



# Sharing the Sun: Understanding Community Solar Deployment and Subscriptions

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NREL Webinar

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# 1. Purpose and Scope

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# Purpose

Community solar allows multiple customers or “subscribers” to purchase the output from a single solar photovoltaic array. Community solar could potentially extend access to solar to customers who could not adopt solar on their own, such as renters and low-income customers. Community solar is one of the fastest growing segments of the U.S. solar photovoltaic market.

This slide deck presents data and analysis from an initial round of data collection for a three-year project studying the U.S. community solar market. The data were collected through a research collaboration between the National Renewable Energy Laboratory, the University of Minnesota, and the Smart Electric Power Alliance. Partners gathered data from public filings, websites, state government websites, and industry collaborators.

# What is Community Solar?

Community solar, for the purposes of this research, refers to a product where the **financial benefits** of a single solar photovoltaic array are distributed among an **exclusive** group of customers that have **chosen** to subscribe to the program.

## The Key Criteria

**Financial benefits:** All community solar products convey some part of the financial gains of electricity generation to subscribers. Community solar products may also but do not necessarily include non-financial benefits such as environmental benefits (e.g., renewable energy certificates).

**Exclusive:** All community solar programs are exclusive, meaning that they serve some exclusive set of subscribers *within* a utility or community choice aggregation service territory.

**Chosen:** Participation in community solar is always discretionary. Subscribers opt into the program, either through contractual payments or some non-financial transaction.

# Community Solar Exclusions

- We exclude California IOU Green Tariff programs, which have procured 153 MW of solar.
- We exclude group net metering programs that are not sourced from solar.
- We are likely excluding multifamily affordable housing solar projects that meet our criteria in this data set, but we will be pursuing including these projects in the coming year.

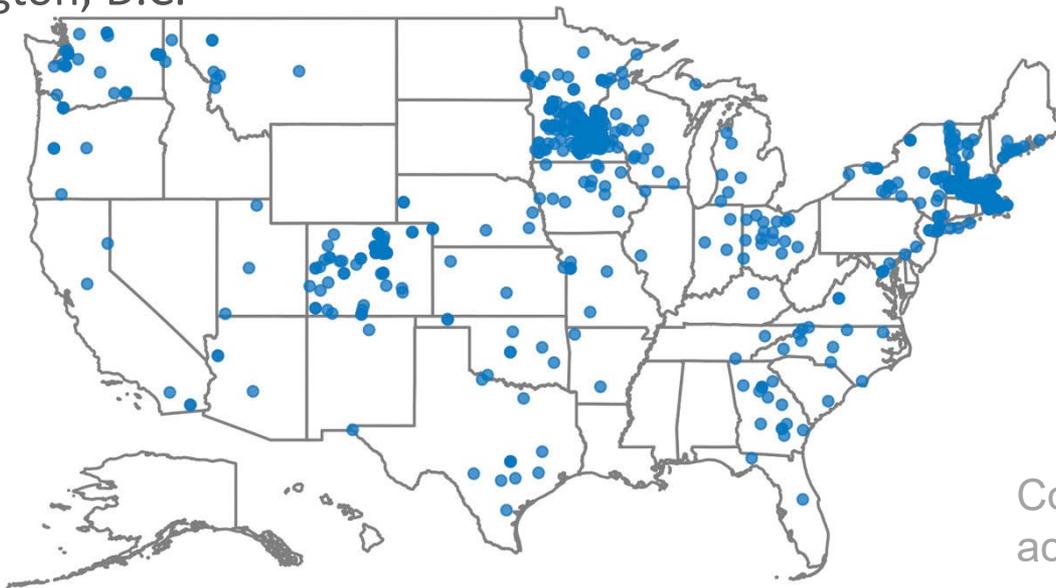
## 2. Market Status

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This section summarizes data on community solar deployment over time, by state, and by project characteristics.

# The Community Solar Market in 2018

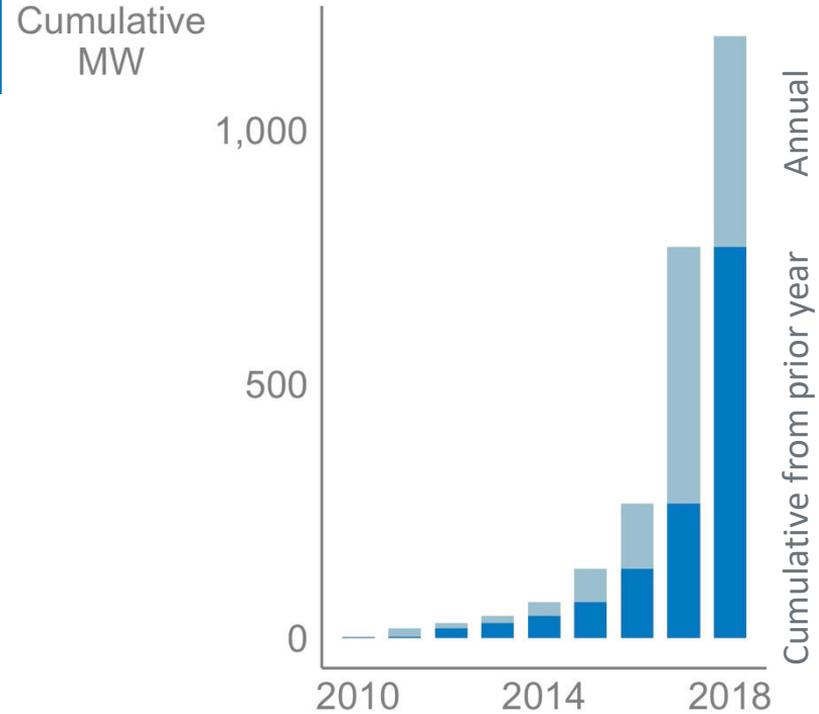
By the end of 2018, we estimate that there were at least 1,184 MW-AC of community solar capacity distributed across 811 projects in 39 states and Washington, D.C.



Community solar projects  
active as of end of 2018

# The Rapid Growth of Community Solar

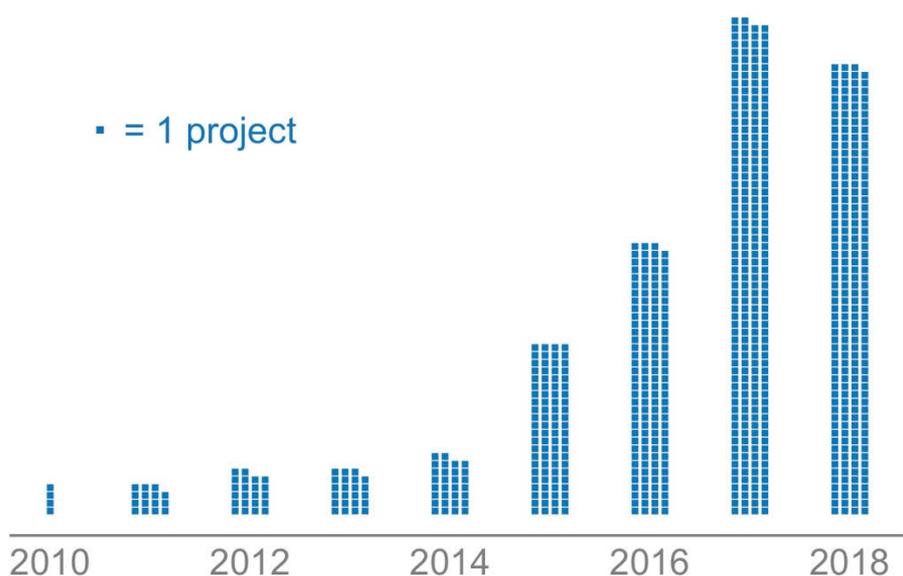
- Cumulative community solar capacity has grown by about 121% year over year since 2010, in other words, capacity has more than doubled on average year over year.
- About 415 MW came online in 2018 alone.



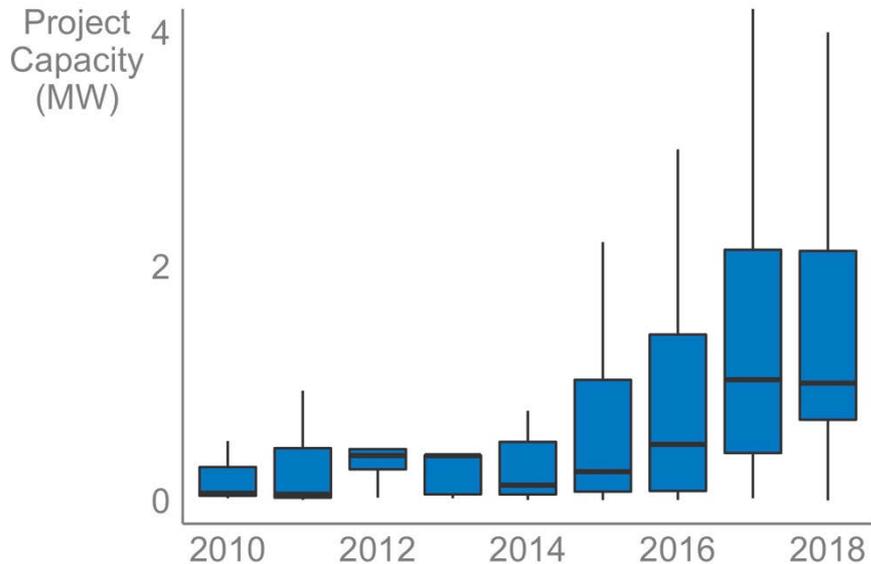
Community solar capacity (MW) by year

# More and Larger Projects

Community solar capacity has increased both because more projects have come online and because projects have generally become larger over time.



