

Growing Solar, Protecting Nature



March 9, 2024

RI Land & Water Conservation Summit

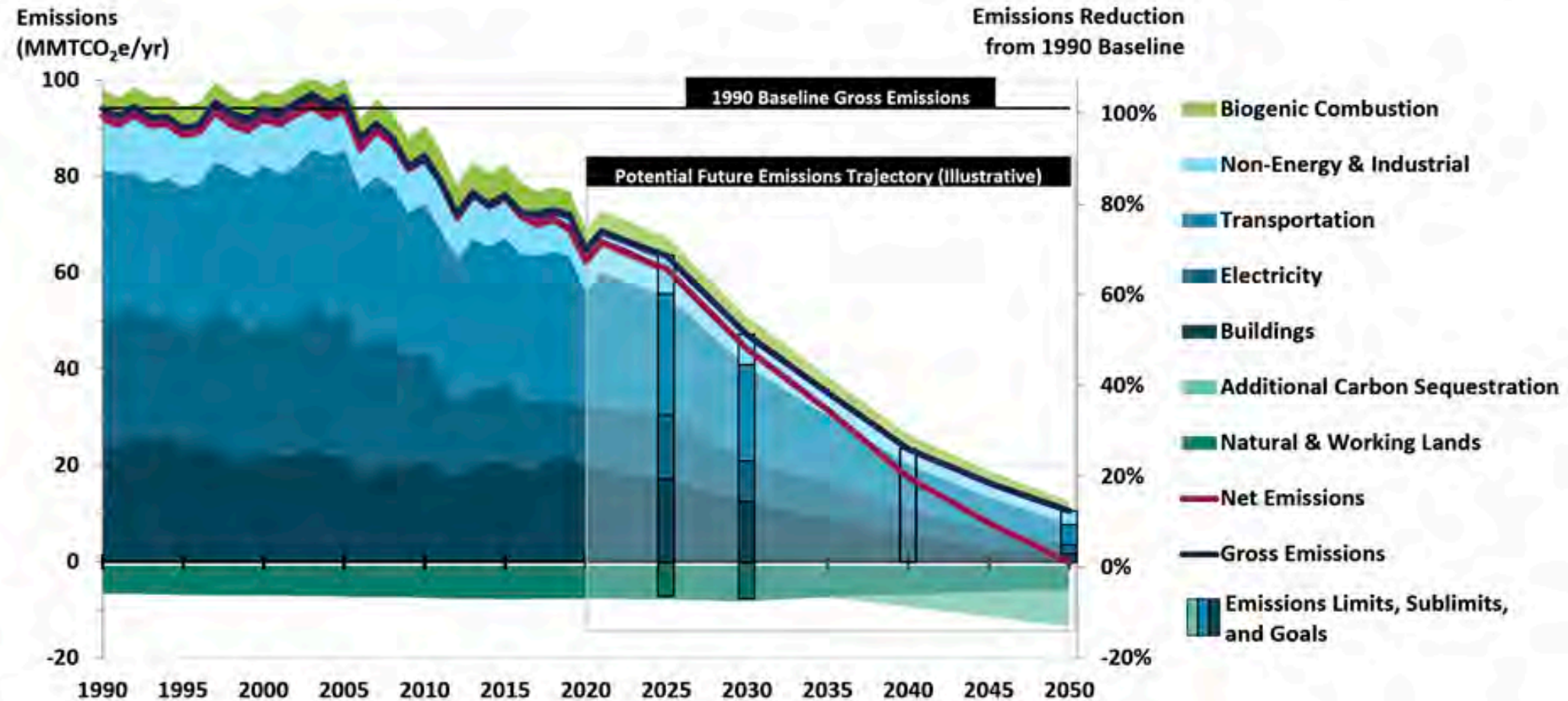
E. Heidi Ricci, Director of Policy and Advocacy

www.massaudubon.org/growingsolar



Progress on Massachusetts' ambitious climate goals is better but we have big challenges over next decade

FIGURE 3-5. PAST EMISSIONS THROUGH 2020, EMISSIONS LIMITS AND SUBLIMITS, AND ILLUSTRATIVE POTENTIAL EMISSIONS TRAJECTORY THROUGH 2050



Source: MA 2050 Clean Energy and Climate Plan (2022).

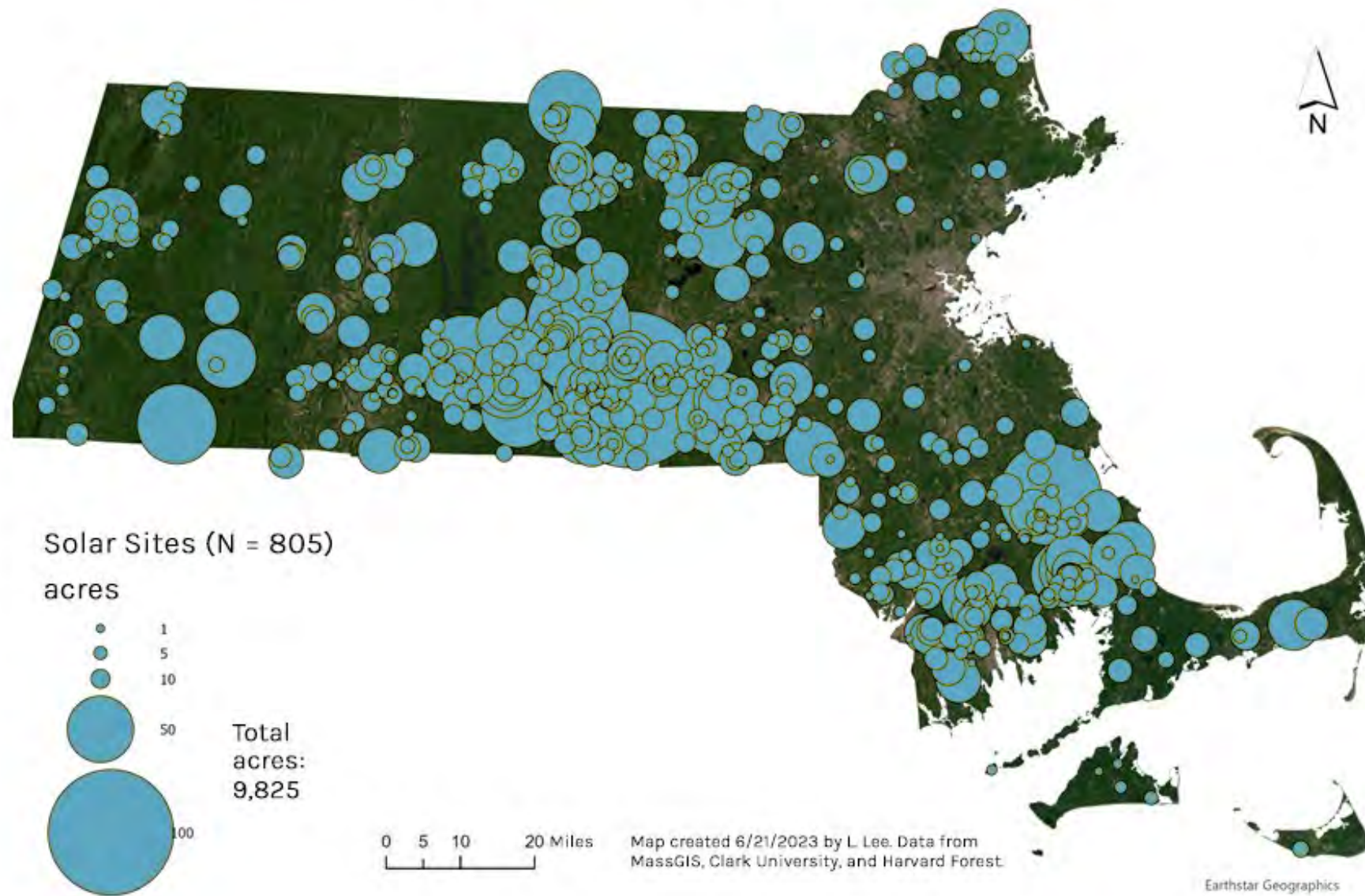
Massachusetts is a national leader on solar

- Massachusetts is a trailblazer on equitable community solar and siting solar on landfills:
 - #1 in Landfill solar projects
 - #2 in Distributed solar per capita
 - #3 in Community solar per capita
- MA's solar incentives and net metering programs directly support deployment of low-impact solar (e.g., urban infill, community solar)

