Principles and Policies for Low and Moderate-Income Solar

Part 7:

Solar+Storage for LMI Communities

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Learning Objectives

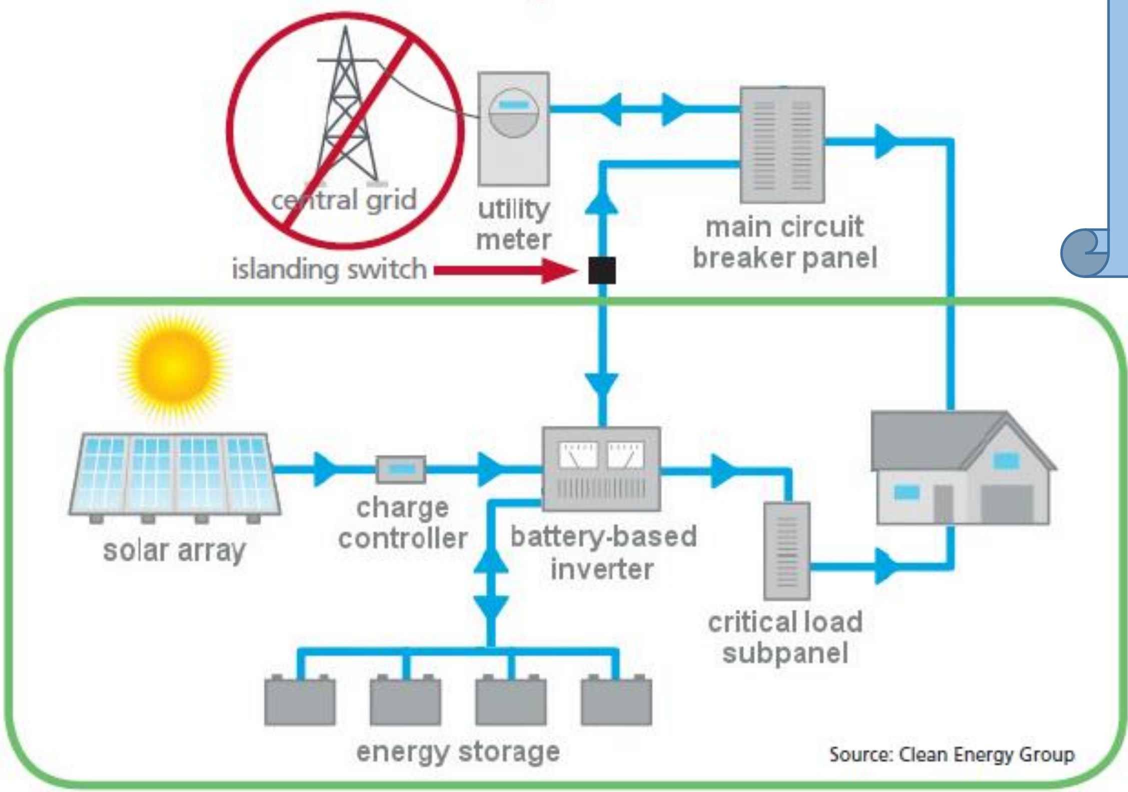
- To understand what energy storage is, and how it works with solar PV
- To understand the major benefits of solar+storage for LMI communities
- To understand the economics of solar+storage behind the meter

What Is Solar+Storage?

Solar+storage: a marriage of two clean energy technologies, solar PV and battery storage, capable of providing unique benefits that cannot be achieved by the use of either solar or storage alone.

In a solar+storage project, both solar and storage are eligible for the federal ITC, *if storage charges only (or mainly) from solar.*