# of Projects by Year

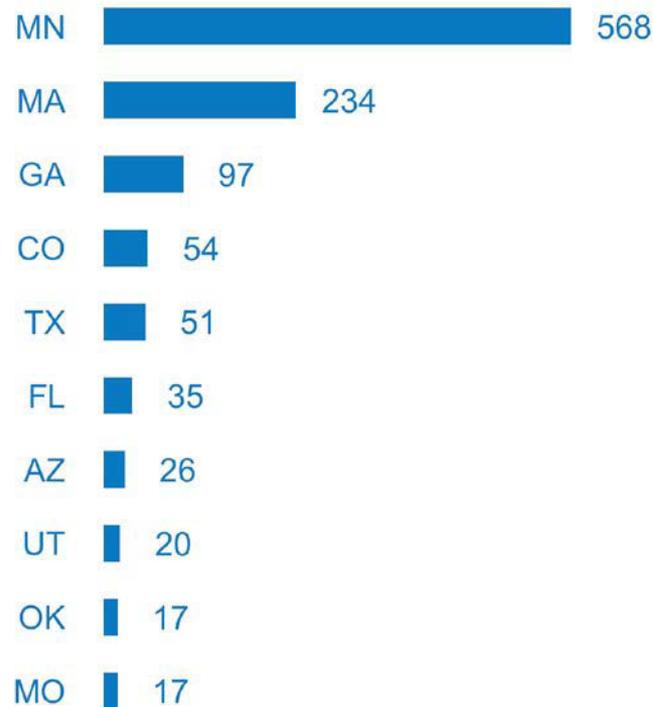


Distributions of Project Capacity by Year

Note: Boxes represent the inter-quartile ranges (25%, median, and 75%). Bars represent the minimum and maximum excluding outliers.

# A Few Key States Lead the Community Solar Market

- About 91% of cumulative community solar capacity is located in the top 10 states.
- About 66% of cumulative capacity is in just two states: Massachusetts and Minnesota.

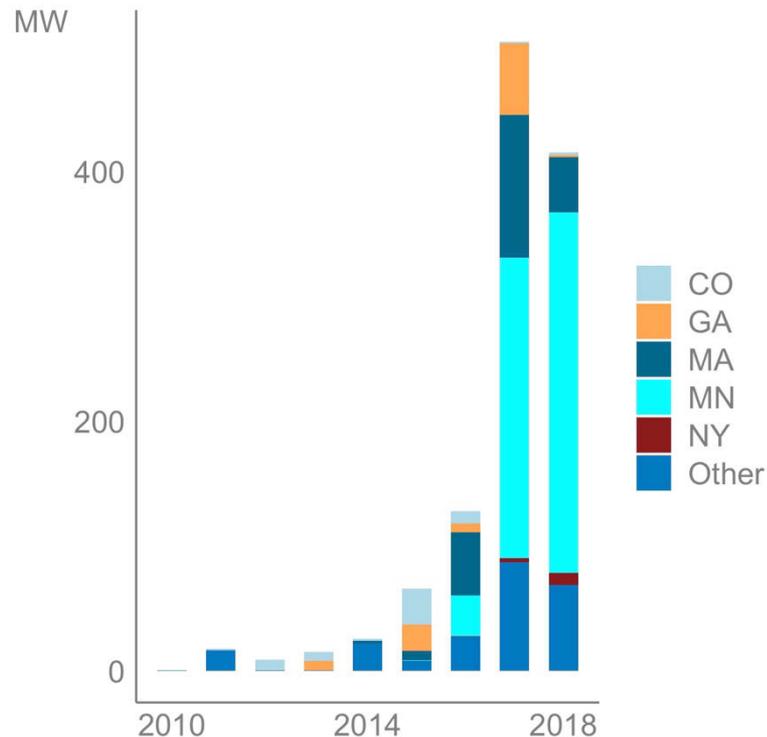


Capacity (MW)

Cumulative community solar capacity (MW) by year

## Different States Have Taken the Lead on Community Solar Deployment

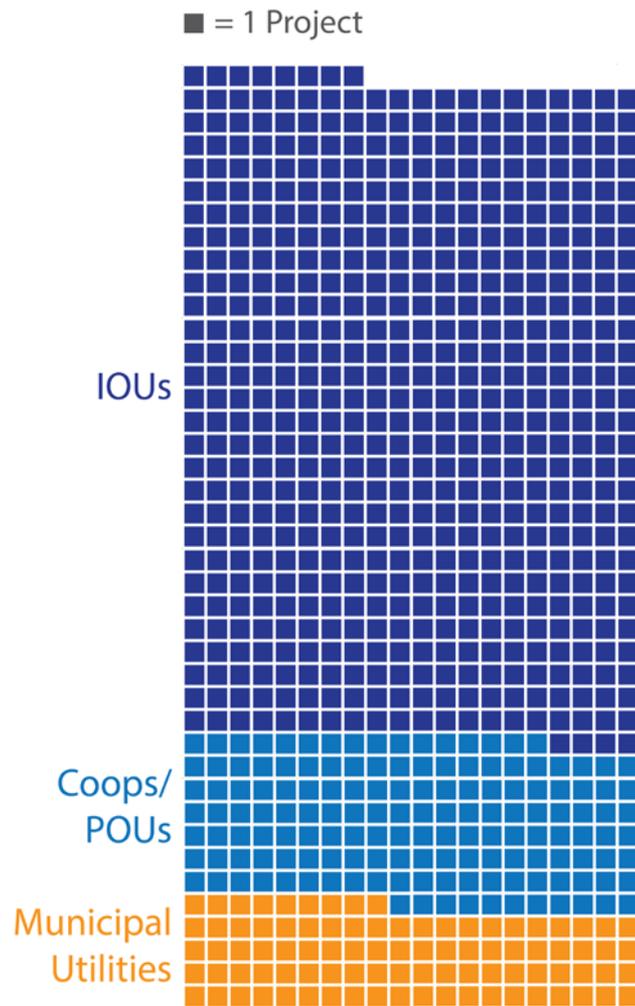
- Colorado was the early state leader, with significant capacity expansions from 2011 to 2015.
- Massachusetts and Minnesota expanded capacity significantly in 2016-2018.
- Georgia added 57 MW in 2017.



New community solar capacity (MW)  
by year and state

## Deployment by Utility Type

- Most capacity (75%) and projects (71%) are located in investor-owned utility (IOUs) service territories.
- Deployment of relatively small-scale projects has also been strong in electric cooperatives (Coops) and publicly owned utilities (POUs) and municipal utilities, with more than 230 coop and municipal utility projects deployed.



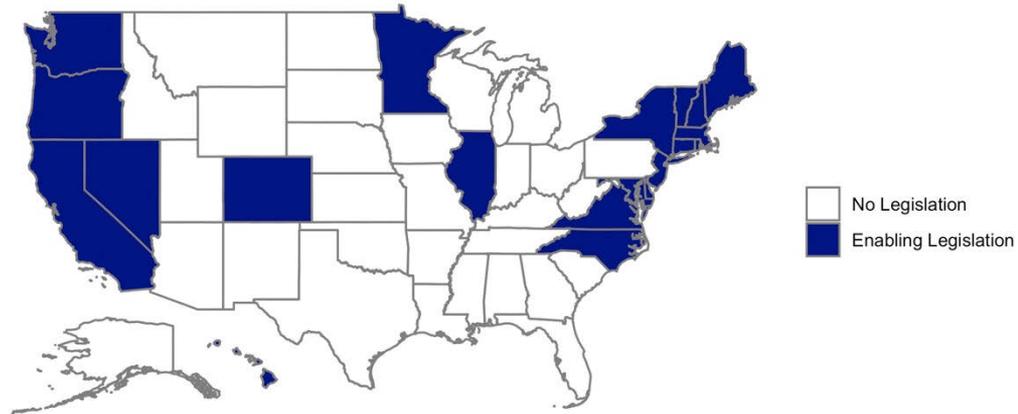
## 3. Impact of Market Conditions

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This section discusses how market factors have shaped community solar deployment.

