CONNECTICUT GREEN BANK®

Residential Solar Investment & Deployment in Connecticut:

An In-Depth Review of a 10-Year Incentive Program (2012-2022)

May 4, 2023

Welcome & Agenda

Introduction

Overview of the Greenhouse Gas Reduction Fund

Residential Solar Market in Connecticut

Residential Solar Public Policy in Connecticut (2012-2022)

Residential Solar Investment Program Performance

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Introduction

CONNECTICUT GREEN BANK

Connecticut Green Bank is the nation's first state green bank. Established in 2011 as a quasi-public agency, the Green Bank uses limited public dollars to attract private capital investment and offers green solutions that help people, businesses and all of Connecticut thrive.

Our mission is to confront climate change by increasing and accelerating investment into Connecticut's green economy to create more resilient, healthier, and equitable communities

Guiding this mission is our vision for
"…a planet protected by the love of humanity."

Overview of the Greenhouse Gas Reduction Fund

Greenhouse Gas Reduction Fund

- **Inflation Reduction Act** – provides $27 billion to the U.S. Environmental Protection Agency (EPA) to administer the Greenhouse Gas Reduction Fund (GGRF)
- **Implementation Framework** – EPA recently released a three-part implementation framework for the GGRF, including:
  - **National Clean Investment Fund** - $14 billion competition that will fund 2-3 national nonprofits that will partner with private capital providers to deliver financing at scale to businesses, communities, community lenders, and others
  - **Clean Communities Investment Accelerator** - $6 billion competition that will fund 2-7 hub nonprofits with the plans and capabilities to rapidly build the clean financing capacity of specific networks of public, quasi-public, and nonprofit community lenders to ensure that households, small businesses, schools, and community institutions in low-income and disadvantaged communities have access to financing
  - **Solar for All** - $7 billion competition that will provide up to 60 grants to states, tribes, municipalities and nonprofits to expand the number of low-income and disadvantaged communities for investment in residential and community solar

Solar for All Competition

- **Funding and Awards** – $7 billion from Section 134(a)(1) of the Clean Air Act for up to 60 awards (i.e., states (including territories), Tribal governments, municipalities, and eligible entities) which must be invested in low-income and disadvantaged communities to deploy or benefit from zero-emission technologies
- **Activities** – expand existing low-income solar programs or design and deploy new Solar for All programs, including the following types of projects:
  - **Residential Rooftop** – rooftop and ground-mounted that support individual households, master-metered facilities, and/or common areas in multifamily buildings
  - **Community Solar** – solar PV producing facility or power purchasing program in which benefits flow to multiple residential customers
  - **Associated Storage** – store solar for various purposes (e.g., resilience, demand response)
  - **Enabling Upgrades** – building infrastructure to support solar deployment (e.g., roof repairs)

Greenhouse Gas Reduction Fund

EPA Marks Earth Week with Release of Implementation Framework

The Greenhouse Gas Reduction Fund will be implemented via three complementary grant competitions to fund projects that will combat the climate crisis and create good-paying jobs.

Residential Solar Market in CT

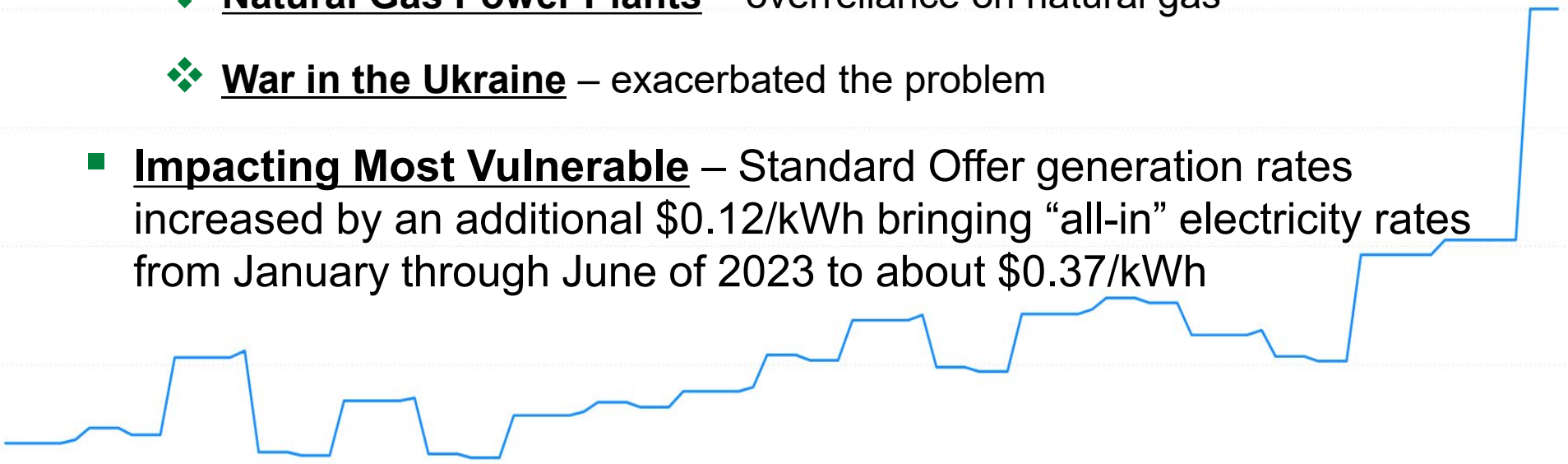
Solar Potential

- **Addressable Market** – conducted study in 2013 that determined technical potential for residential solar is 6.5 GW and economic potential is 3.9 GW
  - **Viability** – approximately ¾ of single-family homes (i.e., ~825,000 homes) in Connecticut are viable for solar with respect to 25-year payback
  - **Production Potential** – if residential solar were to achieve its economic potential from residential solar deployment, then an estimated 3,915 GWh of zero emission solar power could be produced, which is about 15% of electric demand in Connecticut
  - **To Date** – reached about 50,000 single family homes in Connecticut (i.e., 6% of homes) and 385 MW (10% of economic potential)

REFERENCES
"The Addressable Solar Market in Connecticut" by Geostellar (December 6, 2013) – click here

