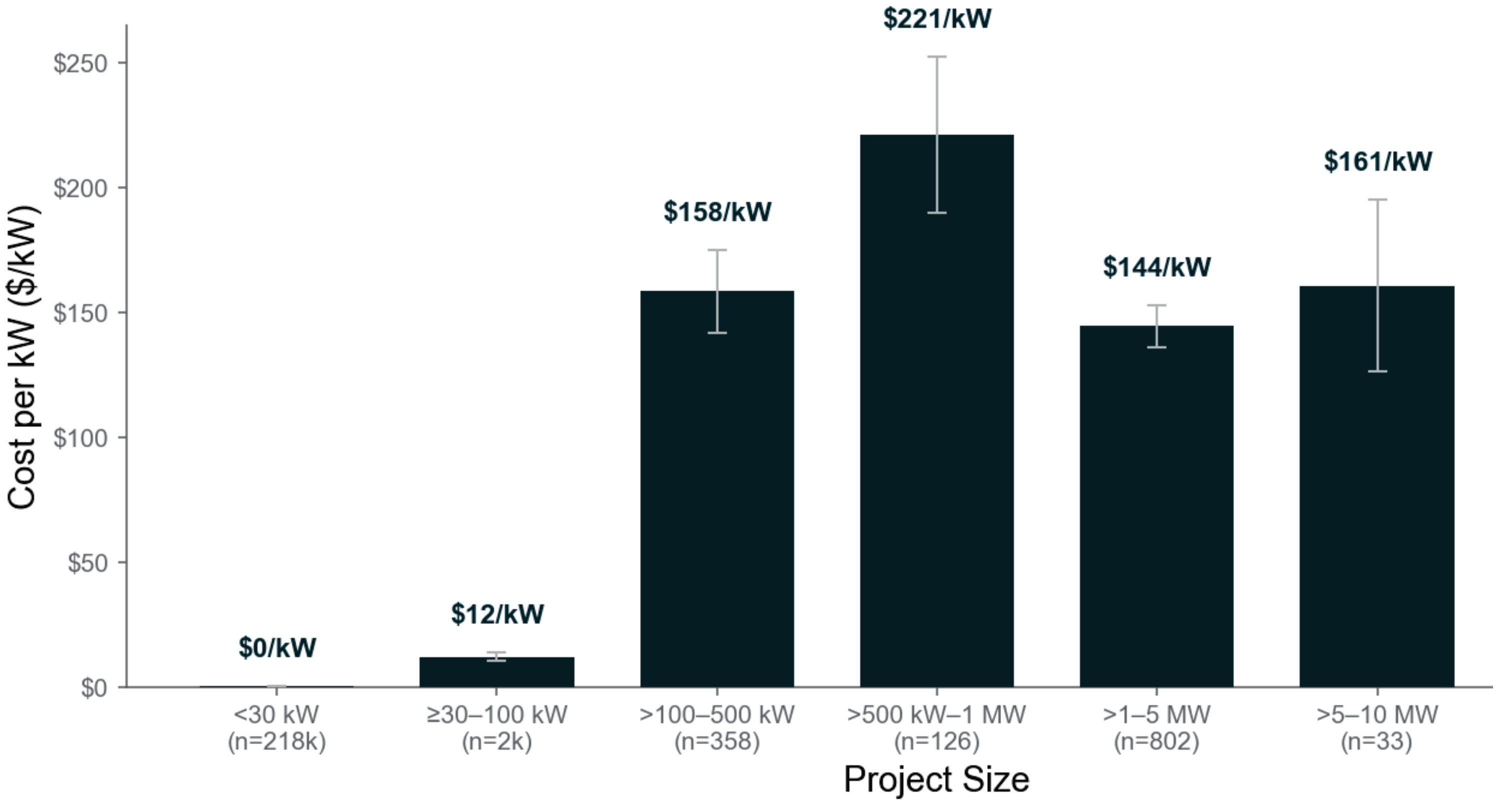
Average Upgrade Costs (per kW) by Project Size and Status (2015–2025)



- High upgrade costs (per kW) for projects <30 kW are associated with withdrawal of projects.
- The average upgrade cost per kW was lower for withdrawn projects >1–5 MW than withdrawn projects >100 kW–1 MW.