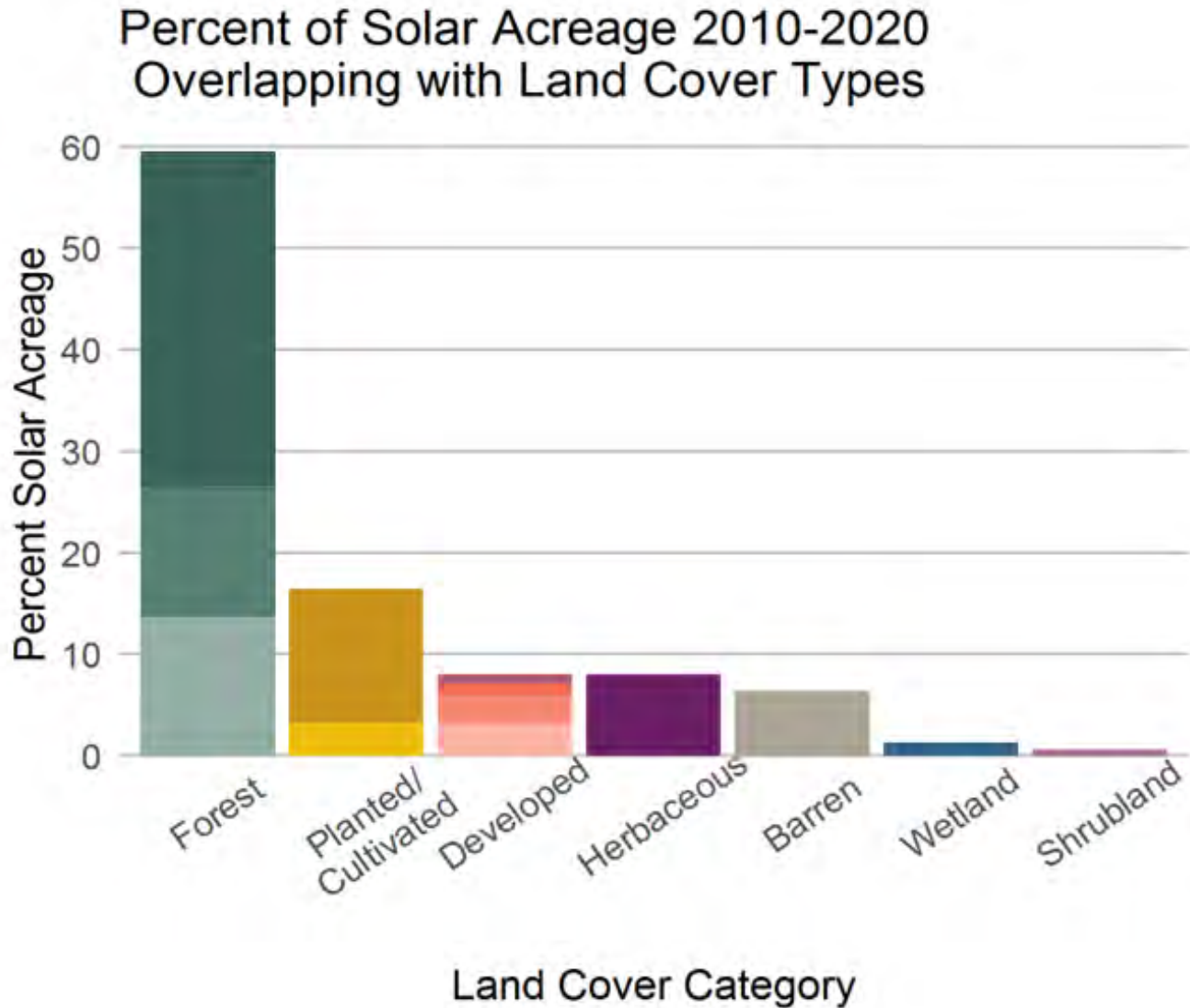


State of Solar in Massachusetts

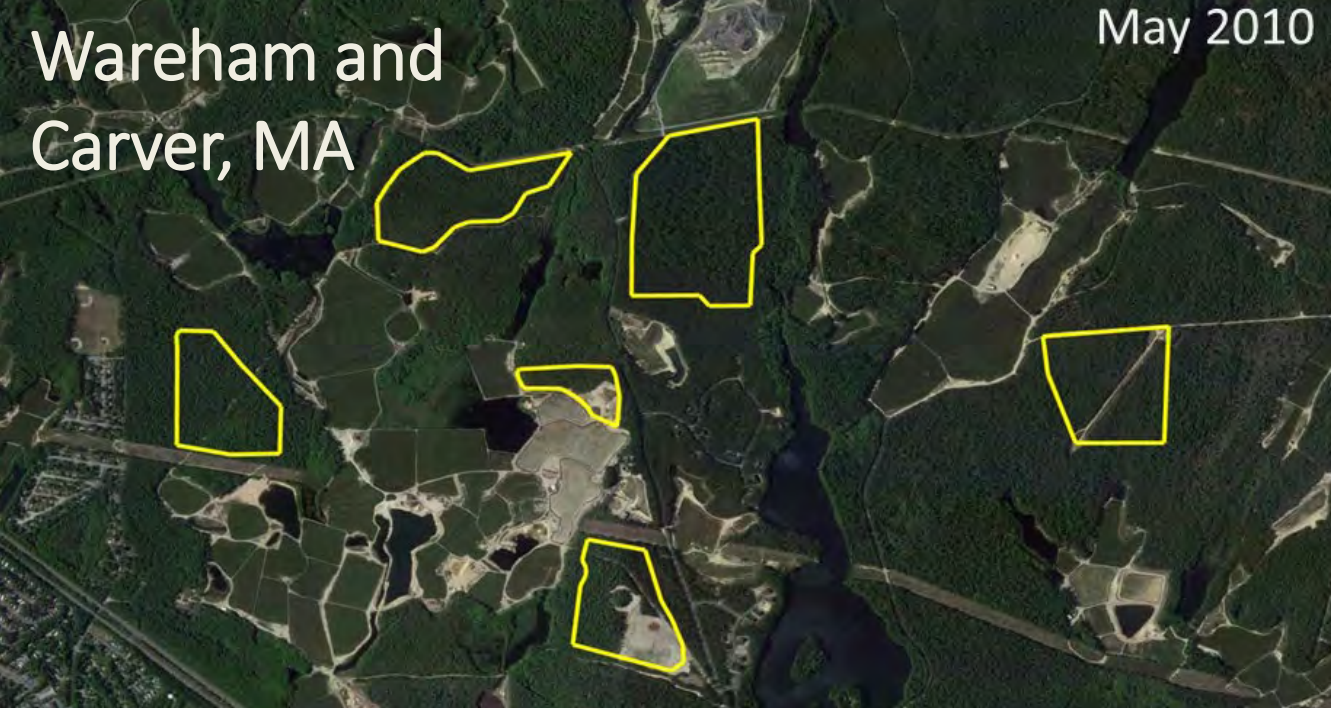
Ground-Mounted Solar Arrays by Size



Location Matters: From 2010-2020, most large-scale solar sited in MA forests and on farms



- Harvard Forest and Clark Univ. estimate that 60% of ground-mount solar installed in MA between 2010 & 2020 impacted forests
- >3,500 acres of forest converted to solar as of 2020, releasing carbon equal to annual GHG emissions of 112,000 cars (>510,000 tons CO₂e)



Biodiversity and prime farmland also at risk from under current siting trends

- More than 10% of installed solar was built on core wildlife habitat
- Nearly 1,300 acres of prime farmland converted to ground-mount solar between 2010 to 2020
- Solar development in Southeastern MA overlaps with globally unique habitat and biodiversity

Erosion and Runoff

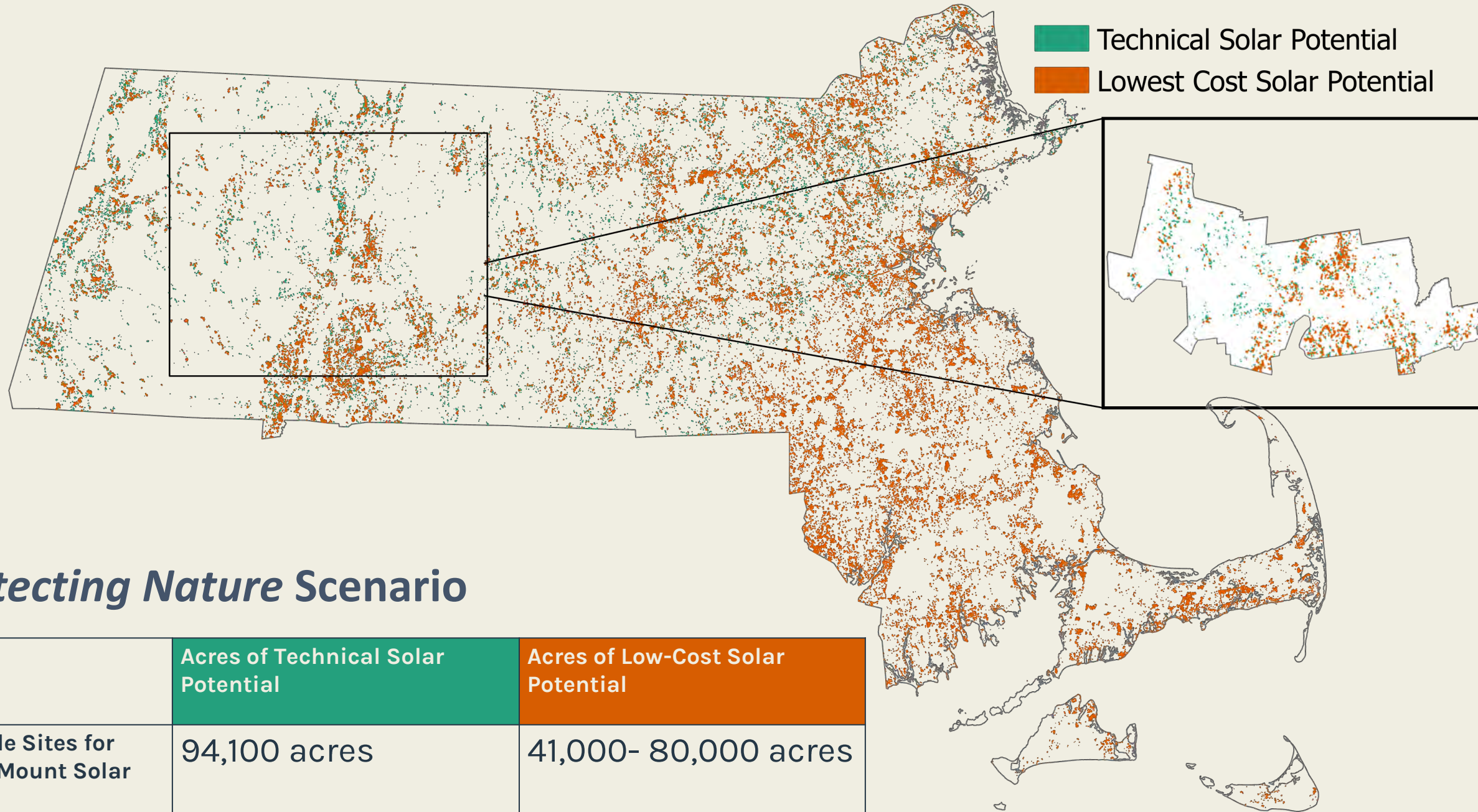
- Removing forest on slopes can result in serious erosion and sedimentation into sensitive wetlands and streams as well as increasing downstream neighborhood flooding