Residential Electricity Rates

- **Electricity Rates** – Connecticut has among the highest electricity rates in the continental United States
  - **Deregulation** – in the late 1990's separated generation from transmission and distribution
  - **Natural Gas Power Plants** – overreliance on natural gas
  - **War in the Ukraine** – exacerbated the problem
- **Impacting Most Vulnerable** – Standard Offer generation rates increased by an additional $0.12/kWh bringing "all-in" electricity rates from January through June of 2023 to about $0.37/kWh



Solar Savings from Net Metering

Location	Capacity Factor	Production (kWh/kW)	Electricity Rates ($/kWh)	Solar Savings ($/kW)
Arizona	27.0%	2,365	$0.1262	$298
California	28.1%	2,462	$0.2645	$651
Connecticut	16.7%	1,463	$0.3024	$442
Nevada	26.7%	2,339	$0.1681	$393
Texas	21.7%	1,901	$0.1418	$270

REFERENCES
Capacity Factors – click here
Electricity Rates – click here

Housing Units

# of Housing Units 1,390,000					
Non-LMI (≥100% AMI) 660,000 48%		**LMI** (<100% AMI) 720,000 52%			
Own 550,000 40%	**Rent** 110,000 8%	**Moderate Income** (80-100% AMI) 270,000 20%		**Low Income** (<80% AMI) 450,000 32%	
		Own 180,000 13%	**Rent** 100,000 7%	**Own** 190,000 14%	**Rent** 260,000 18%

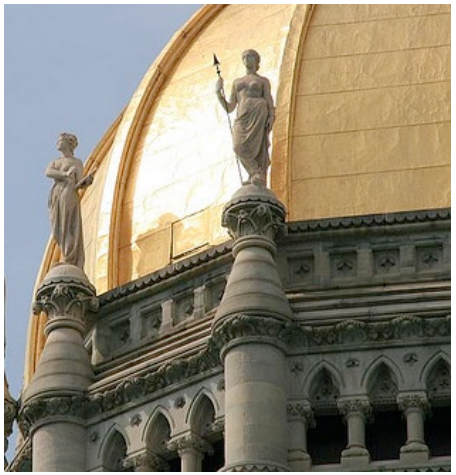
Approximately 1,100,000 single family and 300,000 multifamily housing units, of which **450,000 are low-income (i.e., 32%) – 190,000 (14%) own vs. 260,000 (18%) rent**

REFERENCES
U.S. Census Bureau: American Community Survey, 2020 American Community Survey 5-Year Estimates, Table DP03: Selected Economic Characteristics

Residential Solar Public Policy in CT (2012-2022)

Residential Solar Supportive Public Policy

- **Net Metering** – created through the passage of Public Act 98-28 on electric deregulation, CGS 16-243h provided net metering for solar
- **Renewable Portfolio Standards** – created through the passage of Public Act 98-28 on electric deregulation, CGS 16-245a establishes a renewable portfolio standard (i.e., 40% Class I by 2030 – including zero emission solar)
- **Sales and Use Tax Exemptions** – created through the passage of Public Act 07-242, CGS 12-412 provides sales and use tax exemption for solar
- **Property Tax Exemptions** – created through the passage of Public Act 07-242, CGS 12-81 provides property tax exemption for solar
- **Residential Solar Investment Program** – created through the passage of Public Act 11-80, and subsequently expanded through Public Act 15-194, CGS 16-245ff provides residential solar incentives through the Green Bank



Residential Solar Investment Program

- **Section 106 of Public Act 11-80** – policy passed in **July of 2011** that creates the **Residential Solar Investment Program**, a declining incentive program (e.g., EPBB and PBI) administered by the CGB to deliver **no less than 30 MW** of new residential solar PV by the **end of 2022**, while "**fostering the sustained, orderly development of local solar industry**"
- **Public Act 15-194** – policy passed in **July of 2015** that builds on the Residential Solar Investment Program by requiring the **EDC's** to purchase **SHRECs** through **15-year MPA** at a **price set by the CGB** to deliver **no more than 300 MW** of new residential solar PV by the **end of 2022**.
- **Public Act 19-35** – expanded RSIP by 50 MW to **350 MW by the end of 2022**

Residential Solar Investment Program Performance

Declining Incentive Block Structure with a "Race to the Rooftop" Design

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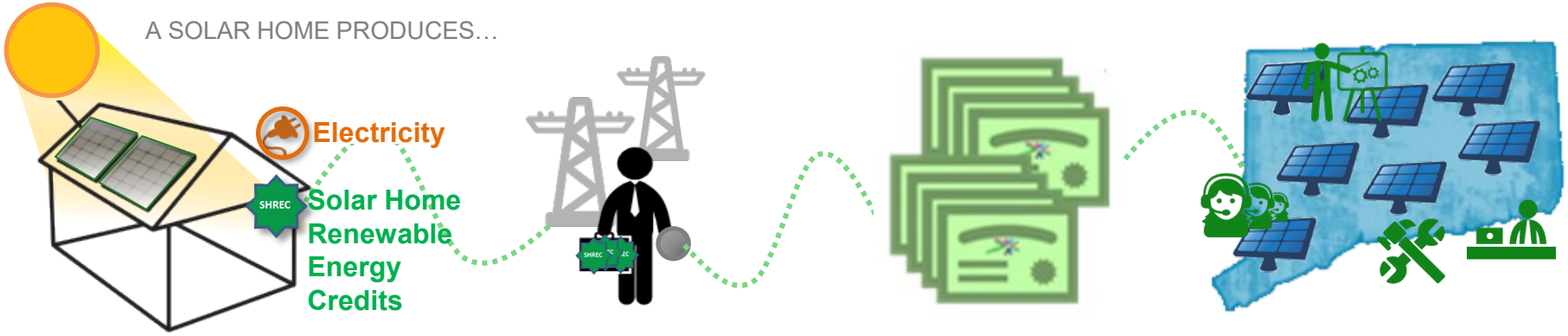
Step	EPBB ($/W)			PBI ($/kWh)		LMI-PBI ($/kWh)		ZREC$_{Eq}$ ($/MWh)
	≤5 kW	5-10 kW	10-20 kW	≤10 kW	10-20 kW	≤10 kW	10-20 kW	
1	$2.450	$1.250	$0.000	$0.300	$0.000	N/A	N/A	$139
2	$2.275	$1.075	$0.000	$0.300	$0.000	N/A	N/A	$121
3	$1.750	$0.550	$0.000	$0.225	$0.000	N/A	N/A	$94
4	$1.250	$0.750	$0.000	$0.180	$0.000	N/A	N/A	$77
5	$0.800		$0.400	$0.125	$0.060	N/A	N/A	$58
6	$0.675		$0.400	$0.080	$0.060	N/A	N/A	$42
7	$0.540		$0.400	$0.064	$0.060	N/A	N/A	$32
8	$0.540		$0.400	$0.054	$0.060	$0.110	$0.055	$28
9	$0.513		$0.400	$0.046		$0.110	$0.055	$25
10	$0.487		$0.400	$0.039		$0.110	$0.055	$22
11	$0.487		$0.400	$0.039		$0.110	$0.055	$23
12	$0.463		$0.400	$0.035		$0.110	$0.055	$20
13	$0.463		$0.400	$0.035		$0.090	$0.045	$20
14	$0.463		$0.400	$0.035		$0.090	$0.045	$20
15	$0.426		$0.328	$0.030		$0.081	$0.041	$18
16	$0.426		$0.328	$0.030		$0.081	$0.041	$23
17	$0.358		$0.207	$0.030		$0.073	$0.036	$21