FIGURE 1: **Islanded Resilient Power System**



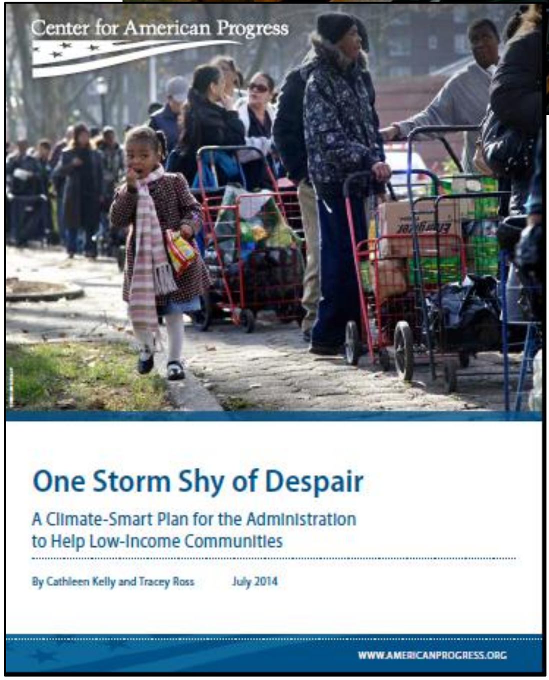
BENEFITS

- **Energy Cost Savings and/or Revenues**
- **Resilient Power**

Why Solar+Storage for LMI Communities?

1. Extreme weather and associated grid outages disproportionately harm LMI communities

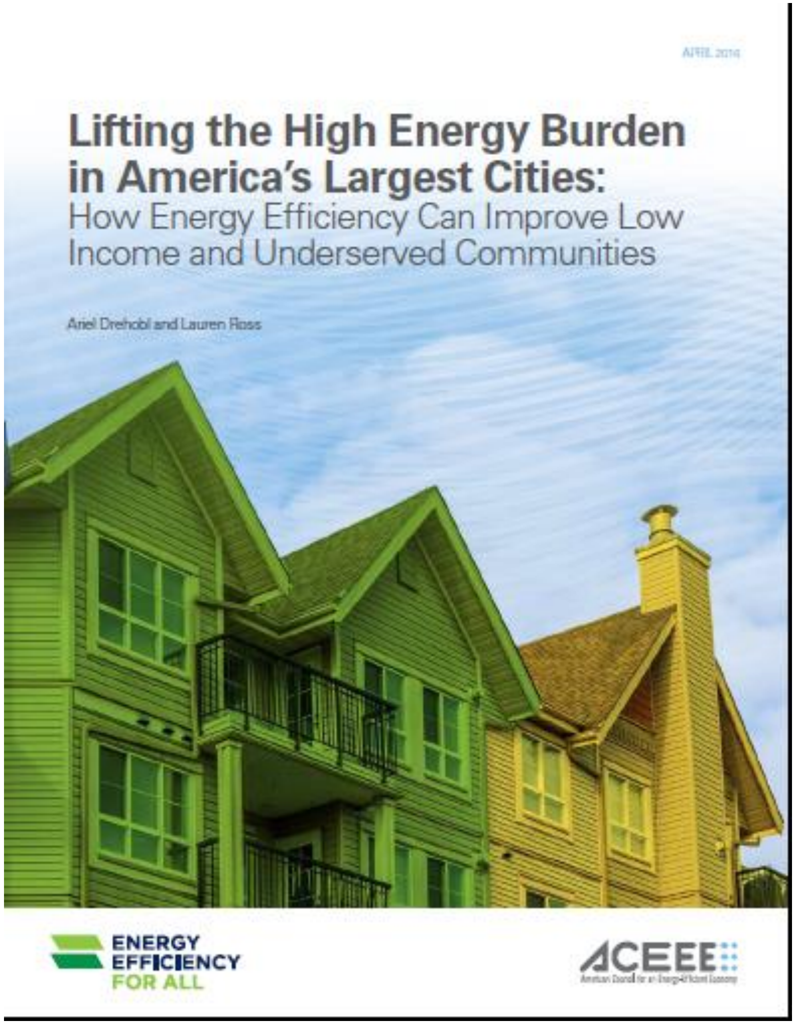
- Extreme weather and associated electric grid outages are becoming more frequent and more severe
- LMI communities may lack resources – income, savings, insurance, transportation, communication channels & information – making them less resilient after severe weather
- The elderly and disabled are particularly vulnerable to grid outages. Often, they rely on elevators, refrigerators (for medicine), electronic medical devices, and electronic communications devices – all of which need electricity to function
- It is frequently safer for people to shelter in place, than to be evacuated to shelters



Why Solar+Storage for LMI Communities?