# Community Solar State Policies

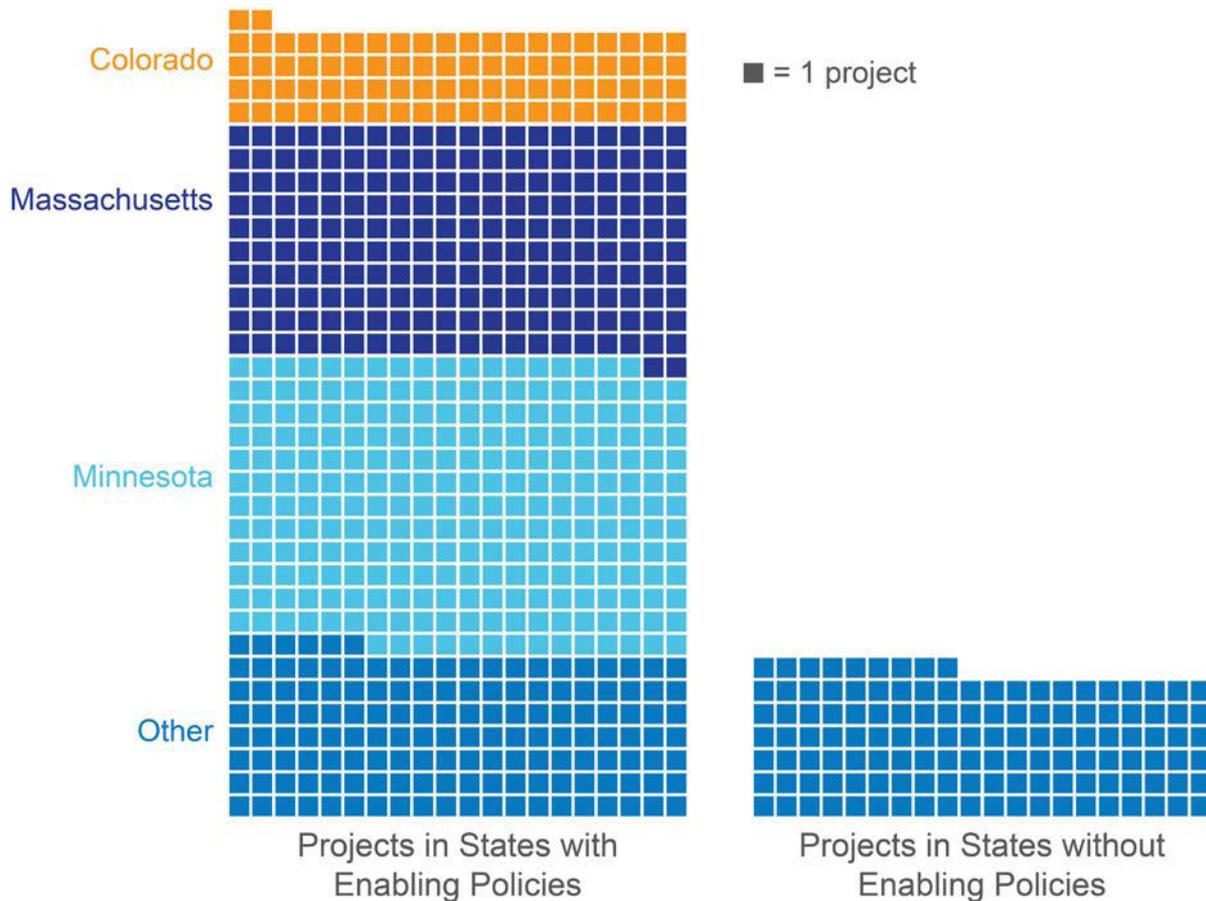
- 20 states and Washington, DC have passed some form of legislation enabling community solar, either through statewide programs or the authorization of a limited number of pilot projects.
- These programs vary in scope, but they generally all allow for some form of virtual net metering so that subscribers can benefit from their community solar subscriptions.



State-level community solar enabling legislation

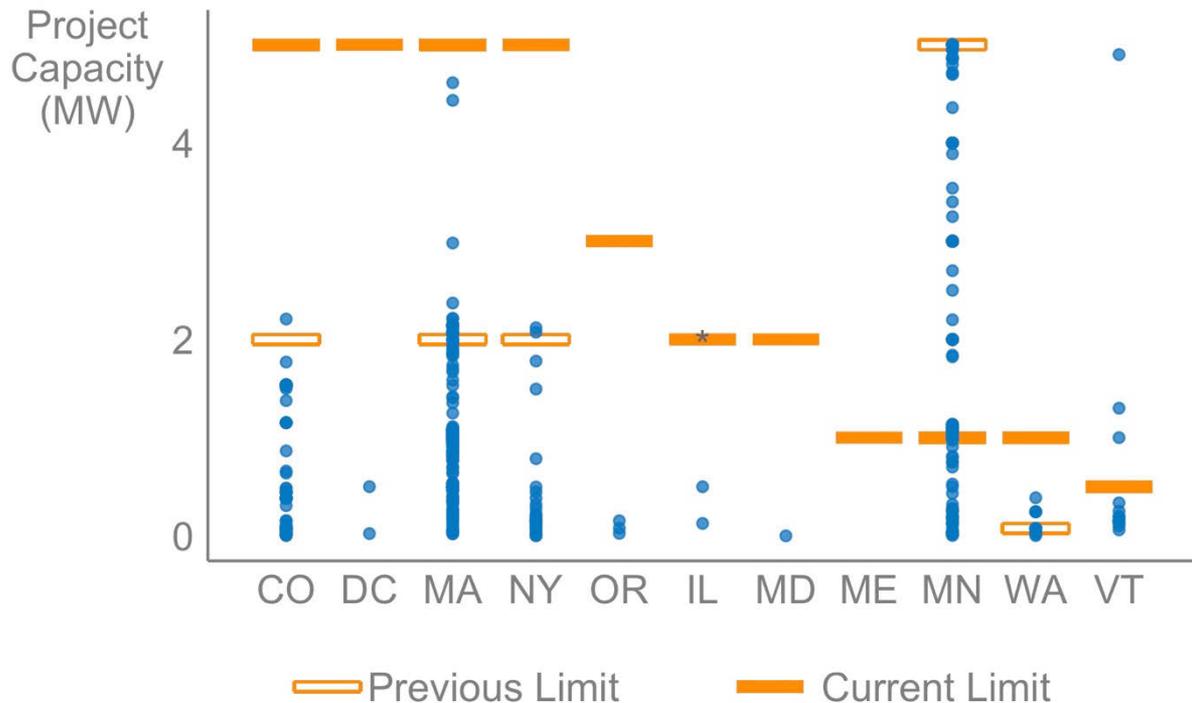
# Deployment by State

- About 76% of capacity and 84% of projects are located in states with enabling legislation, dominated by capacity and projects in Colorado, Massachusetts, and Minnesota.
- Legislation is not a prerequisite for a community solar market. There are about 279 MW in 129 projects located in 23 states without enabling legislation.



## Some States Impose System Size Caps

- 10 states with projects and Washington, D.C. set a maximum size for community solar projects.
- Some states have revised project caps over time.
- In Minnesota, projects were initially co-located up to a 5 MW total cap. Since early 2016, projects could not co-locate beyond the 1 MW cap.

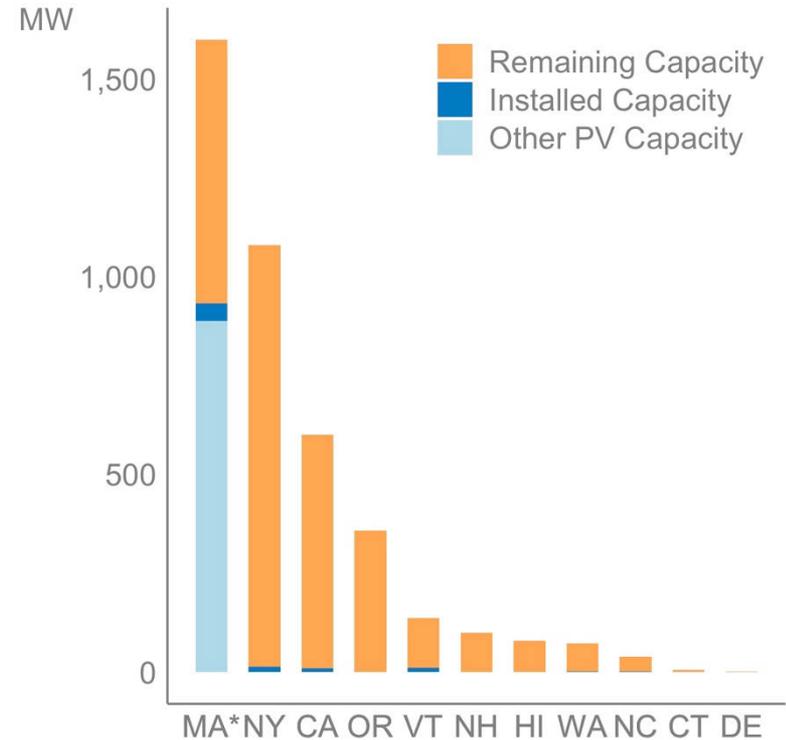


Project capacities compared to state program system size caps

\* Based on 2 MW cap of the Adjustable Block Program. Low-income pilot projects can be larger than this cap.