Pay for Performance Solar Incentive Program



When panels produce electricity for a home, they also produce **Solar Home Renewable Energy Credits (SHRECs)**. The Green Bank provides incentives through RSIP and collects all the SHRECs produced per statute (i.e., PA 15-194).

Utilities required to enter into **15-year Master Purchase Agreement (MPA) with the Green Bank to purchase the stream of SHRECs produced**. This helps utilities comply with their clean energy goals (i.e., Class I RPS).

Green bonds are created from the SHREC revenues received through the MPA and **sold to institutional** (i.e., pension funds, insurance companies, etc.) and **retail investors** (i.e., friends and family) to **receive proceeds upfront**.

The Green Bank uses the green bond proceeds to **support the RSIP incentives** (i.e., PBI and EPBB), **cover admin costs**, and **financing costs** to achieve **350 MW of solar PV deployment and foster sustained orderly development of local solar PV industry**

Mobilizing Private Investment to Increase and Accelerate Residential Solar Deployment

Fiscal Year	# Projects	Installed Capacity (kW)	Total Investment ($000's)	RSIP Incentive ($)	Private Investment ($)	Leverage Ratio
2012	288	1,940	$9.9	$3.4	$6.5	2.9
2013	1,109	7,890	$35.4	$11.9	$23.5	3.0
2014	2,384	17,144	$73.9	$20.1	$53.9	3.7
2015	6,381	48,629	$214.1	$33.1	$180.9	6.5
2016	6,785	53,196	$217.5	$18.8	$198.8	11.6
2017	4,445	34,629	$120.2	$11.6	$108.7	10.4
2018	5,150	41,786	$147.1	$12.6	$134.6	11.7
2019	6,468	54,983	$195.8	$15.2	$180.6	12.9
2020	6,849	57,696	$205.2	$14.7	$190.5	14.0
2021	5,206	47,088	$166.4	$12.2	$154.2	13.7
2022	1,592	15,459	$58.0	$3.8	$54.2	15.4
Total	**46,657**	**380,441**	**$1,443.5**	**$157.2**	**$1,286.3**	**9.2**

REFERENCES

Annual Comprehensive Financial Report for FY23 – Residential Solar Investment Program (Pages 241-265) – click here

slipstream

RSIP Evaluation and Recommendations

Dan Streit | Slipstream

Lee Shaver | Slipstream

May 4, 2023

Objectives

Evaluate RSIP's Impact and Effectiveness

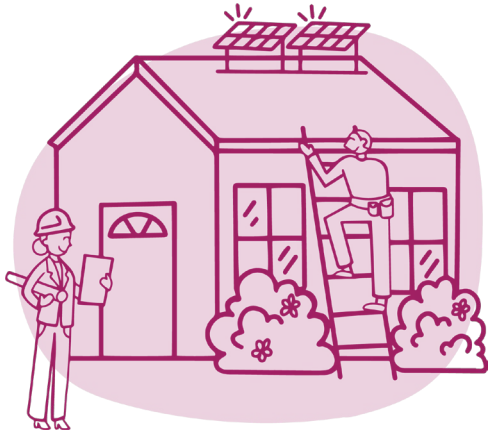
- Cumulative Impacts
- Trends
- Equitable delivery

Compare RSIP with Northeast Residential Solar Programs

- Capacity
- Cost-effectiveness
- Equitable adoption

Share Lessons Learned

- Successes and challenges
- Future roles



Methodology

Background research

- Green Bank evaluation framework
- Evaluation of diverse solar incentives
- LMI solar adoption strategies and trends

RSIP Data Analysis

- Energy (Capacity and Production)
- Investment (Public and Private)
- Avoided Emissions (GHG and Particulate)
- Economic Impact (Cost savings, Jobs, and Taxes)