Our Research Approach

We created and modelled 3 different scenarios of future ground-mount solar deployment in MA. All 3 include identical solar potential for ROOFTOP and PARKING LOT CANOPIES.

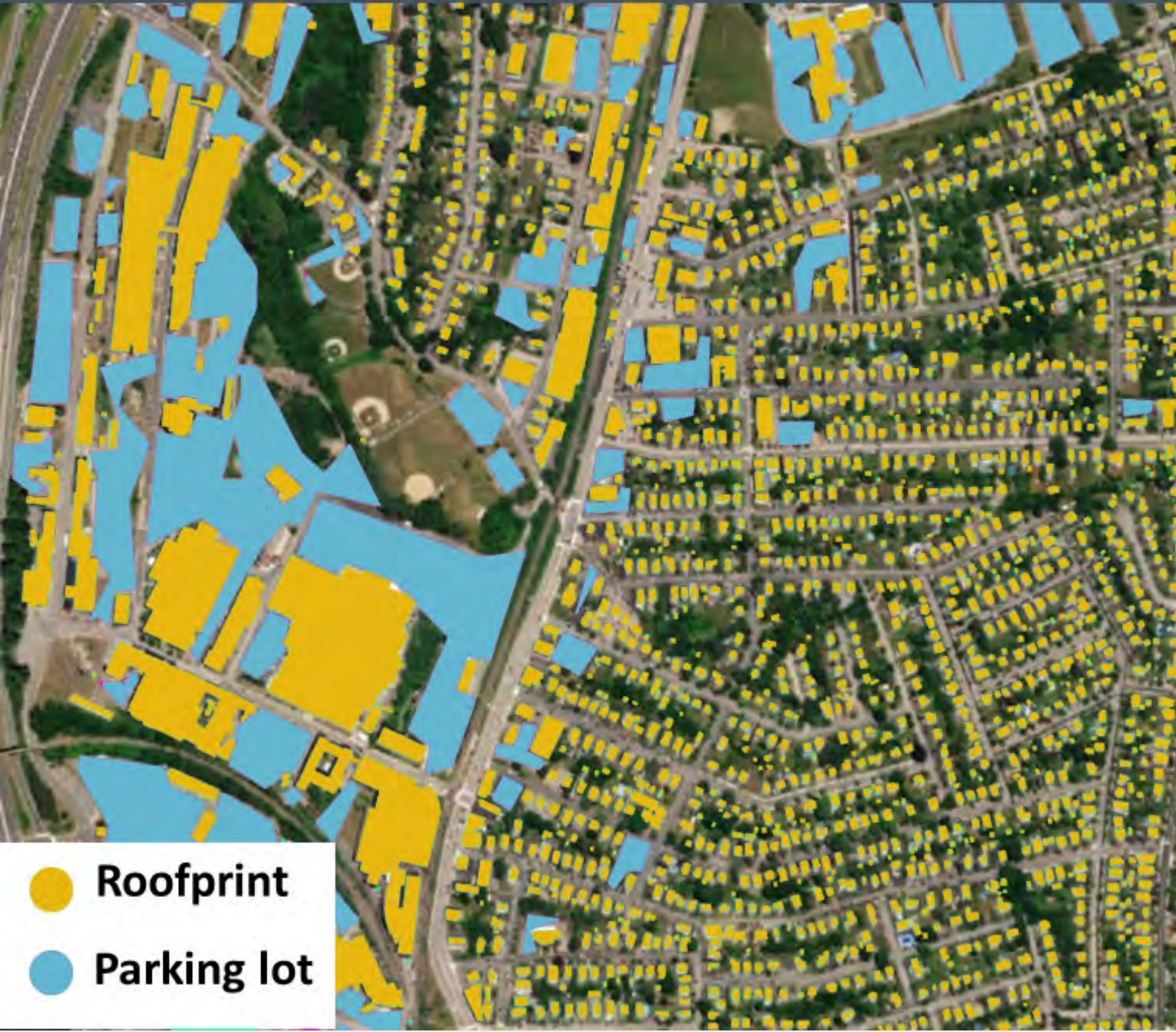
Current Siting Scenario	Protecting Nature Scenario: Mid-Impact	Protecting Nature Scenario: Low-Impact
<ul style="list-style-type: none">Development continues on all land technically & legally viable for ground-mount solar <p>1.1M acres</p>	<p>Protects:</p> <ul style="list-style-type: none">Prime farmlandEssential biodiversity/wildlife habitatSites with highest forest carbonLands most valuable for climate resilience <p>94,000 acres</p>	<p>Protects same lands as Mid-Impact, plus:</p> <ul style="list-style-type: none">~99% of forestsFloodplains and hurricane zonesOpen space w/limited protectionHistoric places <p>22,000 acres</p>



MA can scale up solar while reducing impacts on carbon nature & working lands

	Current Siting Trends, Now to 2050	Protecting Nature Mid-Impact, Now to 2050	Protecting Nature— Low-Impact, Now to 2050
 Forest Carbon Emissions	5.8 Million metric tons of CO ₂	1.1 Million metric tons of CO ₂	0.9 Million metric tons of CO ₂
 Losses of High-Biodiversity Lands	20,969 Acres	0 Acres	0 Acres
 Losses of Prime Farmland	8,119 Acres	0 Acres	0 Acres