States represented in the cost data sample: CO, CT, NY, and RI. NY represents >99% of the cost data, with the majority of projects assigned zero costs. (100% of projects <30 kW paid no upgrade costs.)
See Technical Appendix for full sample details.

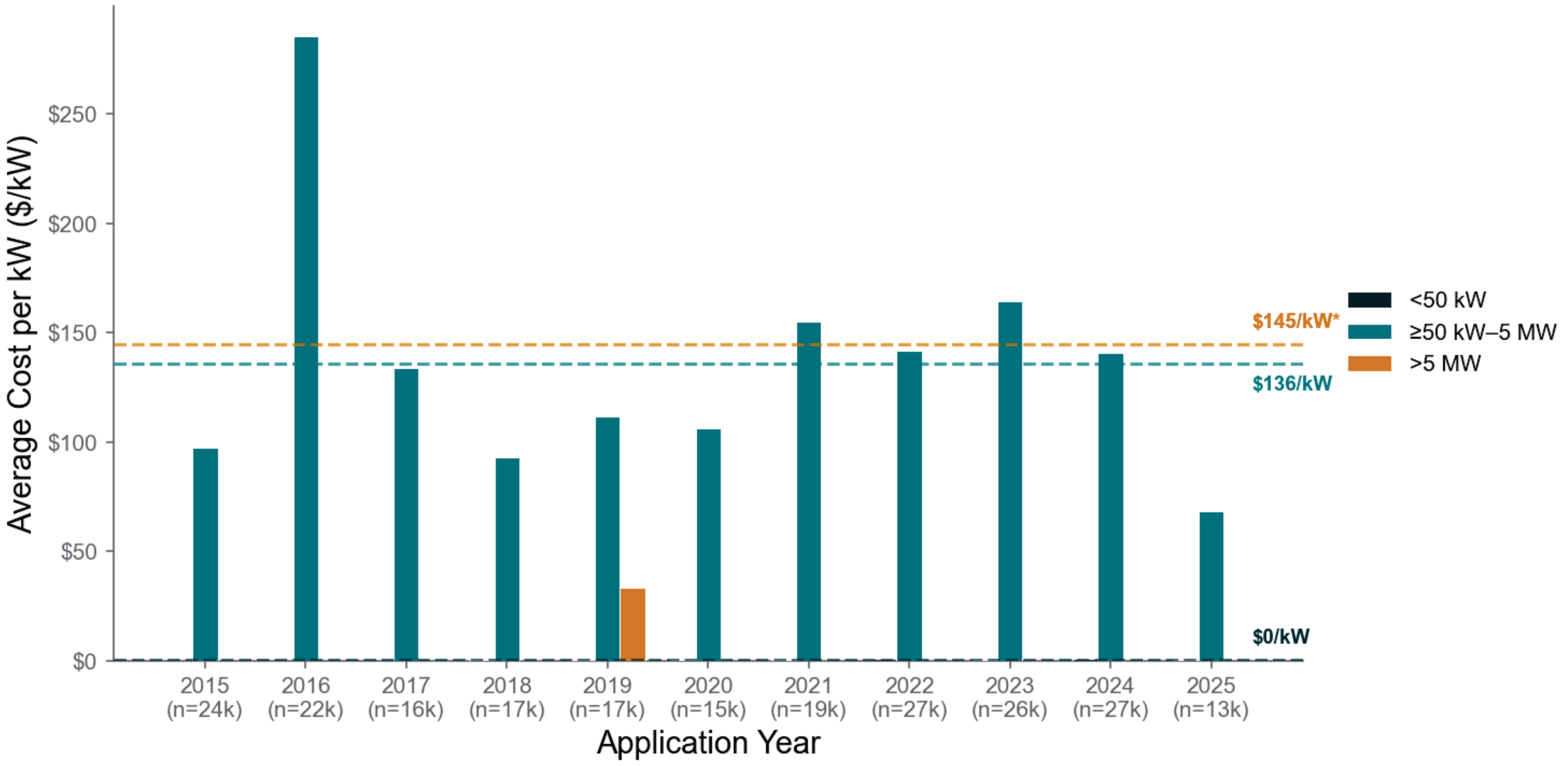
Average Upgrade Costs (per kW) by Project Size (2015–2025)



- The highest average upgrade cost in LBNL's sample is $221/kW, for projects >500 kW–1 MW.
- The lowest average costs were zero for projects <30 kW and $12/kW for projects 30–100 kW.