External Data Analysis

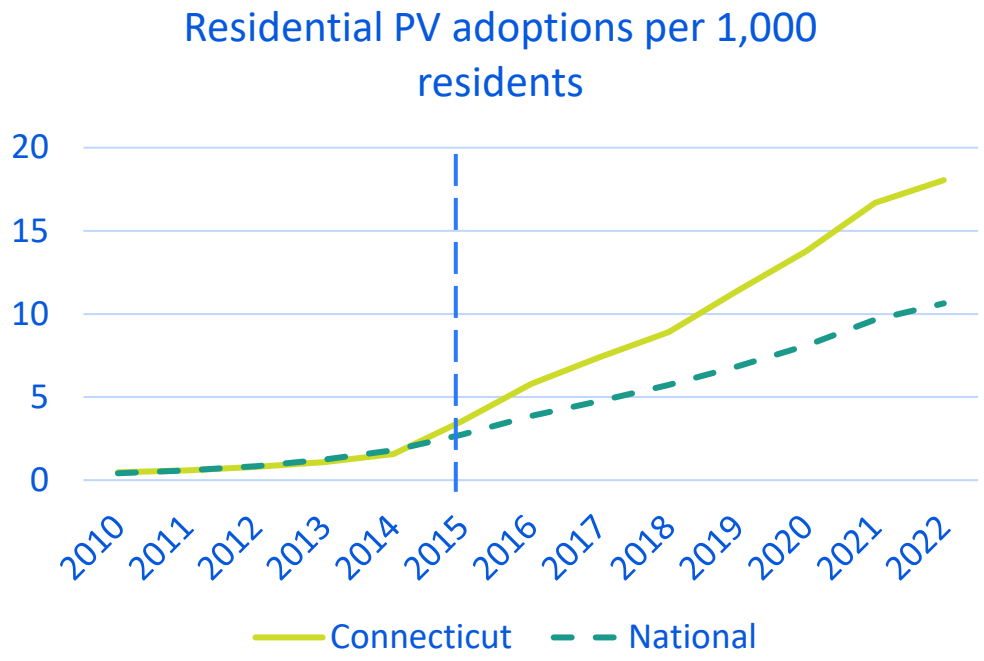
- Northeast state programs
- Regional adoption rates
- National trends

Stakeholder Interviews

- Electric utilities
- Solarize CT/SmartPower
- CT Solar and Storage Association
- Non-CT regulators and utilities