Rooftop/ Canopy Potential: Worcester, MA



Massachusetts has significant solar potential on rooftops and parking lots

20.6 GW of rooftop potential statewide

9.9 GW of canopy solar potential

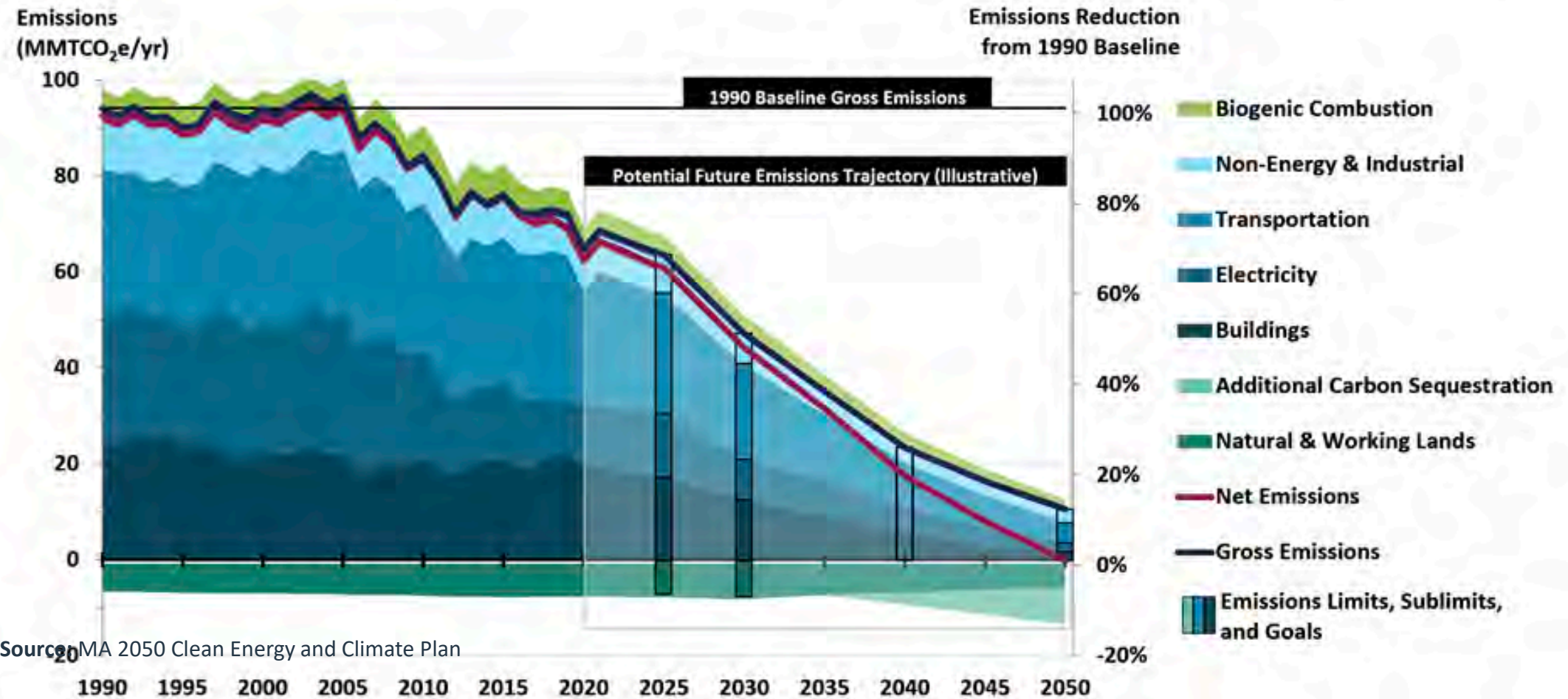
Data sources:

Roofprints - MassGIS 2021,

Parking lots - Dr. Brad Compton

When the value of carbon removal by forests is included, *Protecting Nature* is the lower-cost pathway

FIGURE 3-5. PAST EMISSIONS THROUGH 2020, EMISSIONS LIMITS AND SUBLIMITS, AND ILLUSTRATIVE POTENTIAL EMISSIONS TRAJECTORY THROUGH 2050



Key Takeaways from *Growing Solar, Protecting Nature*

- ***Current siting isn't sustainable.***
- ***Solar v. nature is false choice.*** We can deploy solar at scale AND protect nature and its values for climate and biodiversity.
- ***What gets counted matters.*** Lower-impact solar siting is also our cheapest approach.
- ***Location matters.*** Shift state incentives towards greater use of buildings, parking lots, and low-impact sites.

What's next?

- State and legislature policy reforms, guidance, and support.
- Cities, communities, and property owners, and industry deploy!

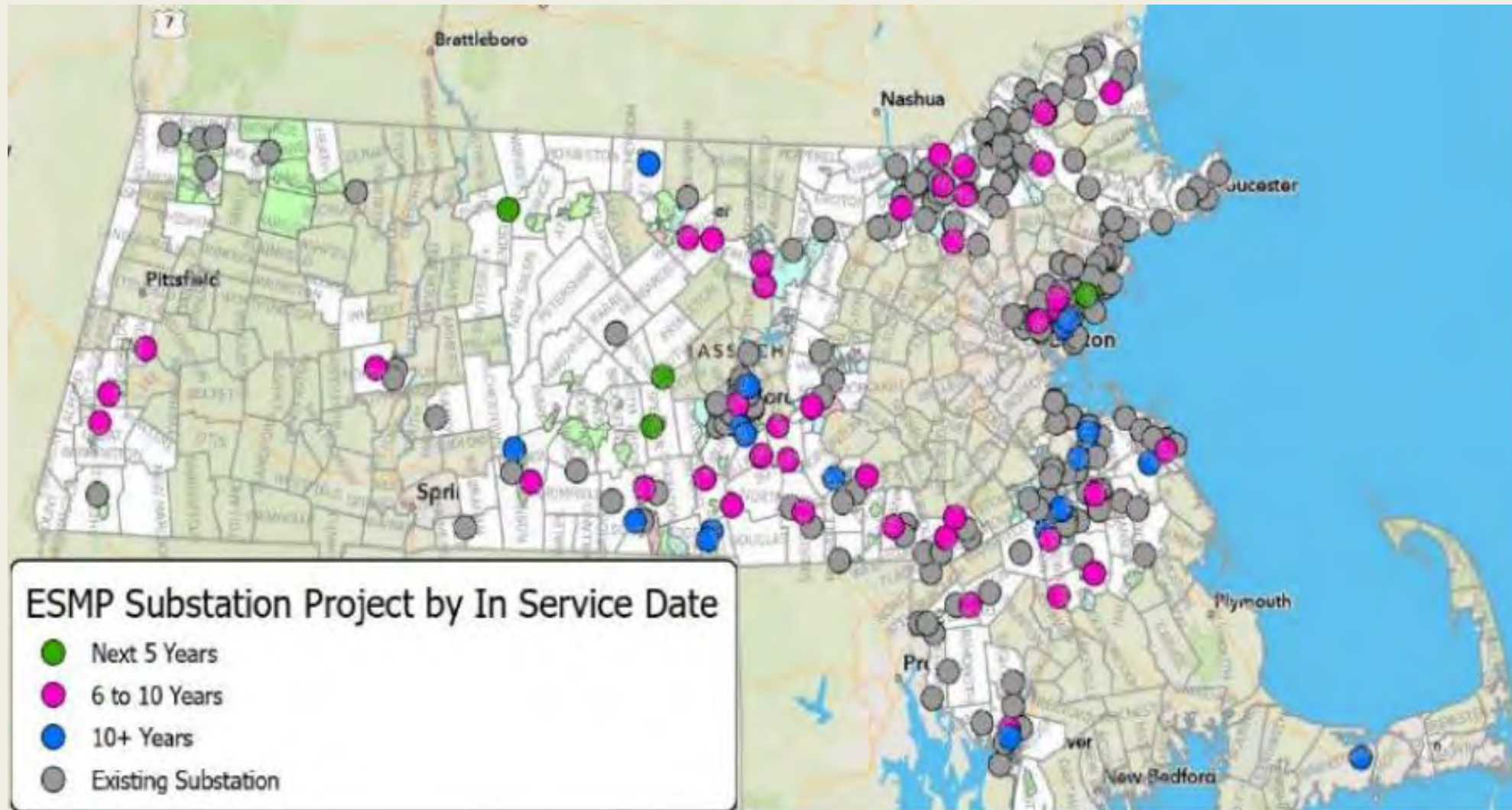
Learn More & Get Involved!