States represented in the cost data sample: CO, CT, NY, and RI. NY represents >99% of the cost data, with the majority of projects assigned zero costs. (100% of projects <30 kW paid no upgrade costs.)
The sample includes only projects in process or in service; it excludes withdrawn or cancelled projects.
See the Technical Appendix for full sample details.

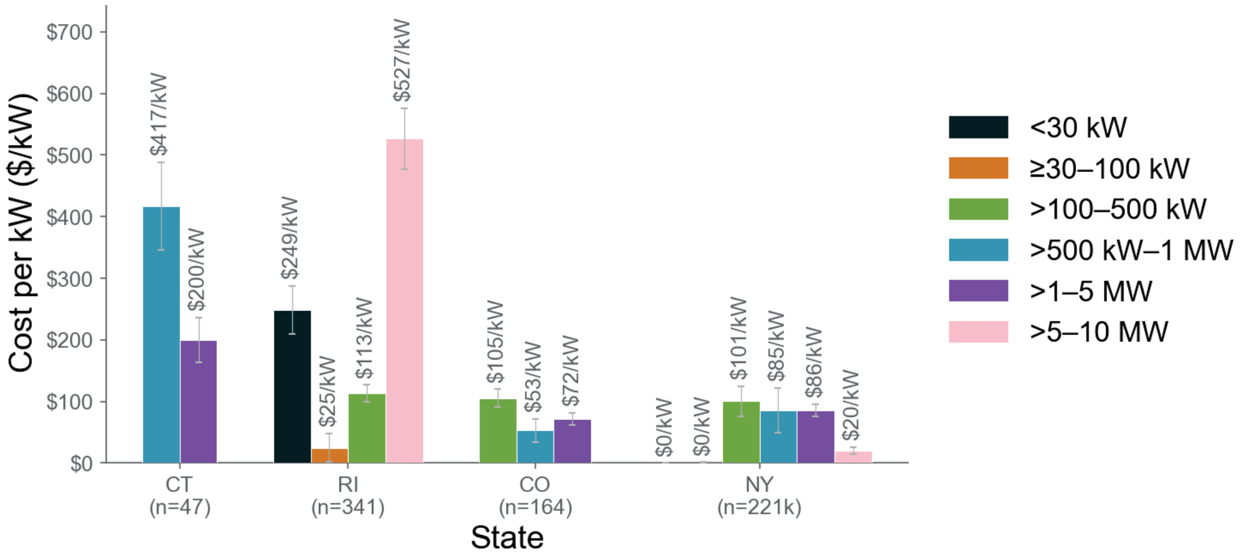
Average Upgrade Costs (per kW) by Application Year and Project Size (2015–2025)



- Projects <50 kW paid zero upgrade costs on average between 2015–2025.
- Projects ≥50 kW–5 MW paid $136/kW on average between 2015–2025.
- Projects >5 MW paid $145/kW on average between 2016–2023—the period for which data were available for the largest projects.

The bars does not include data for cohorts with <10 projects for the application year, but the lines indicate overall averages, inclusive of the cohorts with <10 projects.
States represented in the sample: CO, CT, NY, and RI. NY represents >99% of the cost data, with the majority of projects assigned zero costs. (100% of projects <30 kW paid no upgrade costs.)
The sample includes only projects in process or in service; it excludes withdrawn or cancelled projects.
See Technical Appendix for full sample details.