## States with Program Caps Have Large Amounts of Remaining Capacity

- Programs in 10 states have limited the amount of community solar capacity that can be developed under the policies.
- In Massachusetts and New York, there are limits on how much community solar capacity is eligible for statewide solar incentives.
- Cumulative community solar capacity is not close to the program limit in any of these states.



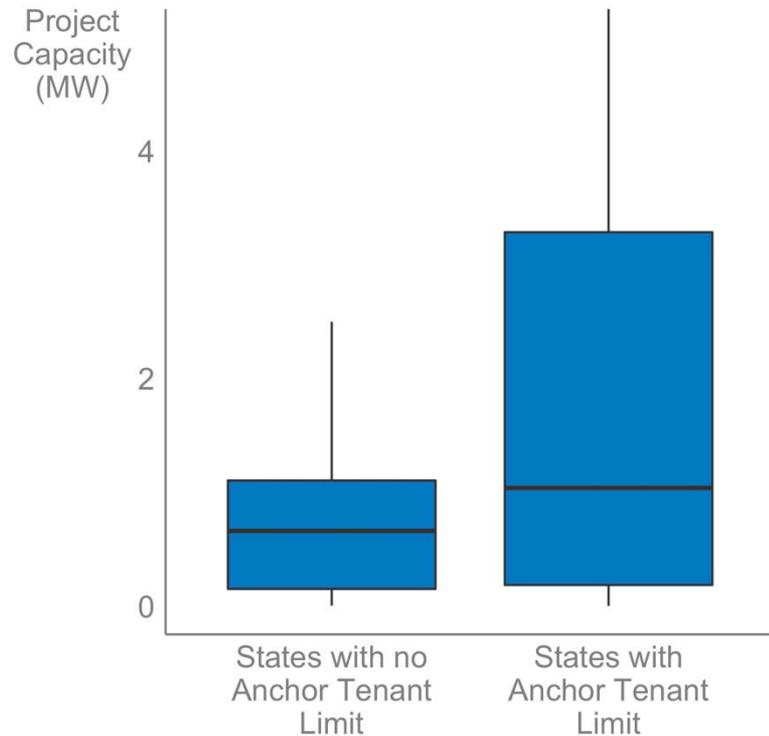
Installed and remaining capacity in states with program size caps

\* Program size cap for financial incentives, includes installed capacity of all eligible solar projects

## More Research is Needed to Determine the Impact of Anchor Tenant Rules

- Anchor tenants are large customers that subscribe to a significant portion of a community solar array.
- Anchor tenants can provide more revenue certainty to community solar projects, potentially increasing the ability to finance projects.
- At the same time, anchor tenants can crowd out other smaller subscribers.
- Six states (CA, IL, MD, MN, NC, NY, OR) limit the amount of capacity that can be held by anchor tenants.
- Future research could examine the impact of these rules on project finance, deployment, and other variables.

Note: Boxes represent the inter-quartile ranges (25%, median, and 75%). Bars represent the minimum and maximum excluding outliers.



Project size distributions in states with and without limits on anchor tenants

## 4. The Subscriber Value Proposition

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This section explores data on the community solar value proposition to subscribers.

# Net Present Value Calculation Methodology (1/2)

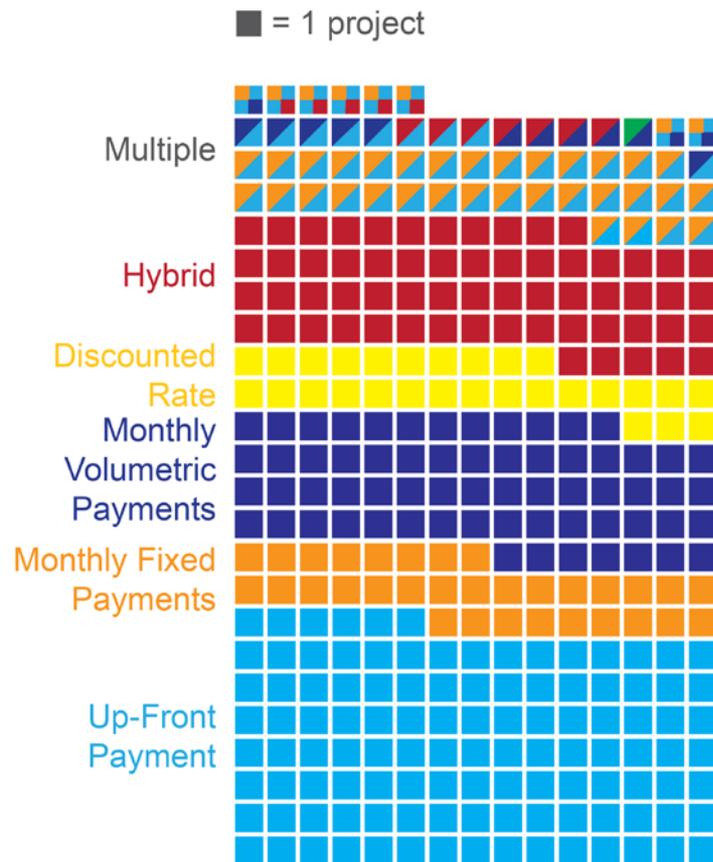
- Residential subscriber contract data are currently available for 320 projects.
- For each available contract, we built a cash flow model to calculate the net present value (NPV) of the contract. We needed to make assumptions in order to determine the financial value of a subscription contract, including:
  - Annual solar facility degradation factor: low scenario 0.75%, central scenario 0.5%, high scenario 0.30%
  - Annual utility rate escalation: low scenario 1.5%, central scenario 2.5%, high scenario 3.5%
  - Discount rate: low scenario 8.4%, central scenario 6.4%, high scenario 4.4%

# Assumptions used in NPV Calculation Methodology

- Additional assumptions included:
  - Standard contract assumptions: We used standard contract term assumptions (see Appendix) where the contracts did not specify or were flexible within a wide range.
  - Retail rates: We used retail rates from the Utility Rate Database and the Energy Information Administration.
  - PV production: We calculated PV production using the System Advisor Model.
- This methodology is sensitive to future retail rate changes, solar production, and economic variables. We performed sensitivities around these factors, which are presented in the following slides.

## Residential Payment Terms are Diverse

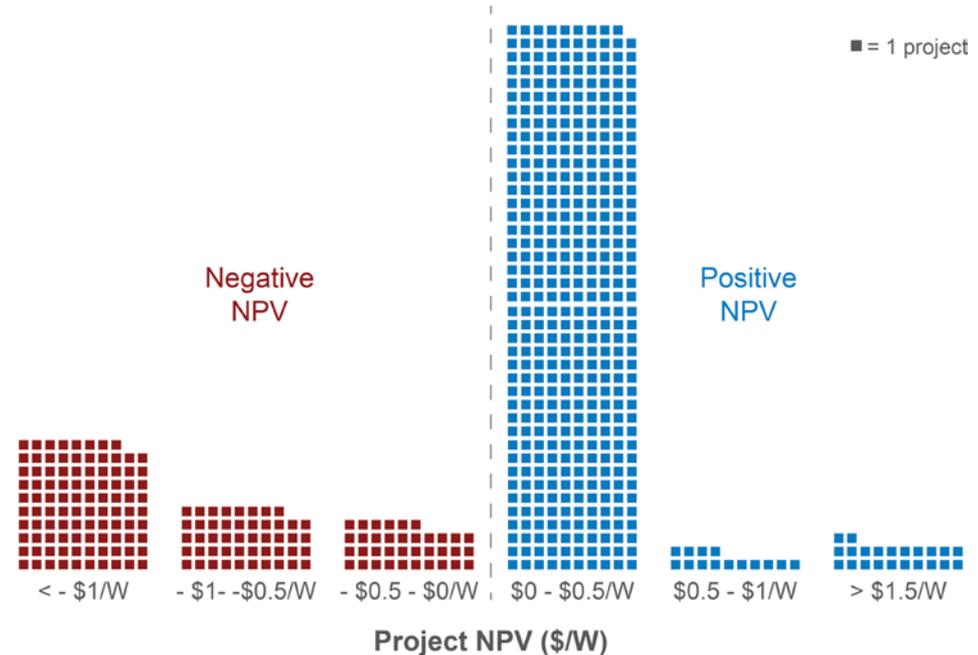
- Up-front payments are the most common payment structure, offered in about 46% of projects, followed by monthly volumetric payments (22%).
- About 21% of projects offer a hybrid model (combining different up-front and monthly payments).
- About 15% of projects offer multiple payment structures, most commonly a combination of upfront and fixed monthly payments.
- About 8% of projects offered a fixed discount over the customer's electricity rate instead of a payment.