massaudubon.org/growingsolar



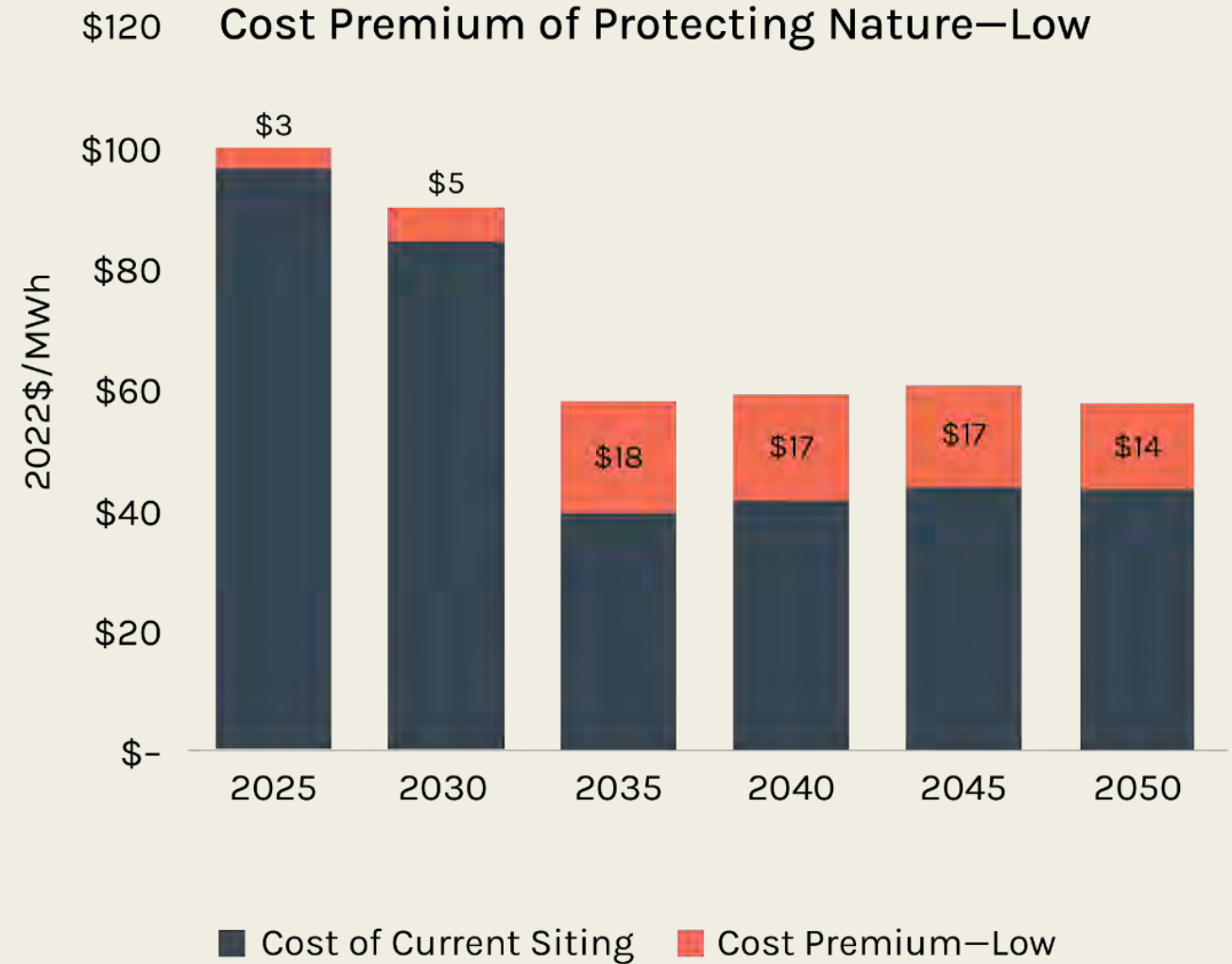
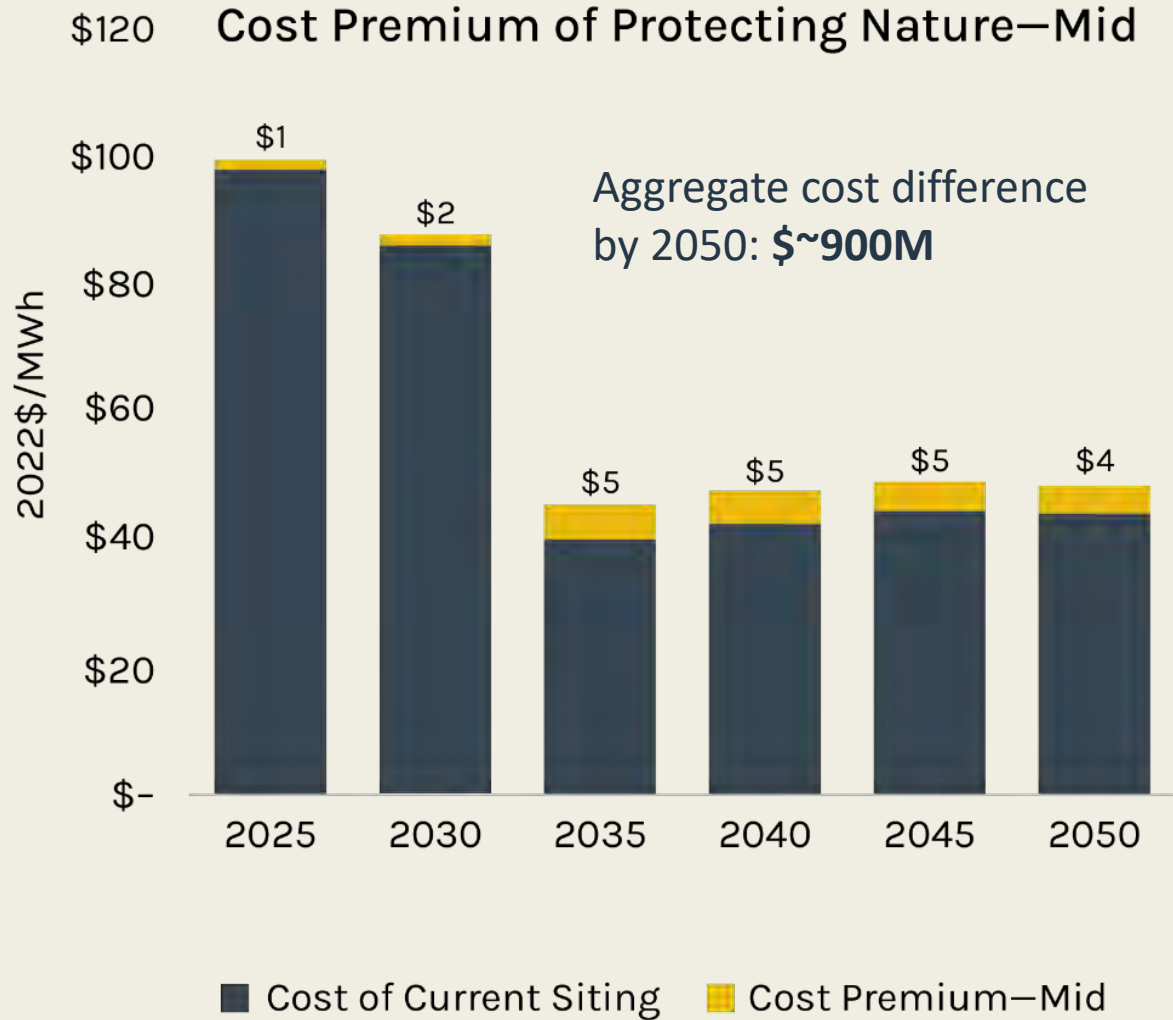
Extra slides

Massachusetts needs a modernized power grid



National Grid proposes 28 new substations and upgrades to 17 existing substations

Cost premium between Current Siting and Protecting Nature scenarios are modest



Legal Boundaries of Local Regulation of Solar

Zoning Act Exemption MGL Ch. 40A S.3, 9th paragraph

"No zoning ordinance or by-law shall prohibit or unreasonably regulate the installation of solar energy systems or the building of structures that facilitate the collection of solar energy, except where necessary to protect the public health, safety or welfare."

Supreme Judicial Court

Tracer Lane II Realty, LLC v. City of Waltham, 489 Mass. 775 (2022)

*"Like all municipalities, Waltham maintains the discretion to reasonably restrict the magnitude and placement of solar energy systems. An outright ban of large-scale solar energy systems in all but one to two percent of a municipality's land area, however, restricts rather than promotes the legislative goal of promoting solar energy. **In the absence of a reasonable basis grounded in public health, safety, or welfare, such a prohibition is impermissible under the provision.**"*



Mapping Ground Solar Installations in Massachusetts and Rhode Island using Satellite Imagery