Median Upgrade Costs (per kW) by State and Project Size (2015–2025)

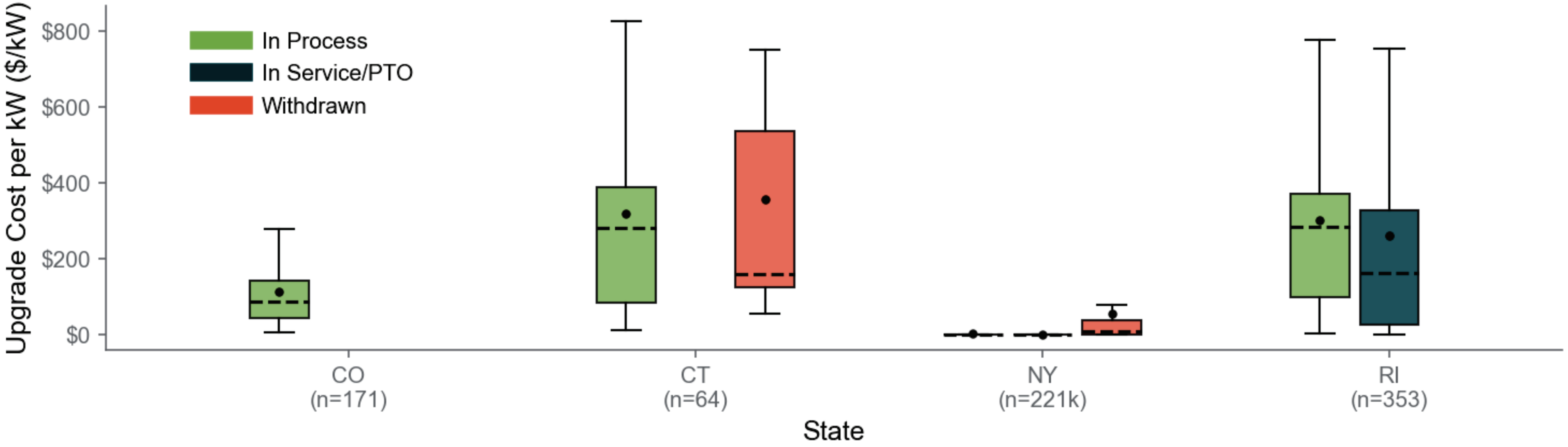


- Median upgrade costs were lowest overall in New York, followed by Colorado.
  - Lower costs may be indicative of cost-sharing mechanisms, particularly in New York.

Median Cost per kW (2015-2025)							
State	**<30 kW**	**≥30–100 kW**	**>100–500 kW**	**>500 kW–1 MW**	**>1–5 MW**	**>5–10 MW**	**Overall**
CT				$417	$200		$281
RI	$249	$25	$113			$527	$173
CO			$105	$53	$72		$87
NY	$0	$0	$101	$85	$86	$20	$0
Overall	$0	$0	$108	$130	$86	$46	$0

The sample includes only in process or in service projects; it excludes withdrawn or cancelled projects.
The figure and table exclude cohorts with <10 projects.
See Technical Appendix for full sample details.