Distribution of Program Payment Methods

## More than 80% of Projects have a Positive Net Present Value (NPV) for Residential Subscribers

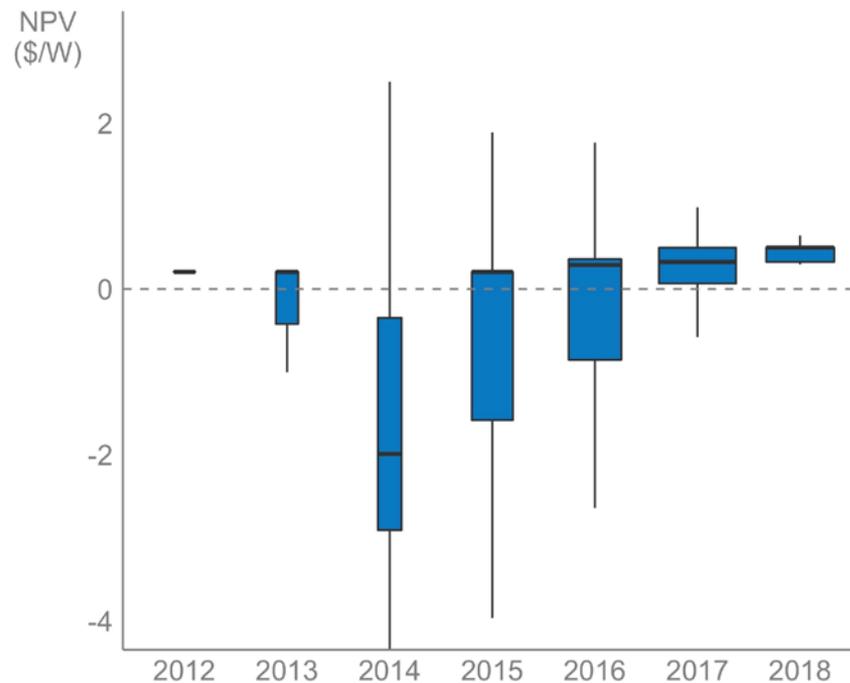
- To evaluate the community solar value proposition from the perspective of residential subscribers, we estimated the NPV under the various contracts offered by each project, where data were available. (See the Appendix for details on the NPV modeling assumptions.)
- The median project-level NPV is about **+\$0.37/W (sensitivity range: +\$0.20/W to +\$0.46/W)** and about **83% (sensitivity range: 74 - 86%)** of projects yield a positive NPV, meaning that most projects result in positive net benefits to the customers over the course of the subscription.



Distribution of Project-Level NPVs

# Average Project NPVs are Increasing Over Time

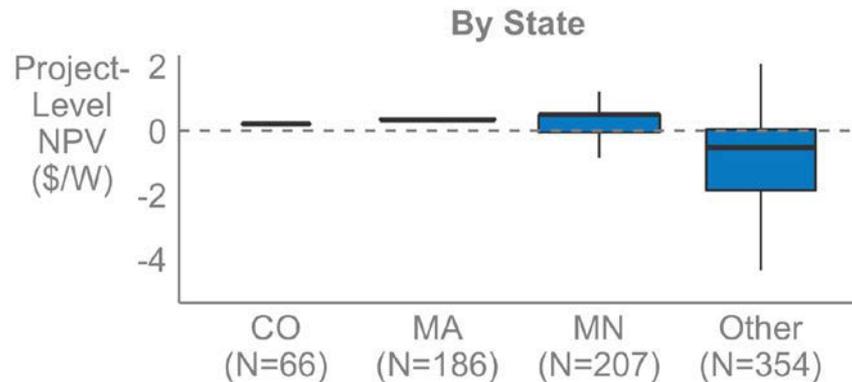
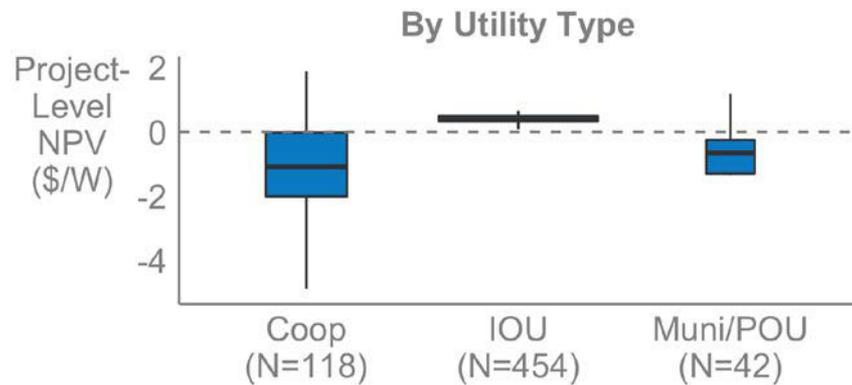
- Project-level NPVs for residential subscribers are changing over time.
- The average project level NPV became positive in 2016 and has continued to remain positive through 2018.



Project-Level NPVs, 2012-2018

## Project NPVs Vary by Utility Type and State

- Community solar value propositions may vary due to numerous factors, including local electricity rates, the local solar resource, and contract structures.
- In general, the data suggest that the value proposition is higher for projects located in IOU service territories and is generally higher in Massachusetts and Minnesota than in other states.
- Further analysis is required to understand any outliers in this dataset as well as additional geographic trends.



Distribution of Mean Project-Level NPVs by utility and state, outliers omitted

Note: Boxes represent the inter-quartile ranges (25%, median, and 75%). Bars represent the minimum and maximum excluding outliers. The width indicates the number of projects represented (also indicated by the n = X note).

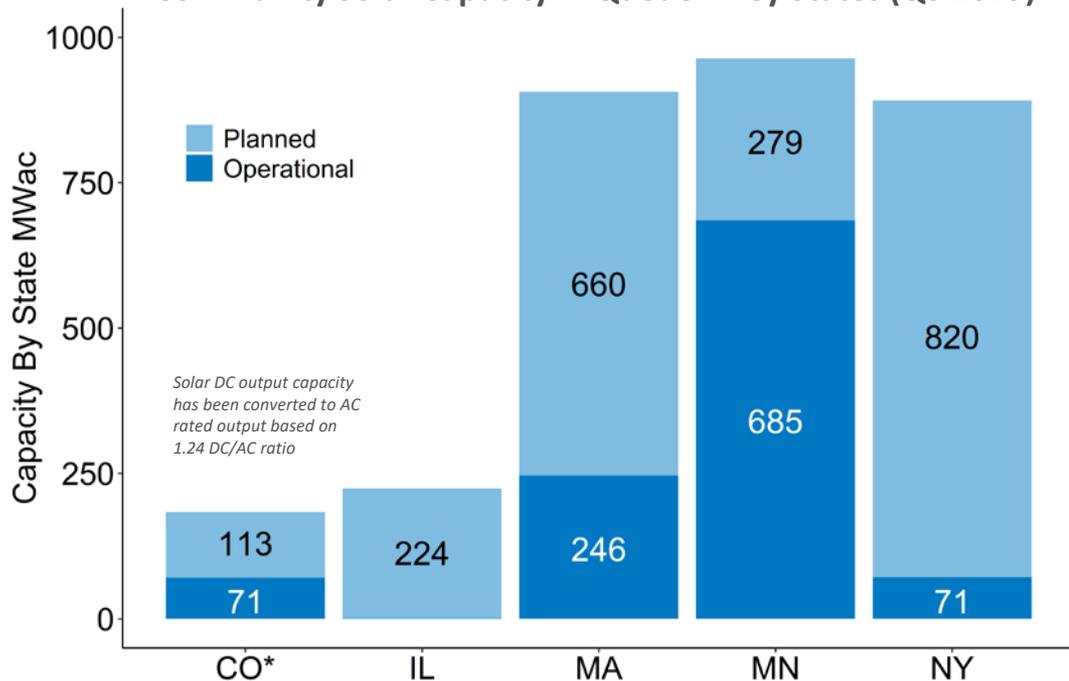
## 5. Looking Forward

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This section discusses planned projects and key markets that will shape the future of community solar deployment.