John Rogan, Emily Heltzel, Shiqi Tao, Su Ye, Nicholas Geron and Denys Godwin

Graduate School of Geography



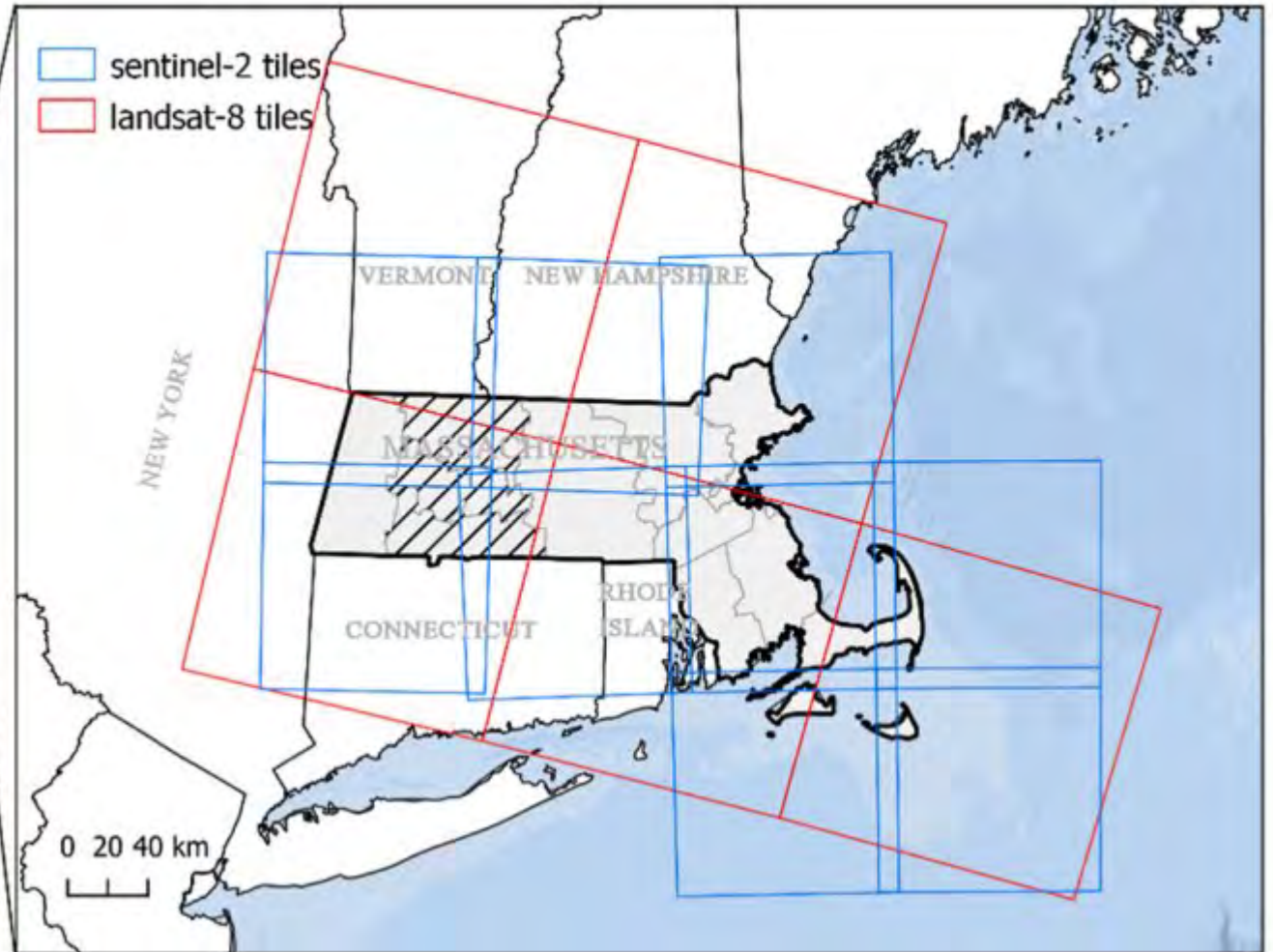
jrogan@clarku.edu



Forest Clearcut
Spencer MA, March 8th 2024
17 acres

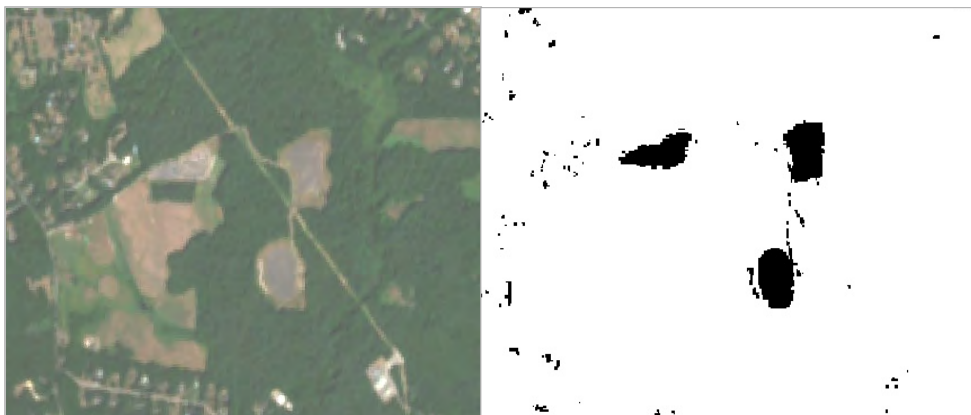
Spencer Solar Farm LLC

Satellite Imagery Assessment



Mapping Solar Installations using Satellite Imagery (Sentinel-2)

- Solar installations are detected using Sentinel-2 (10 m) imagery collected in summer months
- Used a computer model to determine solar and non-solar in the landscape (2001-2022)
- Polygons for solar panels (a); and the solar installation with the surrounding cleared area (b)



Satellite image of solar panels (left) and the machine learning classifier (right)