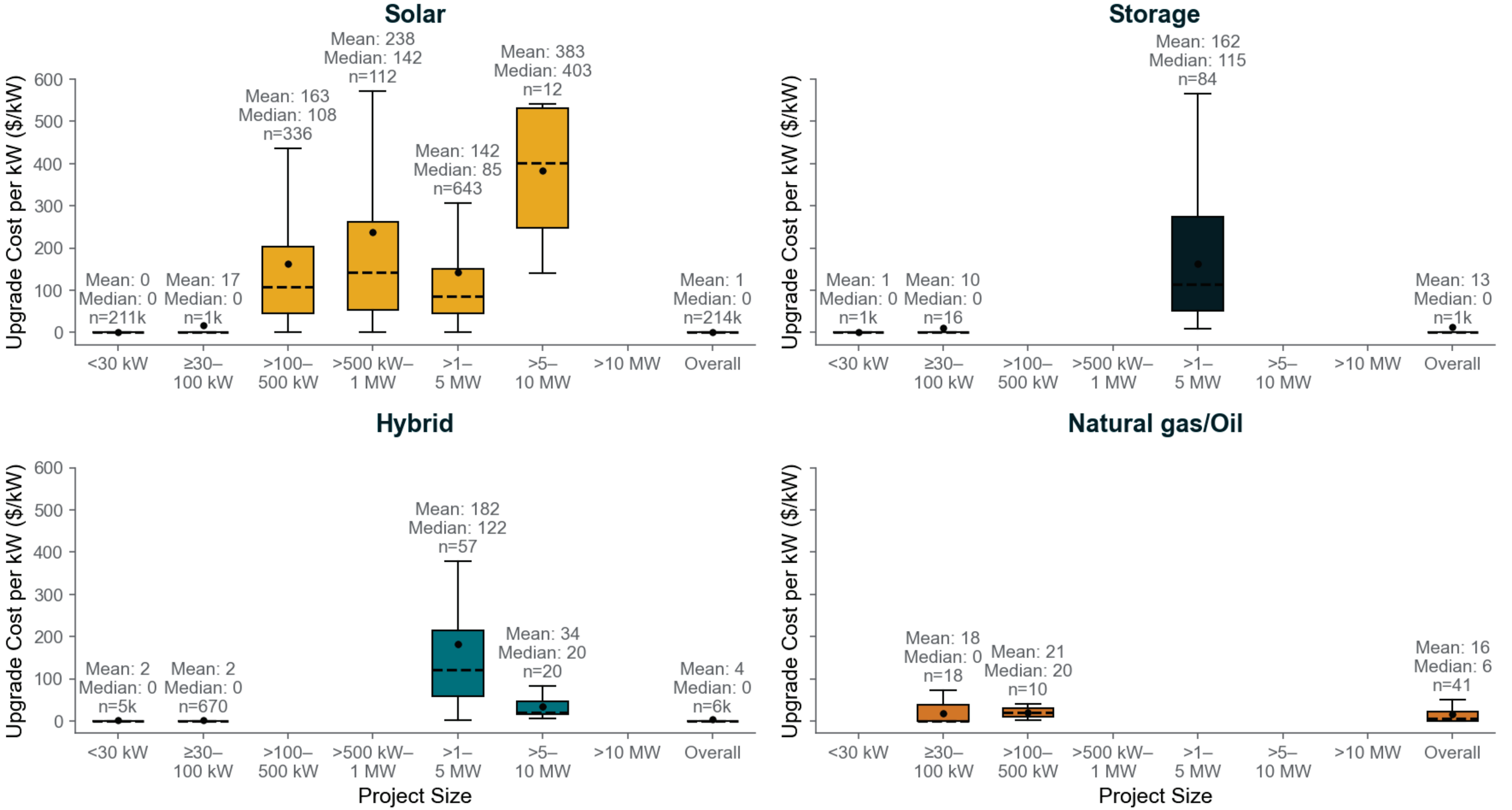
Upgrade Costs (per kW) by Project Status and State (2015–2025)



State	In process			In Service/PTO			Withdrawn		
	Mean	Median	Count	Mean	Median	Count	Mean	Median	Count
CO	$112	$87	171			0			0
CT	$319	$280	52			3	$357	$159	12
NY	$3	$0	13,208	$1	$0	207,601	$54	$9	257
RI	$300	$283	51	$260	$161	302			0

The figure and table exclude cohorts with <10 projects.

Upgrade Cost (per kW) by Technology and Project Size (2015–2025) (1)



- Average upgrade costs were highest overall for natural gas/oil technologies, at $16/kW, in part due to the larger project sizes in the sample.
- Average upgrade costs were lowest overall for solar technologies at $1/kW across all project sizes.
- Average upgrade costs for hybrid technologies also were low, at $4/kW overall.

The sample includes only projects in process or in service; it excludes withdrawn or cancelled projects. Majority of states represented in the sample — solar: NY (>99%); storage: NY (99%); hybrid: NY (>99%); natural gas/oil: NY (98%). The figure excludes box plots where the sample size is <10 projects.

Upgrade Cost (per kW) by Technology and Project Size (2015–2025) (2)

- Costs vary significantly by project size as well as technology—for example:
  - Average upgrade costs were highest for solar projects >5-10 MW ($383/kW) and lowest for solar projects <30 kW ($0/kW).