2. Energy Costs Disproportionately Burden LMI Communities

- LMI customers, on average, pay a larger portion of their income for energy
- Solar PV can provide energy cost savings, but adding battery storage can in some cases provide greater savings than solar alone, resulting in a shorter payback period
- The largest opportunity for cost savings from adding storage at present is in demand charge management at commercial facilities



Cost Savings: Demand Charge Management for Commercial Facilities

Commercial facilities includes:

- Multifamily affordable housing
- Municipal facilities
- Schools
- Churches
- Critical facilities (shelters, medical, fire/police/ambulance, supermarkets, fueling stations, communications, transportation, water treatment)

For commercial customers, **30% - 70%** of their monthly electric bill may be demand charges

SDG1 Annual Electric Bill

ENERGY

		Usage (kWh)	Cost ($/kWh)	Total cost ($)
Max	Summer	13,085	0.11447	1,497.82
	Winter	7,827	0.10565	826.97
Peak	Summer	15,259	0.10568	1,612.59
	Winter	35,189	0.09132	3,213.46
Part-Peak	Summer	26,959	0.07920	2,135.17
	Winter	46,612	0.07160	3,337.42
TOTAL		**144,932**		**$12,623.43**

DEMAND

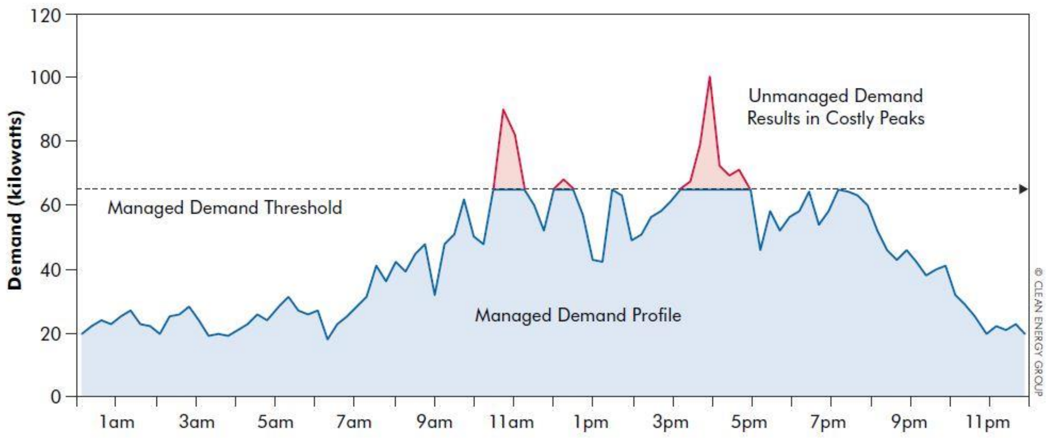
		Avg peak (kW)	Cost ($/kW)	Total cost ($)
Max	Summer	33	22.55	2,958.56
	Winter	30	22.55	5,195.52
Peak	Summer	33	19.19	2,517.73
	Winter	24	6.86	1,279.49
Part-Peak	Summer	30	0.00	0.00
	Winter	30	0.00	0.00
TOTAL				**$11,951.30**

FIXED

	Total cost ($)
Meter charge	1,397.28
TOTAL	**$1,397.28**

TOTAL ANNUAL BILL $25,972.01

How Storage Manages Demand Charges



Peak reduced from 100 kW to 65kW = **35 kW reduction**

Savings depend on **cost of demand**

Demand charges @ $10/kW = **$4,200 annual savings**
Demand charges @ $20/kW = **$8,400 annual savings**

Generally, commercial customers paying **$15/kW or more** in demand charges may be able to install batteries economically for demand charge management (without subsidies). *Resilience should be free.*