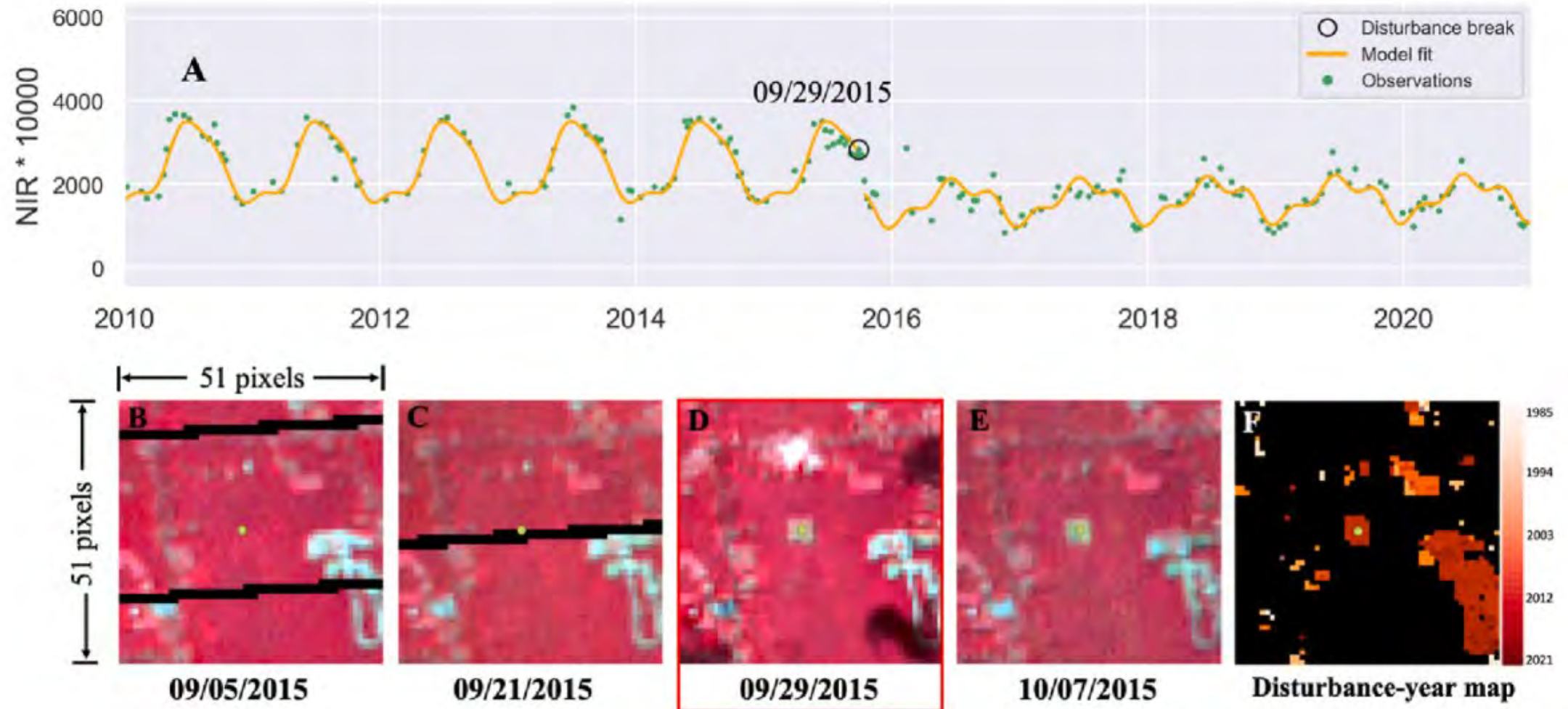


(a) Solar panel polygon



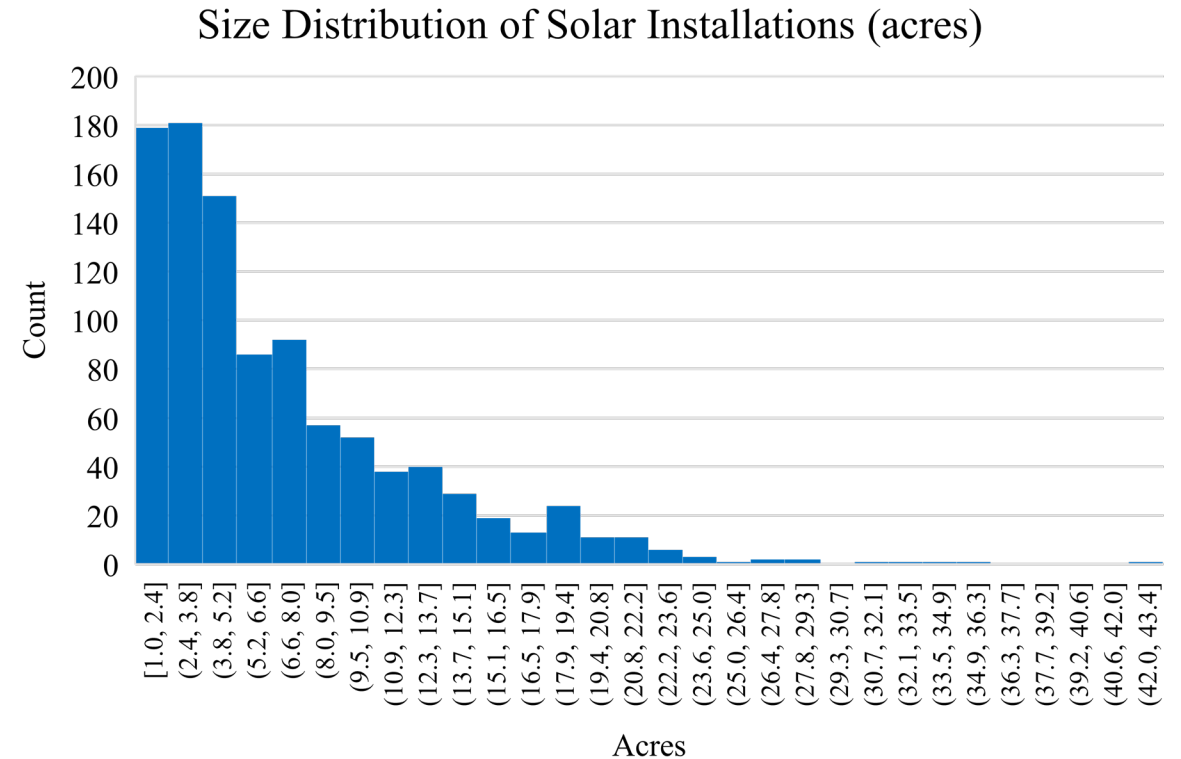
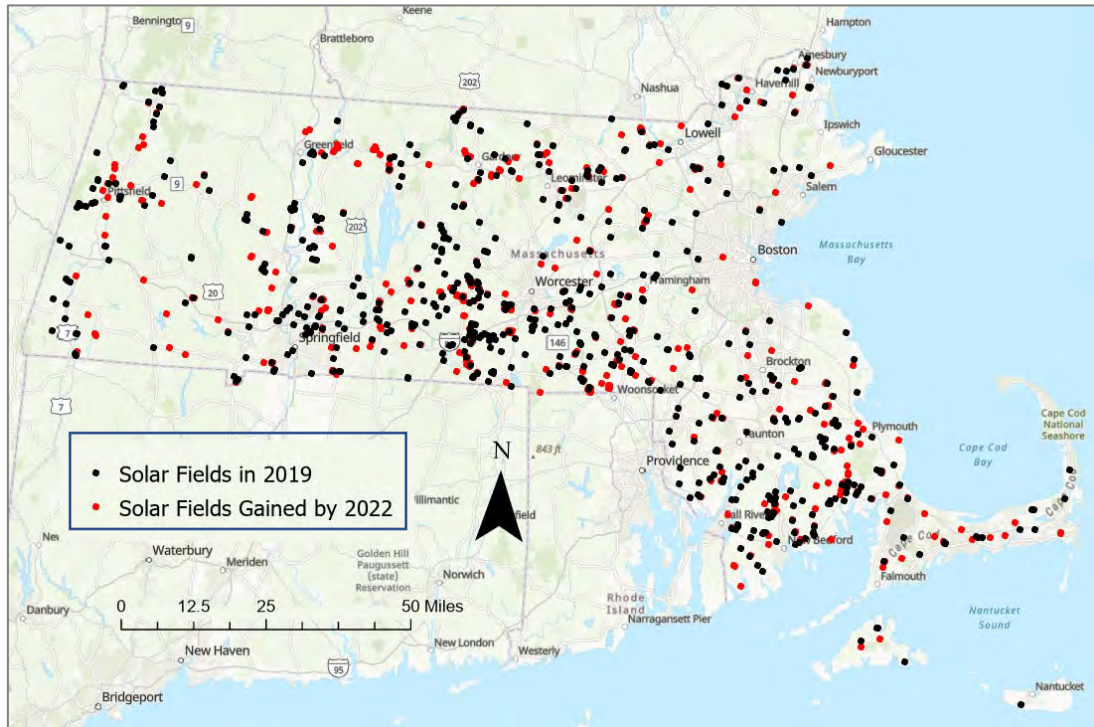
(b) Cleared area polygon

Satellite Imagery Time Series Analysis (Landsat-8)



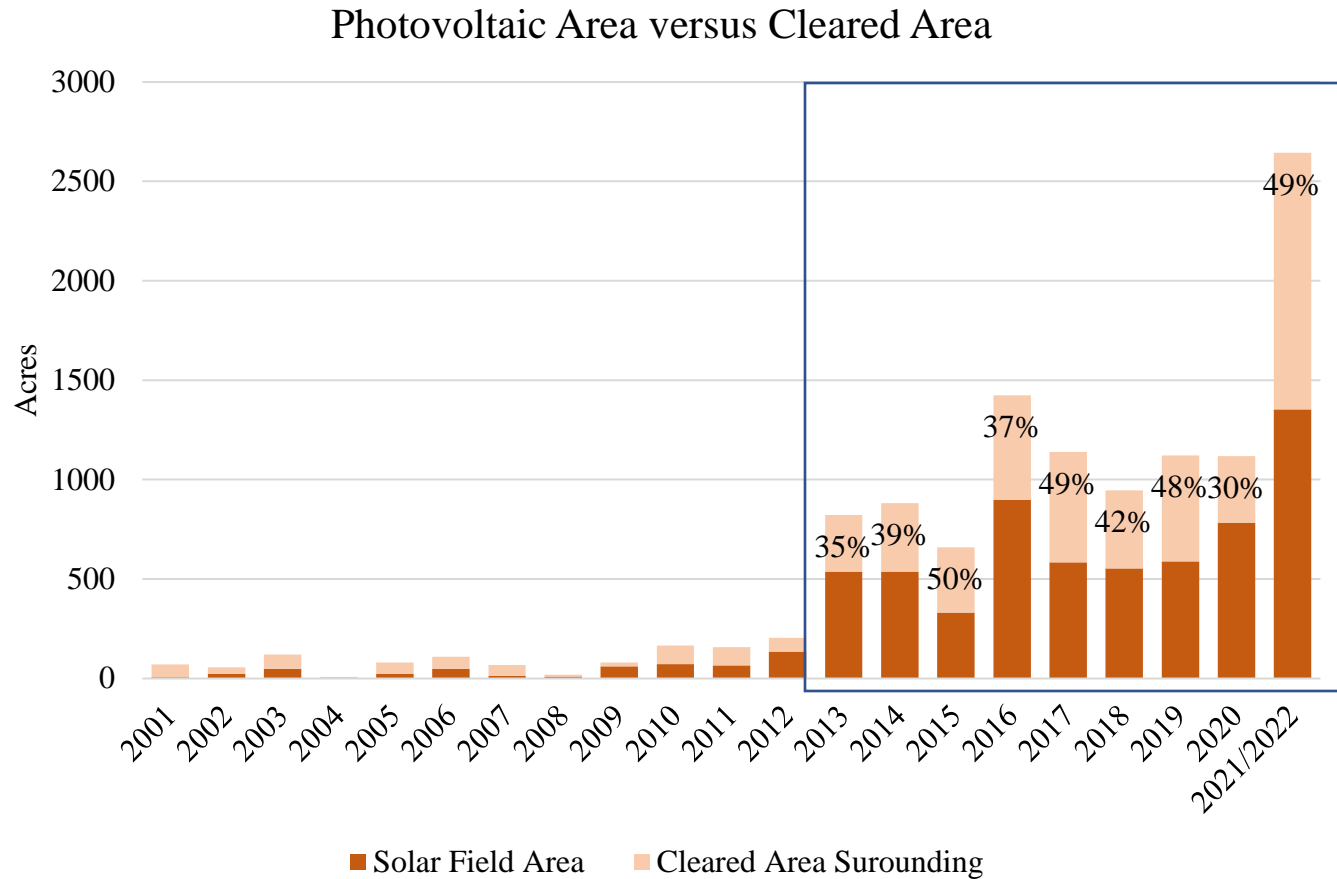
Massachusetts Solar Installation Count and Acreage (2001-2022)

- There are **1000** solar installations as of August 2022 in Massachusetts.
- Between 2019 and 2022, **250** new solar installations were added.



- The solar installation area is **7,000 acres** as of 2022 with a gain of **1,850 acres** since 2019
- The mean area for solar installations is **5.27 acres** and the median is **5.1 acres**

Solar Installation and Cleared Area (2001-2022)