Average and Median Upgrade Cost (per kW)				
Technology Type	**Size Segment**	**Mean**	**Median**	**Count**
Solar	<30 kW	$ 0	$ 0	211354
	≥30–100 kW	$ 17	$ 0	1413
	>100–500 kW	$ 163	$ 108	336
	>500 kW–1 MW	$ 238	$ 142	112
	>1–5 MW	$ 142	$ 85	643
	>5–10 MW	$ 383	$ 403	12
	>10 MW			2
	Overall	$ 1	$ 0	213872
Storage	<30 kW	$ 1	$ 0	1123
	≥30–100 kW	$ 10	$ 0	16
	>100–500 kW			3
	>500 kW–1 MW			6
	>1–5 MW	$ 162	$ 115	84
	>5–10 MW			1
	>10 MW			4
	Overall	$ 13	$ 0	1237
Hybrid	<30 kW	$ 2	$ 0	5367
	≥30–100 kW	$ 2	$ 0	670
	>100–500 kW			3
	>500 kW–1 MW			3
	>1–5 MW	$ 182	$ 122	57
	>5–10 MW	$ 34	$ 20	20
	>10 MW			1
	Overall	$ 4	$ 0	6121
Natural gas/Oil	<30 kW			5
	≥30–100 kW	$ 18	$ 0	18
	>100–500 kW	$ 21	$ 20	10
	>500 kW–1 MW			2
	>1–5 MW			6
	>5–10 MW			0
	>10 MW			0
	Overall	$ 16	$ 6	41

The table excludes cohorts with <10 projects.

Conclusions

Application Analysis for LBNL’s Dataset

- By project count, the vast majority of interconnection applications are:
  - Small systems (<30 kW), mostly residential
  - From California (65%), New York (11%), Arizona (10%) and New Jersey (9%)

- By capacity, about two-thirds of applications are for solar (77.5 GW), followed by hybrid systems—any project that includes more than one technology (11.8%, 13.8 GW)—and storage (7.5%, 8.8 GW).
  - The dataset also includes natural gas/oil systems (1.4 GW, 1.2%) and several other technologies.

- DER interconnection timelines and costs vary dramatically depending on the state, project size, and technology.

Timeline Analysis

- The number of days to execute an ISA decreased on average, across projects of all sizes, by 26% in recent years (2020–2025).
- Time to PTO generally increases as project size increases.
  - From 2020–2025, 8% of projects <100 kW remained in the interconnection process without achieving PTO, compared to 76% of projects >100 kW.
- For the smallest projects (<30 kW), the median time from application to PTO was 3.6 months between 2000 and 2025 and 3.1 months or less between 2020 and 2025.
- For projects >1-5 MW, the median time from application to PTO ranged from about 5 to 48 months between 2000 and 2024.*

*Excludes 2025 data due to sample size.

Cost Analysis

- Cost data are extremely limited. LBNL was able to collect usable cost data for only four states.

- The highest average upgrade costs in LBNL's sample are for projects >500 kW–1 MW ($221/kW). The lowest average costs are for projects <30 kW ($0).

- Variation in upgrade costs across states may be due to different cost allocation practices.
  - New York has significantly lower costs compared to other states.
    - The median upgrade cost that DER customers in the state paid for projects in process and in service was zero. New York's cost-sharing mechanisms likely contributed to lower upgrade costs.
  - The median upgrade cost overall, across all project sizes, was $281/kW in Connecticut, $173/kW in Rhode Island, and $87/kW in Colorado.

Data Access and Potential Areas for Future Research

- Publicly available DER interconnection data are limited across the U.S.
  - Data are not available for all states.
  - Data are generally limited to regulated utilities required to provide the information.
- The LBNL/i2X Distributed Energy Projects Interconnection Dashboard expands data access. Users can download data, use preconfigured or custom queries, and visualize results in multiple formats.
- Standardized data reporting, with regular updates, is essential for benchmarking and tracking DER interconnection performance for individual states and utilities over time and across jurisdictions.
- In addition to updating and expanding data collection and analysis, future research could explore factors that may explain trends in timelines and costs across states and utilities.

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