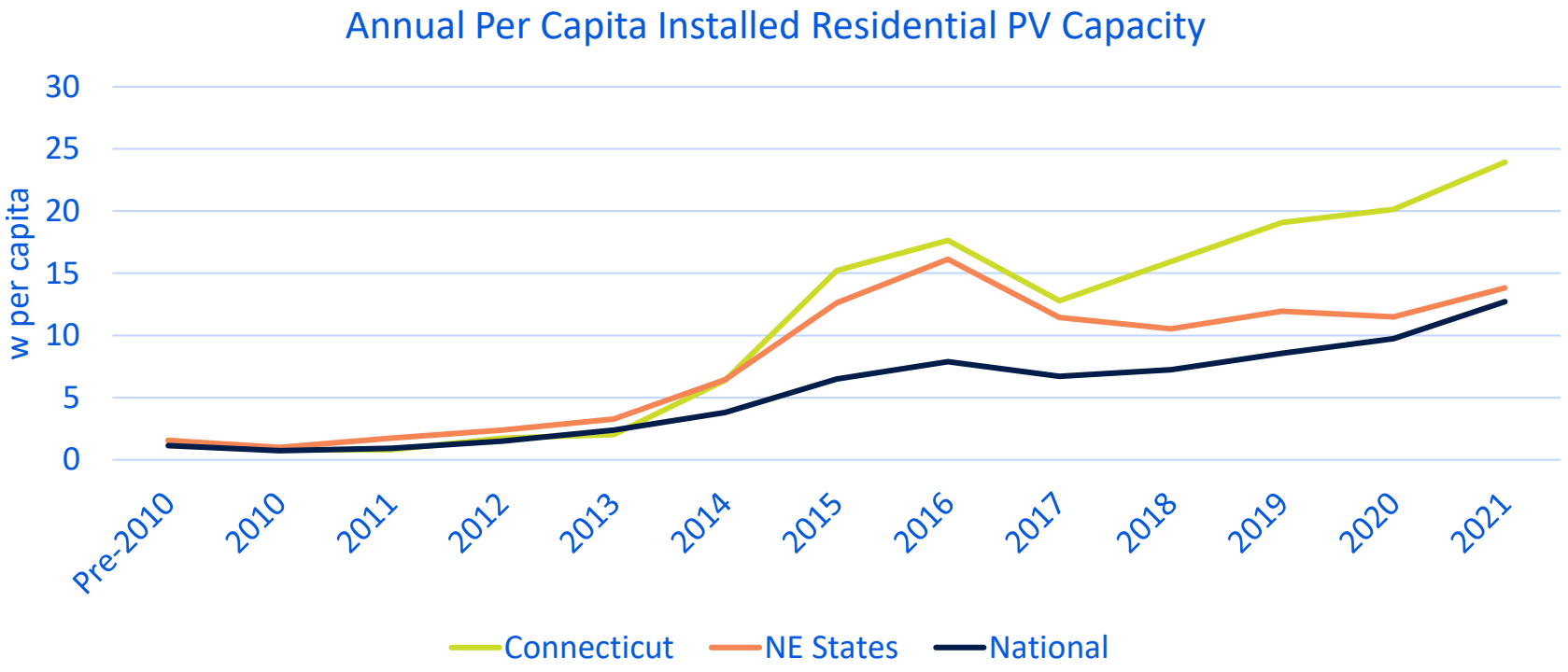
Results:
Program Effectiveness

PV adoption rate

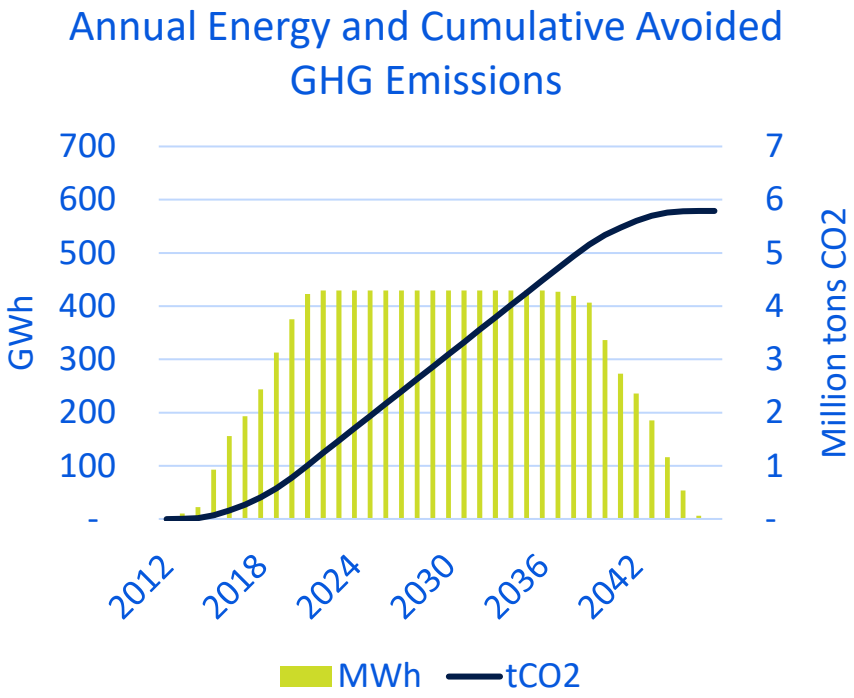


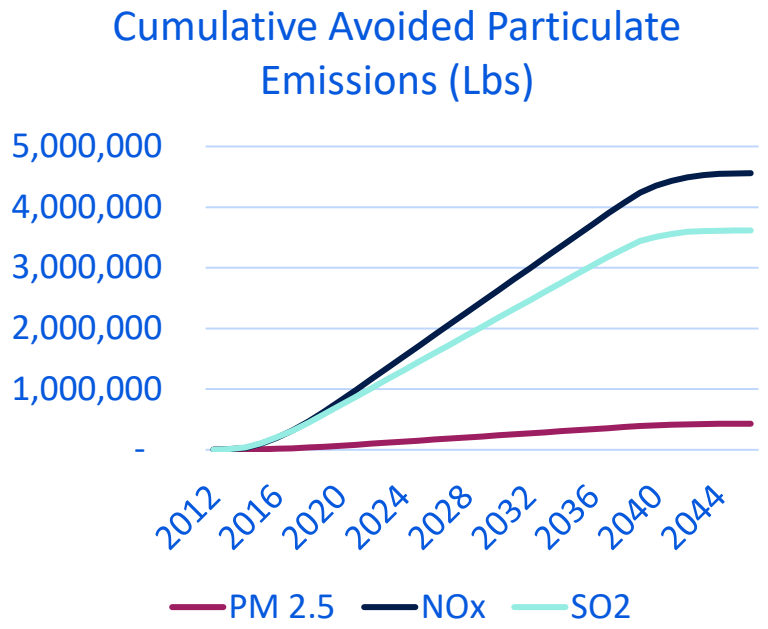
- Connecticut exceeded the national rate of PV adoption since 2015
  - Increased capacity mandate
  - Added LMI PBI to address low adoption in that sector

Connecticut leads national average and New England states in residential PV installations



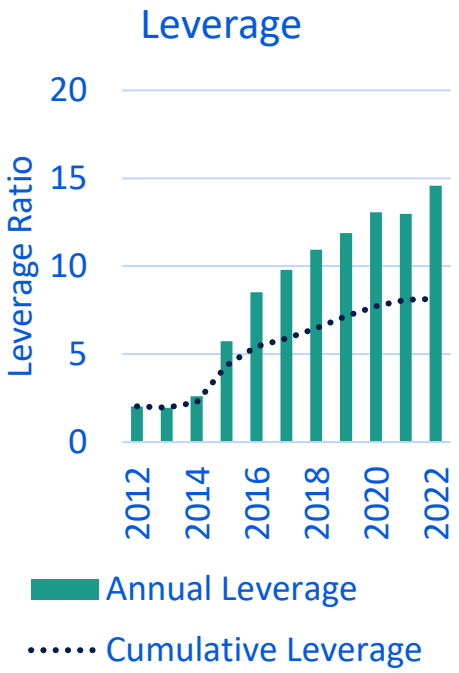
Energy Production and Avoided Emissions

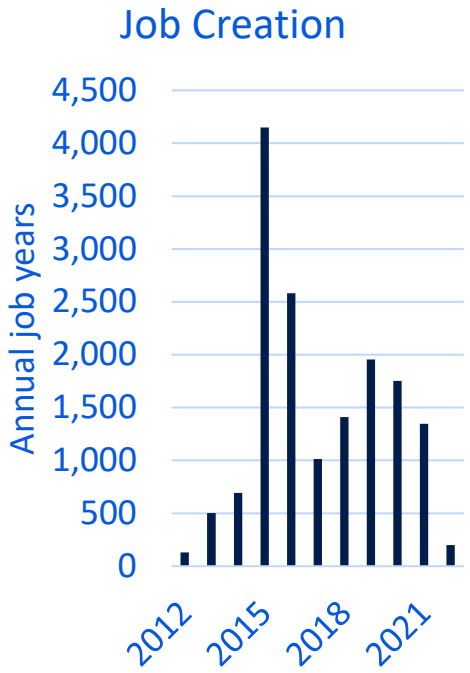




- Significant and durable avoided GHG and particulate emissions
- Global and local impacts