Economic Case Study:
Edwards D. Hassan Apartments, Hyde Park, MA

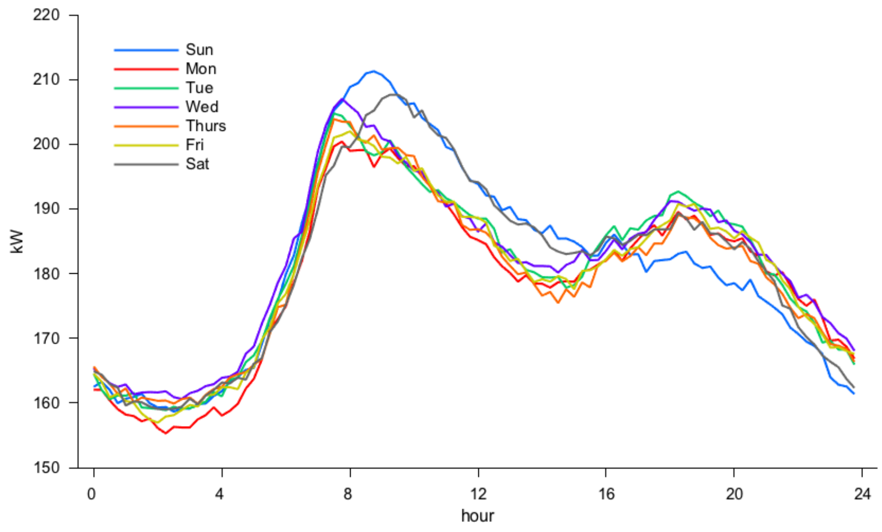
- Boston Housing Authority affordable senior housing facility
- 100 apartments
- **Electric heating**
- Common areas include kitchen, four laundry facilities, common room, 2 elevators
- ~60 kVA diesel generator for backup power
- Analysis of solar vs solar+storage system for DCM and resiliency

System modeled:

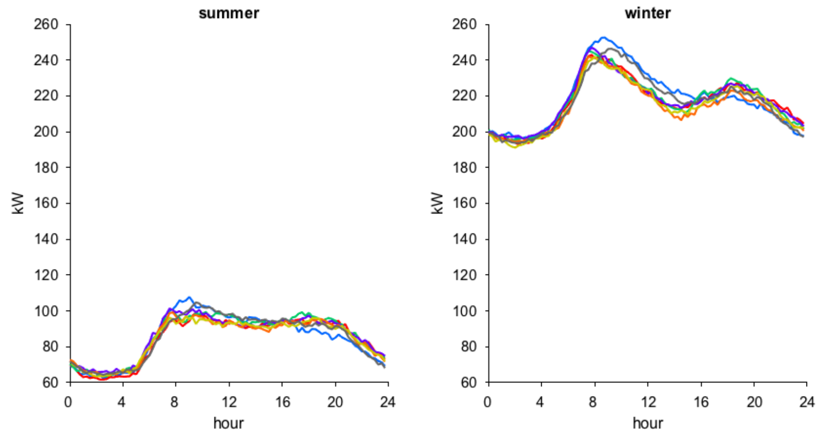
- Solar: 150 kW DC (cost: $375,000)
- Storage: 30 kW/45 kWh L/I battery (cost: $88,604)
- Total capital cost: $463,604

Analysis by Geli

Baseline Facility Load



Average daily load profile



Seasonal load profile

Electric heat = high winter peak loads

Baseline Utility Bill (1 year)

Analysis is on common loads only – not individual apartment loads

Baseline utility bill

ENERGY				baseline (T2)
		Usage, kWh	Cost, $/kWh	Total Cost, $
Peak	Summer	72,196	$0.0925	$6,678
	Winter	489,413	$0.0925	$45,271
Part-peak	Summer	-	$0.0000	$0
	Winter	-	$0.0000	$0
Off-peak	Summer	176,967	$0.0925	$16,369
	Winter	773,548	$0.0925	$71,553
TOTAL, /yr		1,512,124		**$139,871**

Energy

DEMAND				
		Avg Peak, kW	Cost, $/kW	Total Cost, $
Max	Summer	153	$29.80	$18,221
	Winter	352	$21.35	$60,096
Peak	Summer	0	$0.00	$0
	Winter	0	$0.00	$0
Part-Peak	Summer	0	$0.00	$0
	Winter	0	$0.00	$0
TOTAL, /yr				**$78,317**
Meter Charge, $/yr				**$2,000**
TOTAL, $/yr				**$220,188**