# Community Solar Capacity in Queue

## Community Solar Capacity in Queue – Key States (Q3 2019)



Operational data come from the NREL/UMN Sharing the Sun Data List. CO\*: Colorado installed solar capacity only includes projects under Xcel program; IL: Planned capacities include the adjustable block program and solar for all sub-program; MA: Planned capacities include SREC II (converted to AC) and SMART program; MN: Planned capacities only includes projects under Xcel program; NY: Planned capacities are converted to AC output.  
The solid blue represents the cumulative rated AC power output (MW) for community solar in operation by corresponding year in corresponding state. The semi-transparent blue represent capacity in queue

- As of Q3 2019, five States (CO,IL,MA,MN and NY) have the most community solar capacity in queue.
  - Over 2,000 MWac in queue
- In addition, Florida has submitted petition for approval of [1.4 GW community solar](#) in Q1 2019

# Future Community Solar Data Collection

- Is your project missing?
- Do you have a large pipeline of projects we should know about?
- Are you willing to share contract information? An NDA is possible.
- Please contact Jenny Heeter to find out how you can participate in our project:

[Jenny.Heeter@nrel.gov](mailto:Jenny.Heeter@nrel.gov) or 303-275-4366

# Thank you

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[www.nrel.gov](http://www.nrel.gov)

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# Appendix

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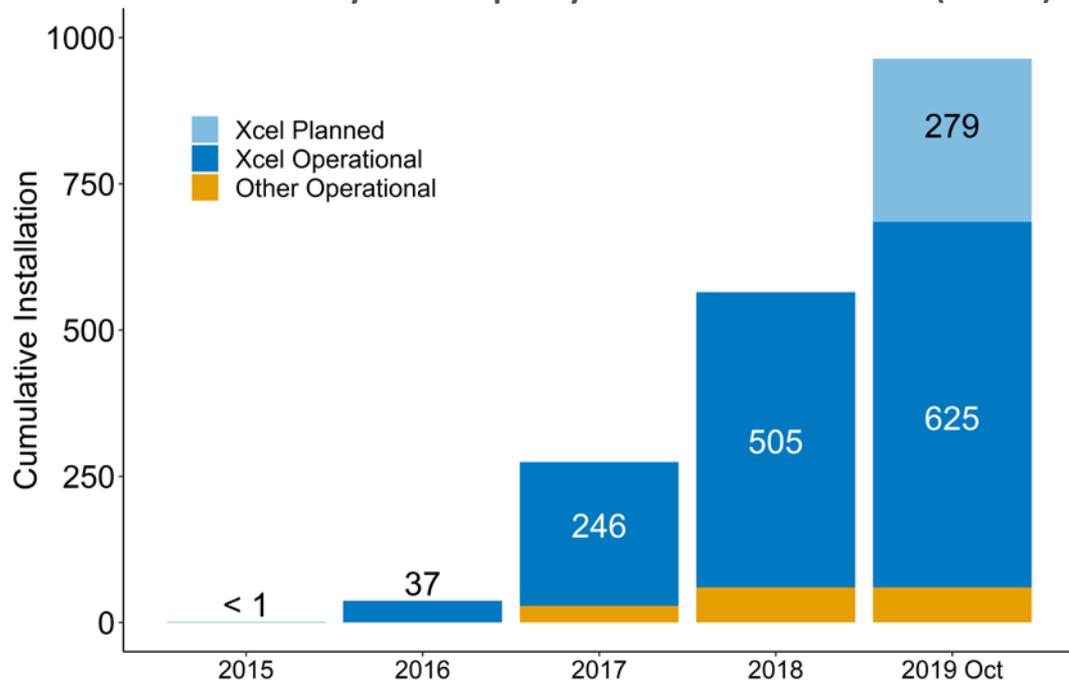
Additional Data and Details on  
Assumptions

# Subscriber Value Calculations (1/2)

- Additional assumptions and considerations include:
  - Multiple contract options: For projects that offered multiple contract options, when conducting analysis weighted by capacity, we used the average value of all contracts offered for that project.
  - Hedge value: We also do not quantify any hedge value that community solar subscriptions can provide (i.e. the value of reduced net electricity payment volatility). Instead, we quantify the expected values of subscription contracts and perform sensitivity analysis around key variables (solar degradation factors, retail rate escalation factors, and discount rates).
  - Retail rates: Retail rates were collected from the Utility Rate Database (URDB) and the Energy Information Administration, when rates were not available in the URDB.
  - Solar production: PV production was calculated using the System Advisor Model using the location of the project or nearest possible location. For projects above 1 MW we assumed 1-axis tracking and for those below 1 MW we assumed fixed tilt.

# Minnesota's Market is the Largest; Has Significant Capacity in Queue

Community Solar Capacity Installed in Minnesota (MWac)



Minnesota leads community solar deployment in the U.S., and ranked 1<sup>st</sup> in terms of cumulative installed community solar capacity by Oct 2019

➤ Over 680 MWac in operation

Most community solar in Minnesota is operating in Xcel's territory

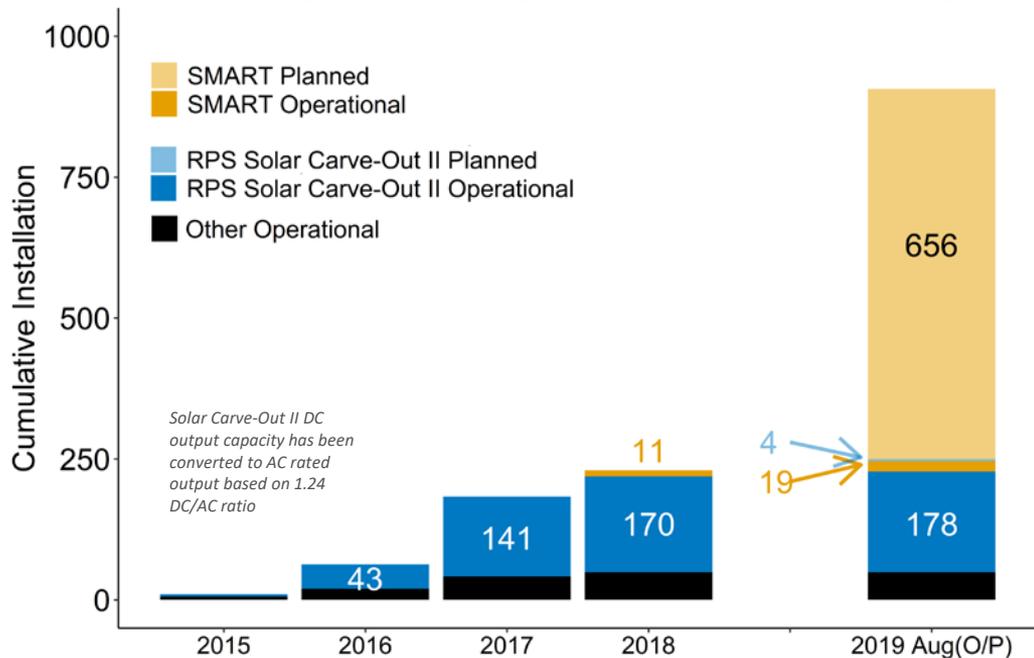
➤ 625 MWac in operation

➤ 279 MWac in queue

Data Source: 2015-2018: NREL/UMN Sharing the Sun Project Lists; 2019 Oct: [Xcel Distributed Generation Interconnection Report 2018](#); [Xcel Compliance Filing Monthly Update, DOCKET No. 13-867](#)The planned status includes in construction, in study analysis and in application stage. The solid blue represents the cumulative rated AC power output (MW) for community solar in operation by corresponding year in MN. The semi-transparent blue represent capacity in queue

# Massachusetts in Transition to SMART Program

## Community Solar Capacity Installed in Massachusetts (MWac)

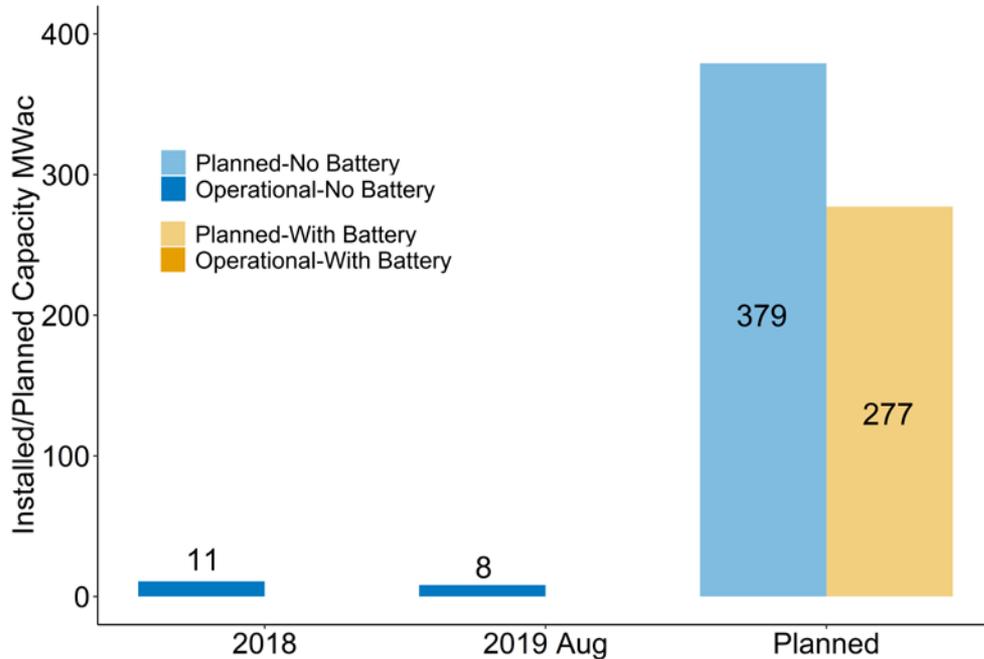


- **By Aug 2019, over 240 MWac of community solar projects were operational**
  - 656 MWac planned (630 MWac for Community Shared projects, 26 MWac for Low Income projects) under the SMART program
- **Y/Y growth from 2017 to 2018 slowed down as the state is transitioning from the RPS Solar Carve-Out II program to the Solar Massachusetts Renewable Target (SMART) Program.**

Data Source: 2015-2018: NREL/UMN Sharing the Sun Project Lists; 2019 Aug: [MA RPS Solar Carve-Out II Renewable Generation Units](#); [Solar Massachusetts Renewable Target \(SMART\) Application Update](#) 2019 Aug(O/P): Operational and Planned by 2019 August. The planned status includes approval/pending/under-construction. The solid colors represent the cumulative AC output (MW) for community solar in operation by corresponding year in MA. The semi-transparent colors represent the AC output (MW) of planned community solar projects.