RSIP Economic Impacts

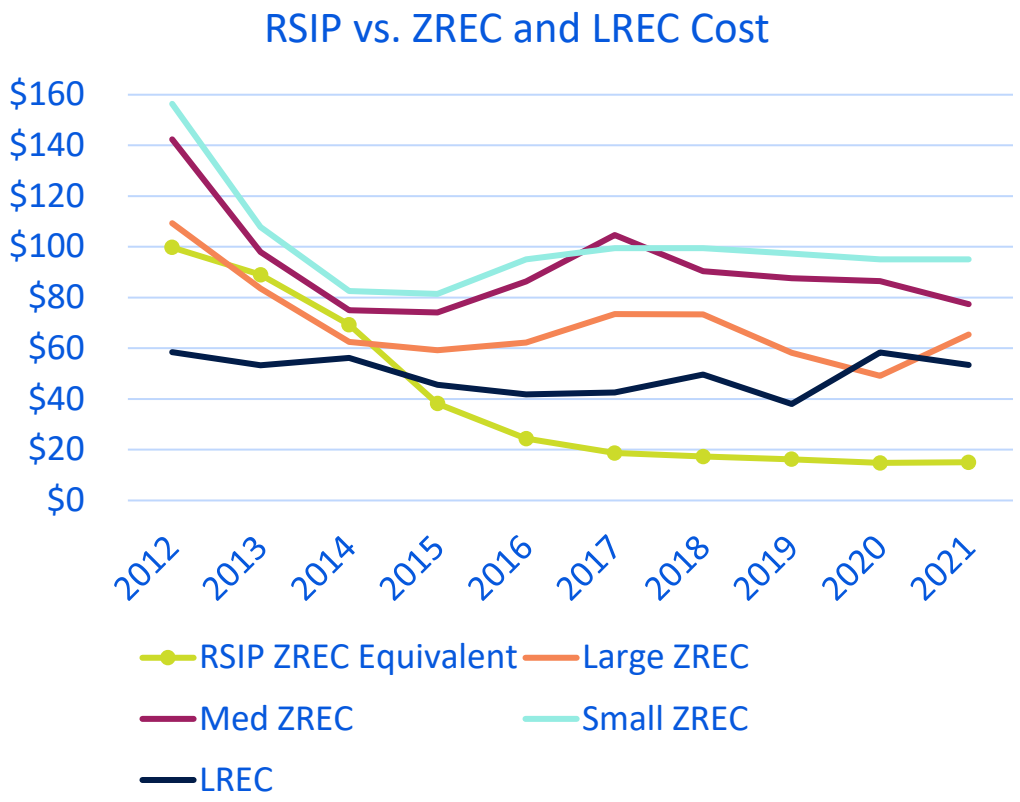




- 8.15 Cumulative leverage ratio
  - $156M of RSIP incentives activated $1.27B of private investment
- Catalyzed growth of solar industry grew clean energy sector jobs

Results:
Program Efficiency

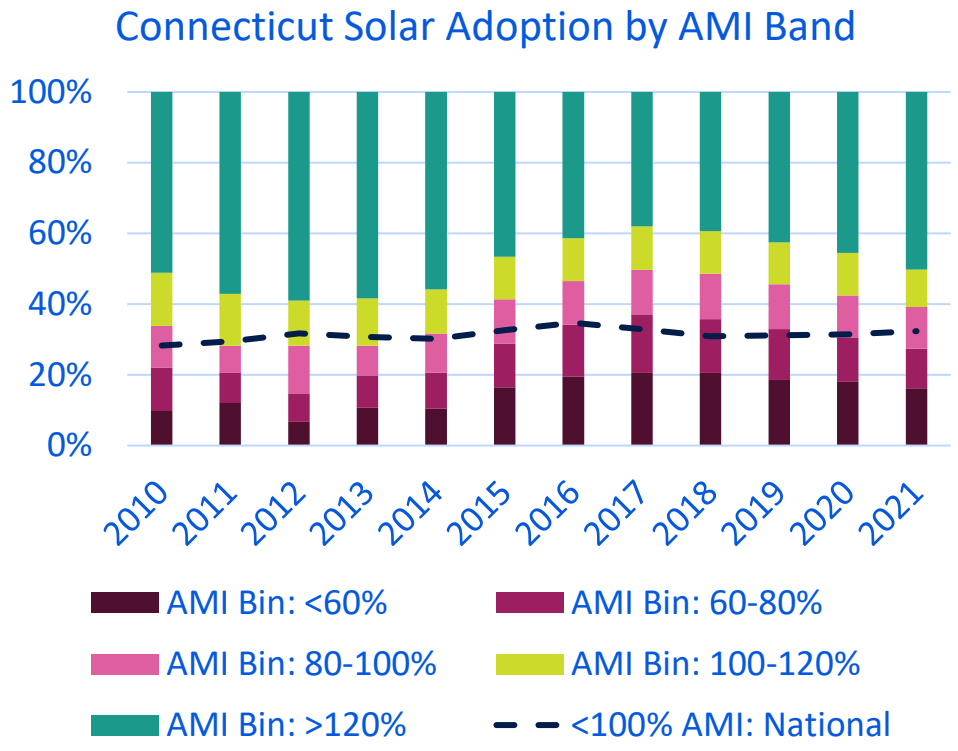
Comparative Costs of CT Solar Incentive Strategies



- RSIP cost-efficiently incentivized private sector solar
- Differentiated by cost-certainty