Demand

Hassan Apartments Payback Comparison

						Year 1 savings		
	Size	Capital cost	Federal ITC	Depreciation	Net cost	Energy charge	Demand charge	Estimated payback
Solar system	150 kW PV	$375,000	$112,500	$144,713	$117,787	$18,204	$5,374	5.7 years
Energy Storage system	30 kW/45 kWh battery	$88,604	$26,581	$34,192	$27,831	$0	$7,645	4.4 years
Combined system	150 kW PV + 30 kW/45 kWh battery	$463,604	$139,081	$178,905	$145,618	$18,204	$13,019	5.3 years

Storage payback = 4.4 years
Solar+Storage payback = 5.3 years
Solar alone payback = 5.7 years

What the analysis includes:

- Federal ITC applied to solar+storage installed costs *(scheduled to phase out)*
- Federal accelerated depreciation

What it doesn't include:

- State solar incentives (and proposed storage adders)
- Income from Alternative Energy Certificates
- Other market programs (demand response)

Three City Analysis: The Economic Impact of Adding Storage

Chicago Project Summary			
System Size	200-kW solar-only	200-kW solar +100-kW/ 50-kWh lithium-ion battery	200-kW solar + 300-kW/ 150-kWh lithium-ion battery
Initial Cost*	$493,000	$606,000	$832,000
Payback Period	20+ years	11.8 years	6.2 years

* Initial project costs refer to year zero net project expenses after federal tax credits and any additional tax credits have been applied.

Washington, D.C. Project Summary		
System Size	360-kW solar-only	360-kW solar +100-kW/ 50-kWh lithium-ion battery
Initial Cost	$788,000	$901,000
Payback Period	3.5 years	3.5 years

New York City Project Summary		
System Size	30-kW solar-only	30-kW solar + 30-kW/ 60-kWh lead-acid battery
Initial Cost	$58,000	$128,000
Payback Period	4.3 years	14.2 years

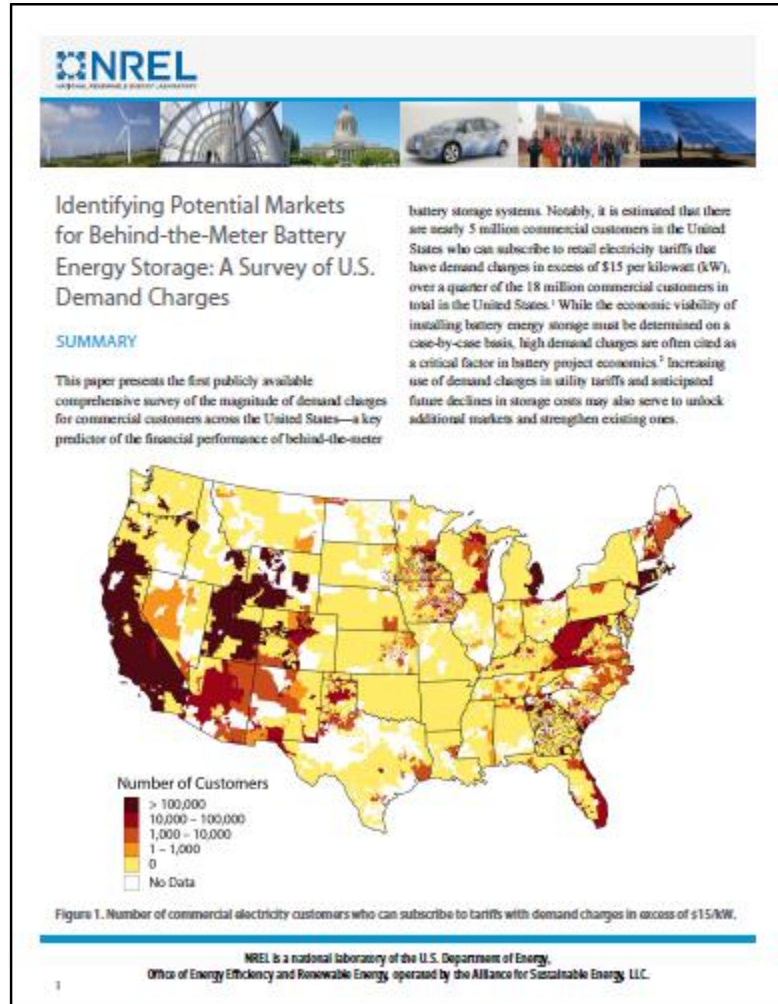
What makes the difference?