# Pairing Community Solar with Storage in Massachusetts

SMART Community Solar in Massachusetts (MWac)

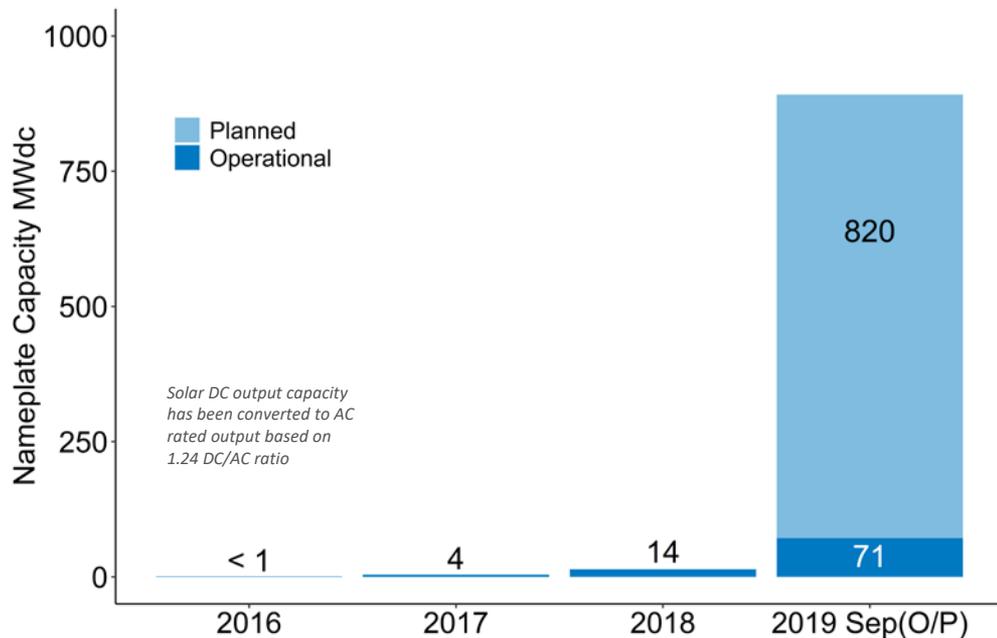


Data Source: [Solar Massachusetts Renewable Target \(SMART\) Application Update](#)

- **SMART program at a glance:**
  - There are two community solar components:
    - 1) community shared and 2) low income community shared
  - There is an added incentive for projects paired with battery storage
- **656 MWac community shared projects are planned under SMART**
  - 277 MW with battery storage (76 projects)

# New York has Little Community Solar to Date, but a Large Pipeline

## Community Solar Capacity Installed in New York (MWac)



- **By September 2019, 71 MWac of community solar projects were operational.**
  - The New York State Energy Research and Development Authority (NYSERDA) has an ambitious community solar plan.
- **The community solar pipeline in New York is above 800 MWac.**

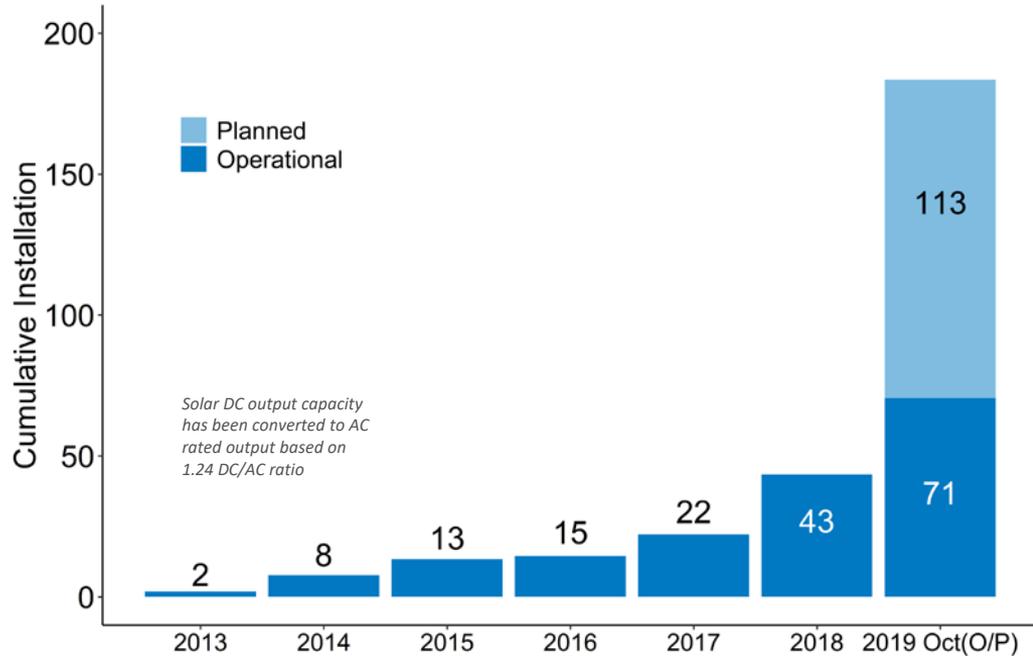
Data Source: 2016-2018: NREL/UMN *Sharing the Sun* Project List; 2019 Sep: [New York Solar Electric Programs Reported by NYSERDA](#)

The planned status includes approved, pending approved, received and submitted

The solid blue represents the cumulative nameplate capacity (MWac) for community solar in operation by September 2019 in NY. The semi-transparent blue represent the nameplate capacity (MWac) of planned community solar projects.

# Colorado Market Grows but Installs are Capped

## Xcel Community Solar Capacity Installed in Colorado (MWac)

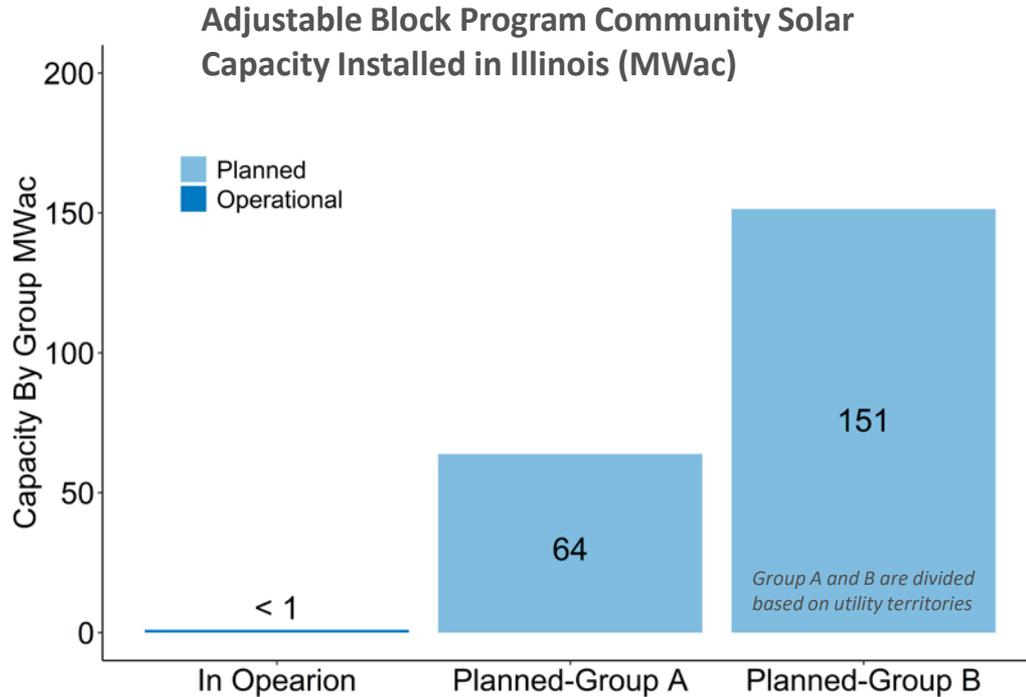


- By Oct 2019, over 70 MWac of community solar projects in operation with more than 110 MWac planned
- Xcel' Solar\*Reward Community program enables solar gardens ranging in size from 10.1 kW to 2 MW

Data Source: For 2013-2019 operational data: [Solar\\*Rewards RES Compliance Report](#); For Planned data, [planned projects are as of 2018 RFP](#)

2019 Oct (O/P): Operational and Planned by 2019 Oct. The planned status includes approval/pending/under-construction  
The solid blue represents the cumulative nameplate capacity (MWac) for community solar in operation by corresponding year in CO. The semi-transparent blue represent the nameplate capacity (MWac) of planned community solar projects.