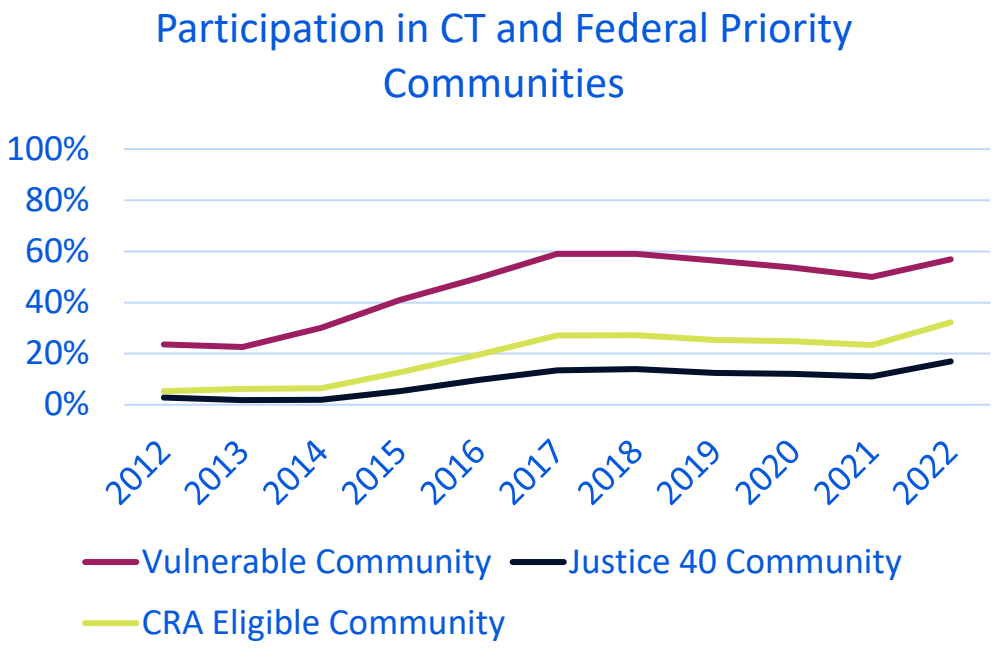
Results:
Equitable Deployment

PV adoption relative to income



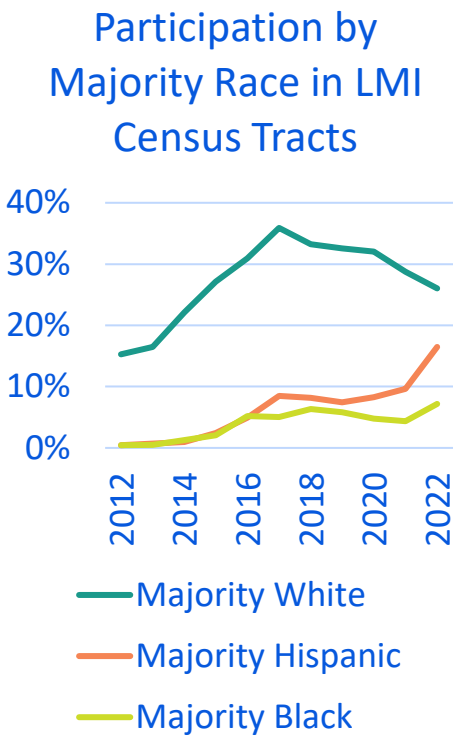
- Since 2015, adoption in tracts where median income < 100% AMI has exceeded national average
- Outside of the highest income bracket (>120%), adoption was greatest in the lowest bracket (<60%)

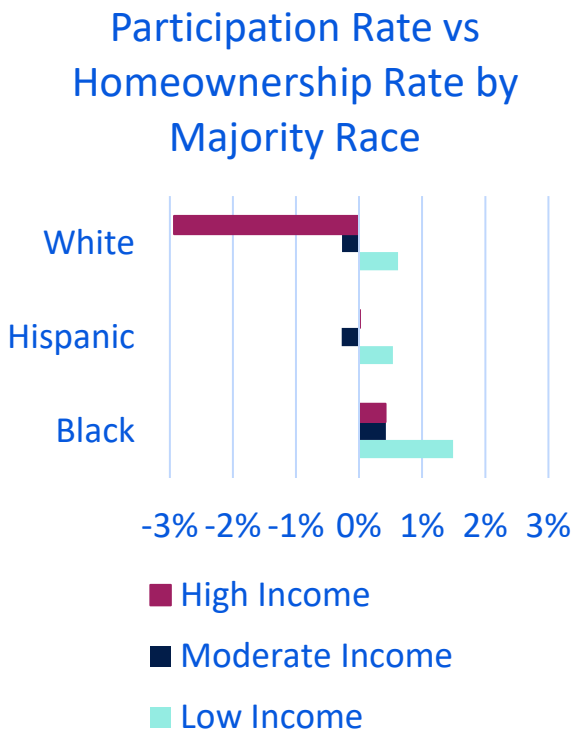
Participation in Priority Communities



LMI-focused program adaptations (2015) boosted participation in state and federal priority communities