- Energy costs
- Demand charge rates
- State incentives
- Regulatory requirements

First National Survey of Demand Charge Rates

Identifying Potential Markets for Behind-the-Meter Battery Energy Storage: A Survey of U.S. Demand Charges

- Based on a survey of more than 10,000 utility tariffs
- Applies to approximately 70% of commercial buildings in the United States
- ***Result: Nearly 5 million commercial customers may be paying more than $15/kW in demand charges***


NREL

Identifying Potential Markets for Behind-the-Meter Battery Energy Storage: A Survey of U.S. Demand Charges

SUMMARY

This paper presents the first publicly available comprehensive survey of the magnitude of demand charges for commercial customers across the United States—a key predictor of the financial performance of behind-the-meter battery storage systems. Notably, it is estimated that there are nearly 5 million commercial customers in the United States who can subscribe to retail electricity tariffs that have demand charges in excess of $15 per kilowatt (kW), over a quarter of the 18 million commercial customers in total in the United States.[1] While the economic viability of installing battery energy storage must be determined on a case-by-case basis, high demand charges are often cited as a critical factor in battery project economics.[2] Increasing use of demand charges in utility tariffs and anticipated future declines in storage costs may also serve to unlock additional markets and strengthen existing ones.

Figure 1. Number of commercial electricity customers who can subscribe to tariffs with demand charges in excess of $15/kW.

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

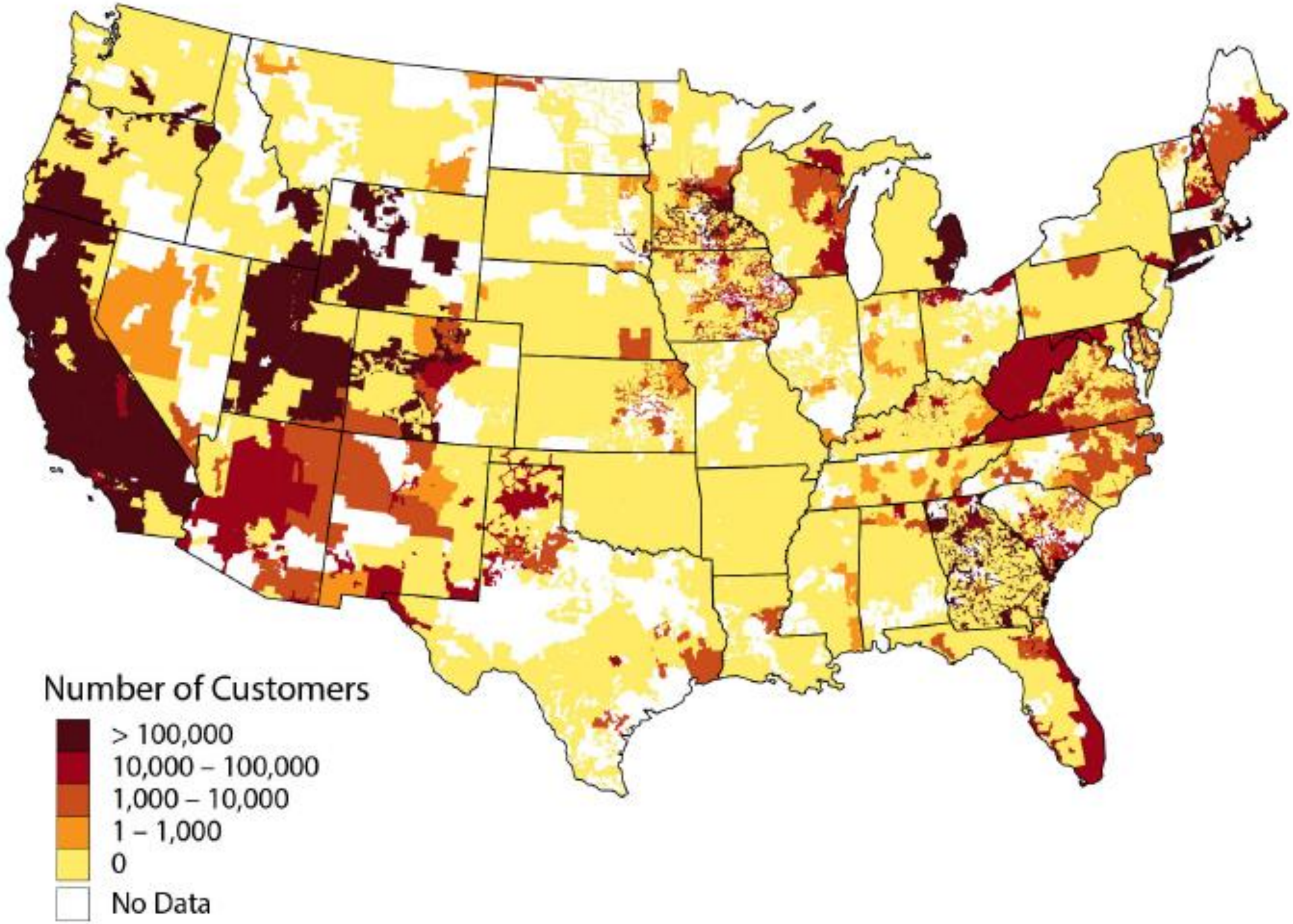
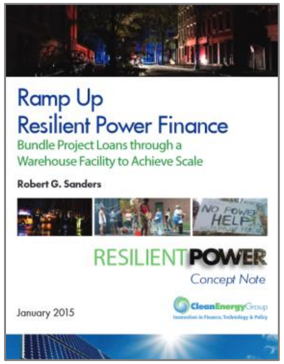