# More than 1,500 MW of Community Solar Waitlisted in Illinois' Adjustable Block Program



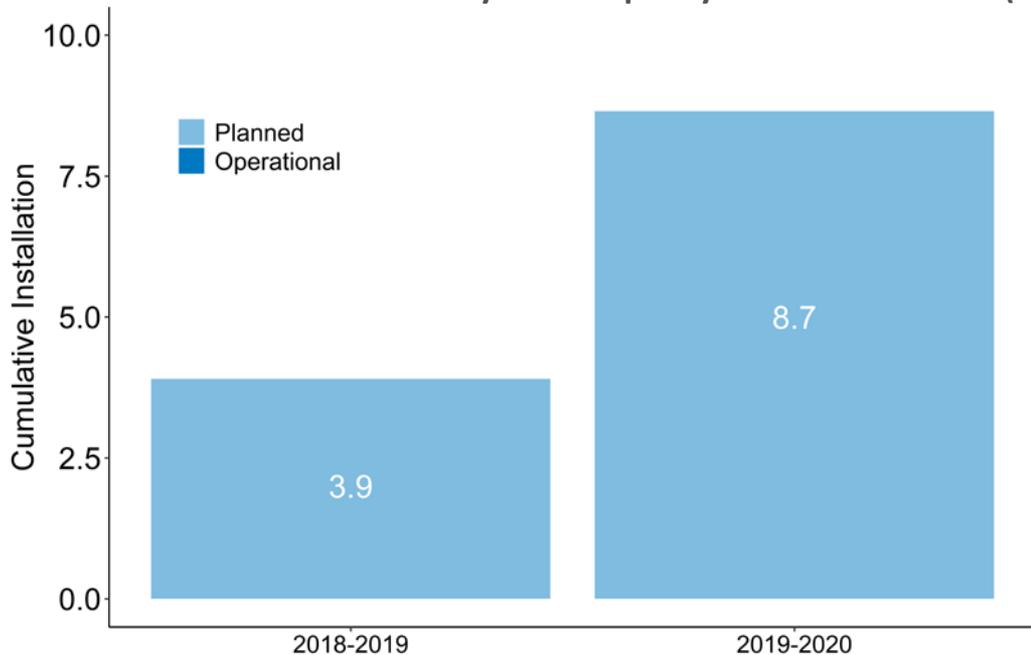
- By Oct 2019, there was less than 1 MW of community solar in operation in Illinois.
- The lottery for projects to receive an incentive via the Illinois Power Agency's Adjustable Block Program resulted in more than 200 MW of community solar.
- An additional ~1,500 MW of community solar was not selected in the lottery process.

*Data Source: For community solar projects in operation: NREL/UMN Sharing the Sun Project List; for planned community solar: [Illinois Power Agency Adjustable Block Program Lottery Results](#)*

*The planned status in this figure represents community solar projects accepted through the lottery. The solid blue represents the cumulative nameplate capacity (MWac) for solar gardens in operation by Oct 2019 in IL. The semi-transparent blue represent the nameplate capacity (MWac) of planned solar gardens.*

# Illinois has a Separate Initiative for Low Income Community Solar

Solar for All Community Solar Capacity Installed in Illinois (MWac)



Data Source: *Illinois Solar for All Dashboard*

The x-axis, [2018-2019](#) and [2019-2020](#) refer to project selection period. By Oct 2019, none of the project in operation

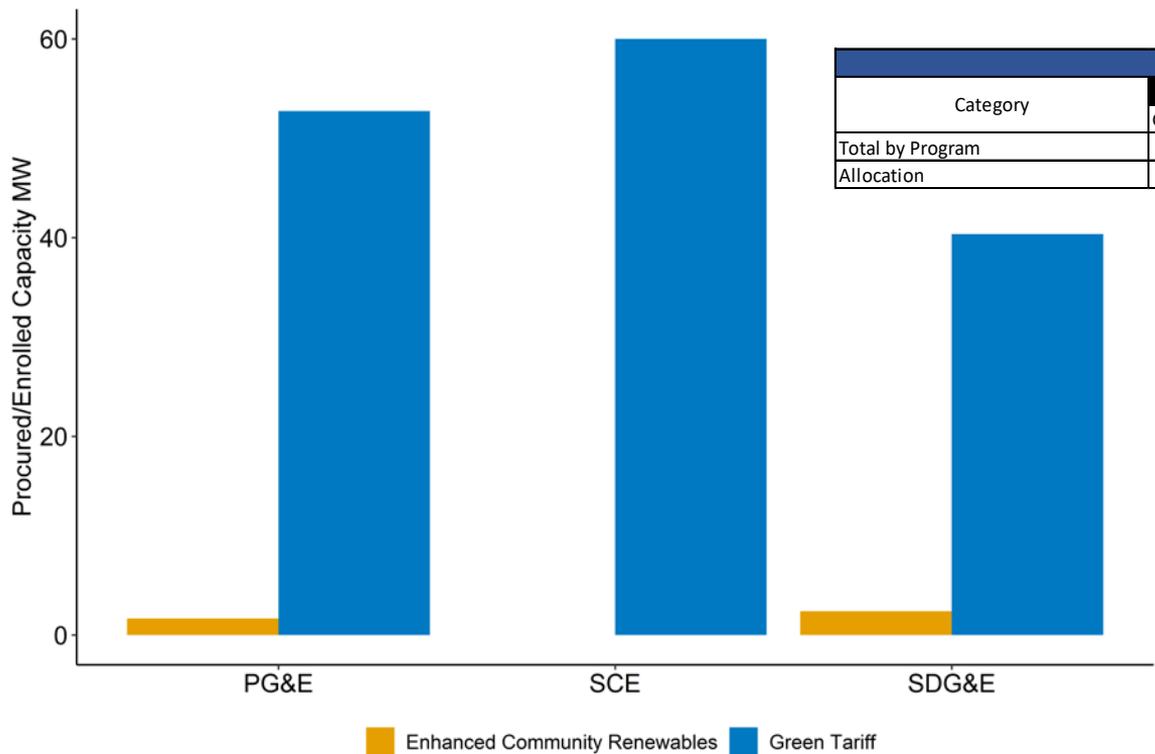
The planned status in this figure represents community solar projects accepted

The semi-transparent blue represent the nameplate capacity (MWac) of planned solar gardens.

- By Oct 2019, less than 10 MW of community solar planned under the Solar for All program
- About 19 MW of community solar [waitlisted](#)
- In addition, the upcoming [Low-Income Community Solar Pilot program](#), as another sub-program taking 25% of available RERF funds under Solar for All, will provide up to \$20 million budgets for each selected project

# Community Solar Updates – California

GTSR Capacity Cap and Procured by Utilities, by 2018



Senate Bill (SB) 43 enacted the Green Tariff Shared Renewables (GTSR) Program in CA. This program has a capped enrollment of 600 MW solar power statewide

The GTSR program has two components: 1) the Green Tariff and 2) Enhanced Community Renewables. By the end of 2018, less than 5 MW of enhance community renewable has been procured by utilities and the customers enrollment capacity is still zero.

# How are “Queues” Defined

State	Queue Definition
CO	<p>Project capacity awarded under the Solar*Reward Community (SRC) program, and marked as “Not Operation” in the RFP Bidder List.</p> <p>Xcel also updated another SRC queue spread sheet monthly. The SRC queue is specific to SRC projects and accurate as of the last updated date.</p> <p>In this slide, we use the first definition.</p>
IL	<p>IL Adjustable Block Program Queue: Lottery results status marked as “Accepted” but not in operation</p> <p>IL Solar for All Program Queue: Project marked as “Selected” but not in operation</p>
MA	<p>SREC carve out II: Project marked as “Qualified &amp; Not Operation”</p> <p>SMART: Qualified Units but not operation</p>
MN	<p>SRC Program Queue: Project marked as “Active Applications”</p>
NY	<p>NY Community Solar Queue: Project status marked as “Pipeline”</p>