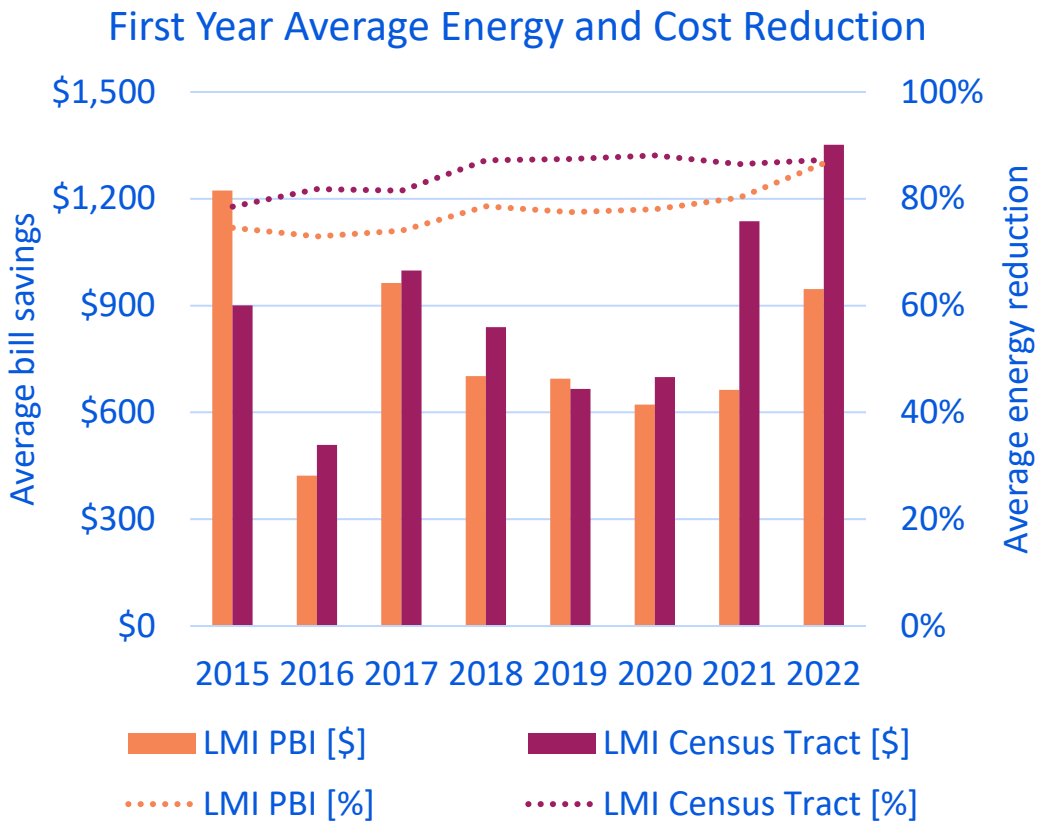
Program Participation by Race





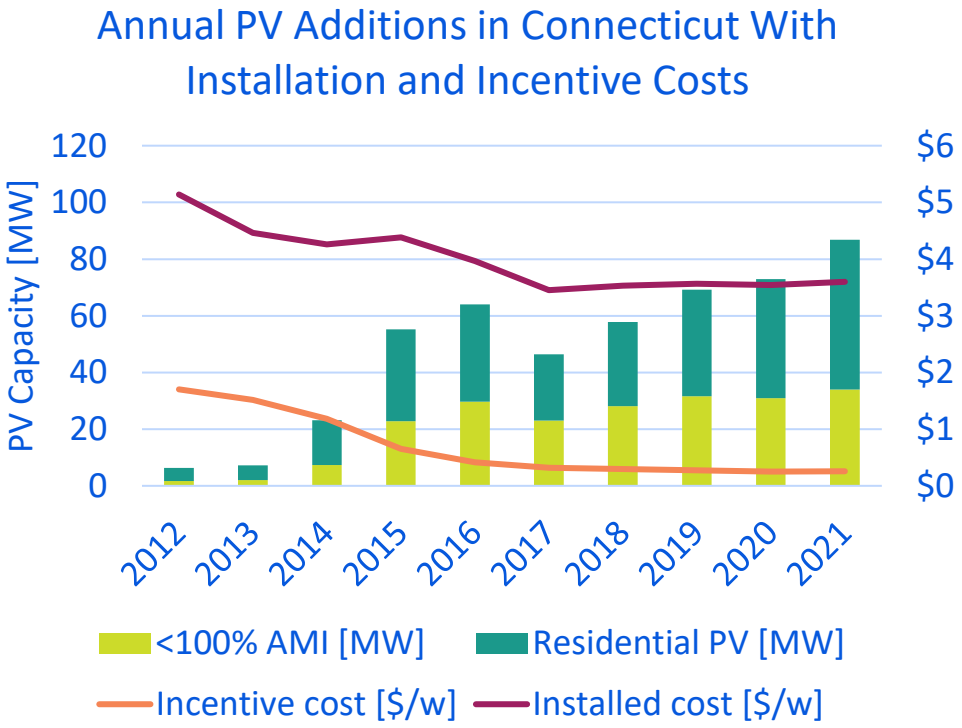
- Participation in majority Black and Hispanic census tracts increased throughout the program
- Participation rates in these census tracts exceeded corresponding homeownership rates.

Total and relative energy and cost savings from PV adoption



- Consistent reduction in usage around 80% for all program years
- Meaningful energy cost savings may reduce LMI energy burden

Effective, Efficient, and Equitable Solar Market Development



Connecticut efficiently scaled residential solar adoption while simultaneously decreasing incentive rates to enable a smooth transition to a post-incentive solar market.

Lessons Learned and Future Role

RSIP Keys to Success

- The Green Bank was a trusted and effective convener of stakeholders with diverse interests
- The State made long-term commitments to residential solar development
- The Green Bank identified and addressed market failures
- Declining incentive levels provided early stimulus and smoothed market transformation

Questions and Discussion

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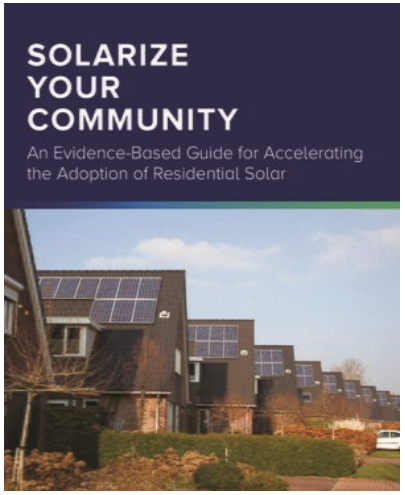
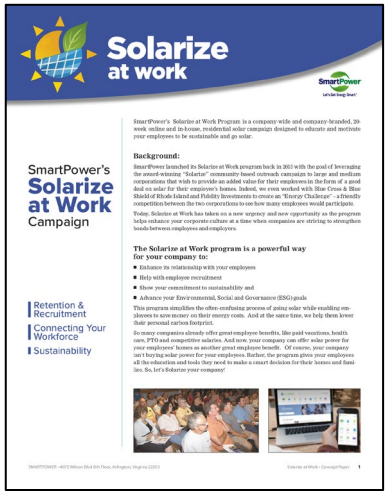
Closing Thoughts

Additional Thoughts on Residential Solar Incentive Programs

- **Transparency** – to ensure accountability of ratepayer (or taxpayer) funds, don't be afraid to request and collect data from participating contractors and customers – we collected more than 200 data points per project and have access to performance meters for every installation
- **Community Based Marketing** – it just works! Seek technical assistance from Solarize community-based marketing providers (e.g., SmartPower and Yale) and engage local ambassadors to increase and accelerate investment and deployment of solar
- **Community Engagement** – through federal government technical assistance (i.e., DOE, EPA), support efforts to help communities engage in energy action plans (e.g., Communities LEAP) and environmental justice (e.g., Environmental Justice Thriving Communities Technical Assistance Centers)





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Additional Information and Engagement

Residential Solar Investment and Deployment in Connecticut

An In-Depth Review of an Incentive Program (2012-2022)

Connecticut Green Bank - May 5th, 2023

- **Story Map** – further details and interactive maps on "Residential Solar Investment and Deployment in Connecticut"
- **Public Comments** – invite your public comments on both (1) "Solar for All" competition through the Greenhouse Gas Reduction Fund, and (2) the Residential Solar Investment Program

https://www.ctgreenbank.com/Residential-Solar-Investment-Deployment-in-CT

Follow-On Webinars to Support Greenhouse Gas Reduction Fund Solar for All Competition

- **Webinar #2** – Financing Residential Solar in Connecticut #1: Insights into Loan Programs (Monday, June 5, 2023, from 12:00-1:00 EDT)
- **Webinar #3** – Financing Residential Solar in Connecticut #2: Insights into Lease Programs (Thursday, August 3, 2023 from 12:00-1:00 EDT)
- **Webinar #4?** –Residential Renewable Energy Solutions, Energy Storage Solutions, Shared Clean Energy Facilities – Focus on Low-Income and Distressed Communities Single Family and Affordable Housing

Questions & Answers

Thank You

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