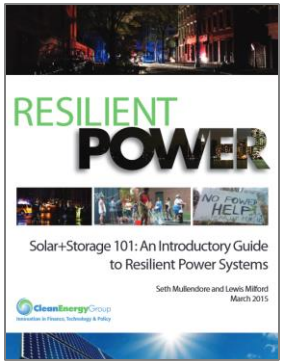
Figure 1. Number of commercial electricity customers who can subscribe to tariffs with demand charges in excess of $15/kW.

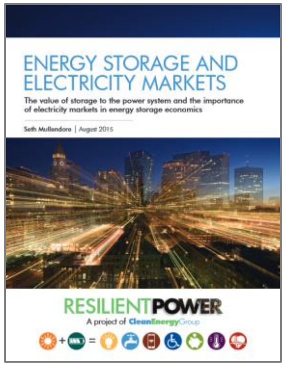
Darker areas on map = more customers paying high demand charges

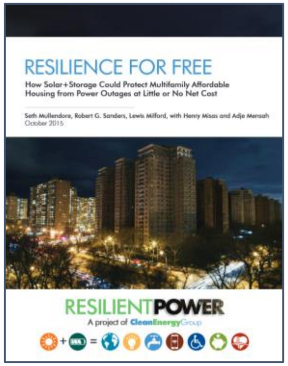
Resources

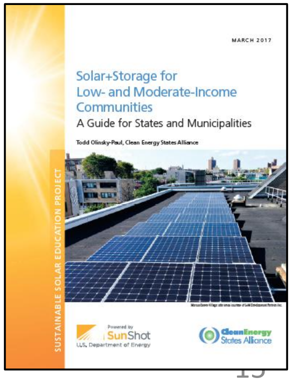
See www.resilient-power.org for reports, newsletters, webinar recordings and other solar+storage resources











Thank you for attending our webinar

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Slides and recordings from this webinar series are available on CESA's website at:
www.cesa.org/projects/sustainable-solar/solar-in-your-community-challenge-webinar-series

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