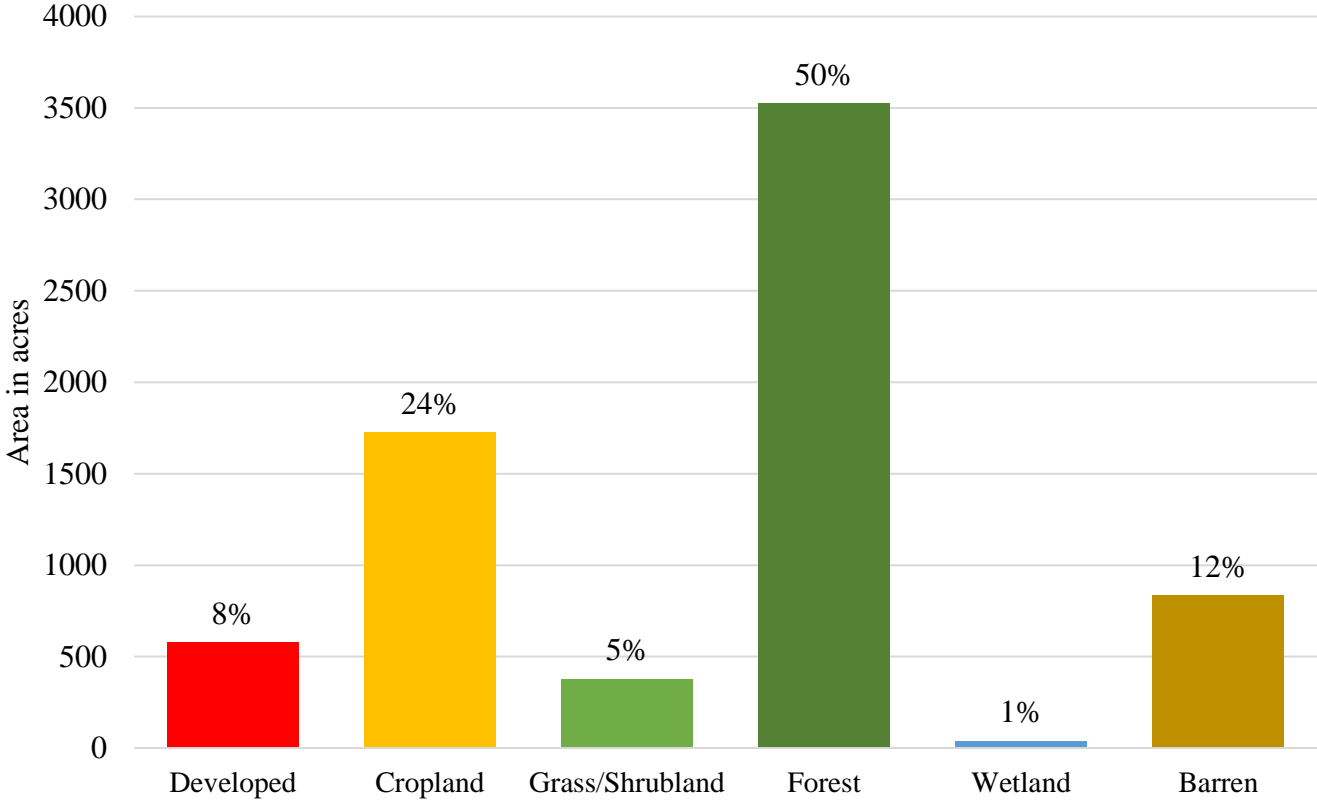


- Solar installations have been increasing in total acreage since 2013.
- The cleared area surrounding is defined as the mowed area around the panels themselves.
- As seen in the figure to the left, **the cleared area takes up a large portion of the total area covered.**
- Since 2013, the area surrounding solar panels has been **approximately 40%** of the total area taken over by the entire solar installation.

Solar Installations and Land Use in Massachusetts

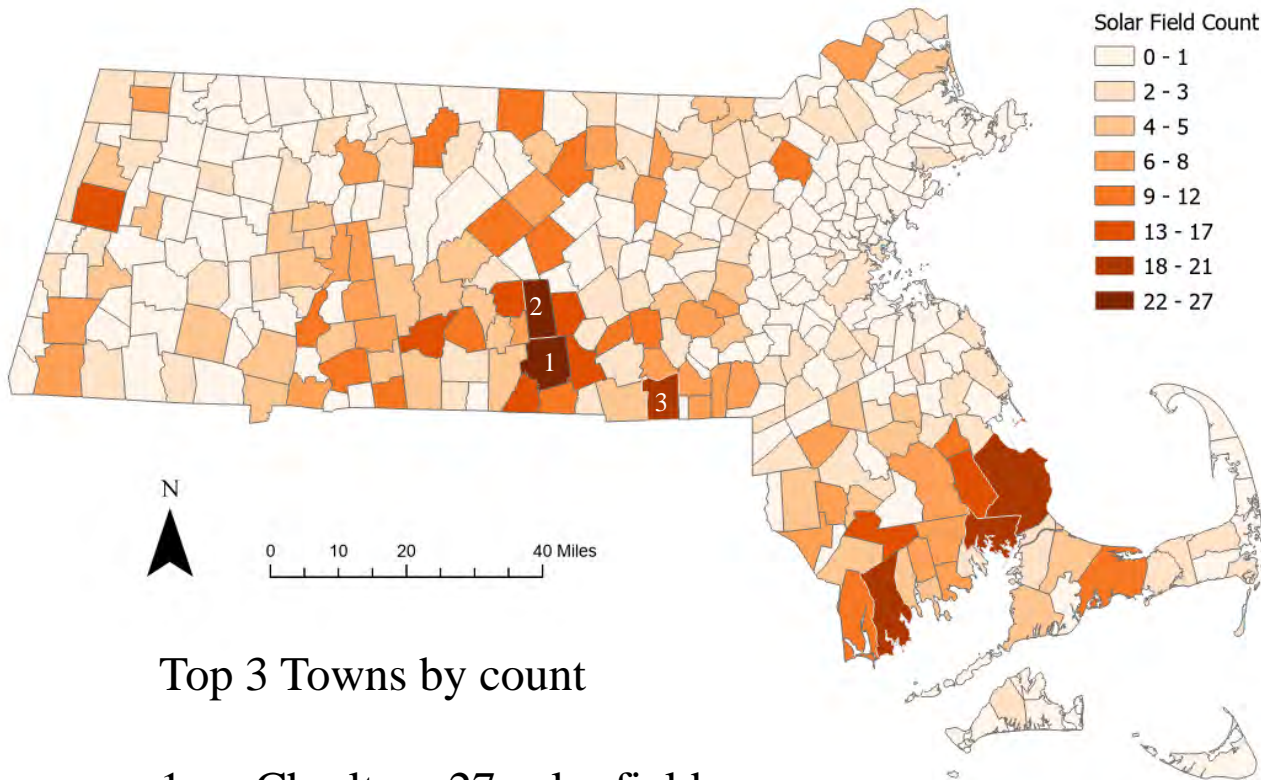
- Solar installations have converted forest by **50% of the total land use (3500 acres)**.
- Cropland is the second most abundant land use type at **24% (1700 acres)**.
- Finally, barren or dirt ground is the third most abundant land use type at **11% (830 acres)**.

Acreage of Solar Installation Land Use in Massachusetts



Solar Installations by Town

Distribution of solar installations by town

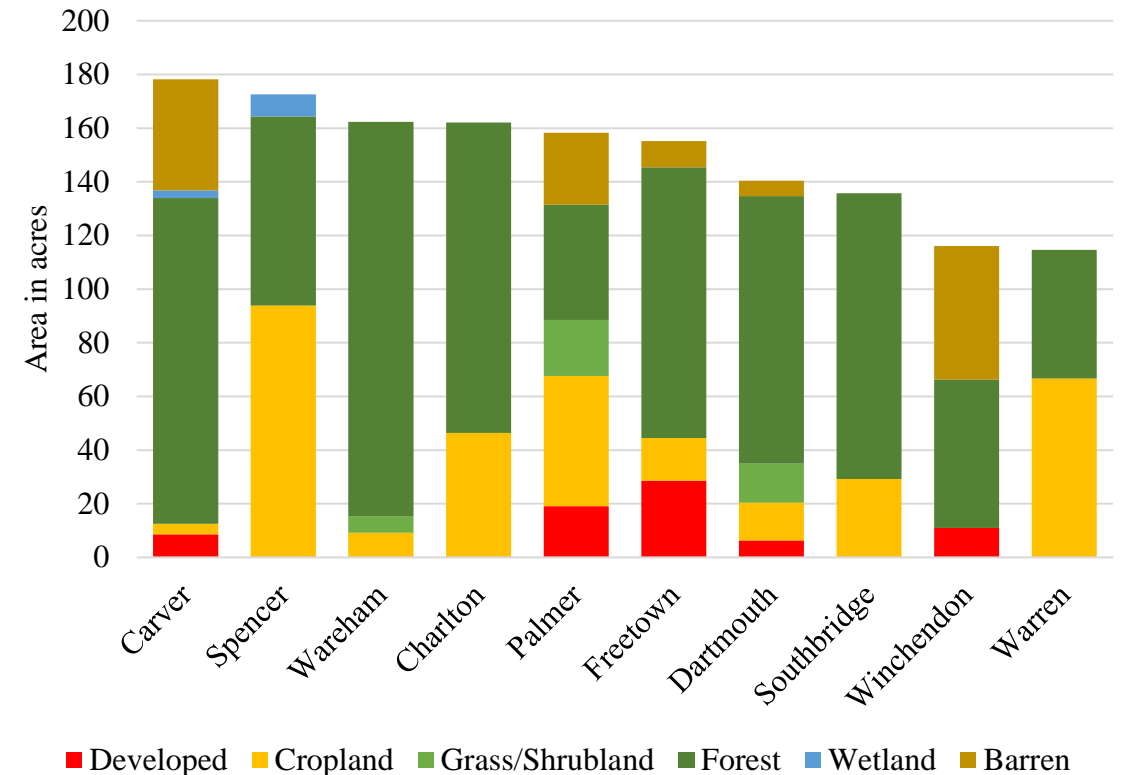


Top 3 Towns by count

1. Charlton: 27 solar fields
2. Spencer: 22 solar fields
3. Uxbridge: 21 solar fields

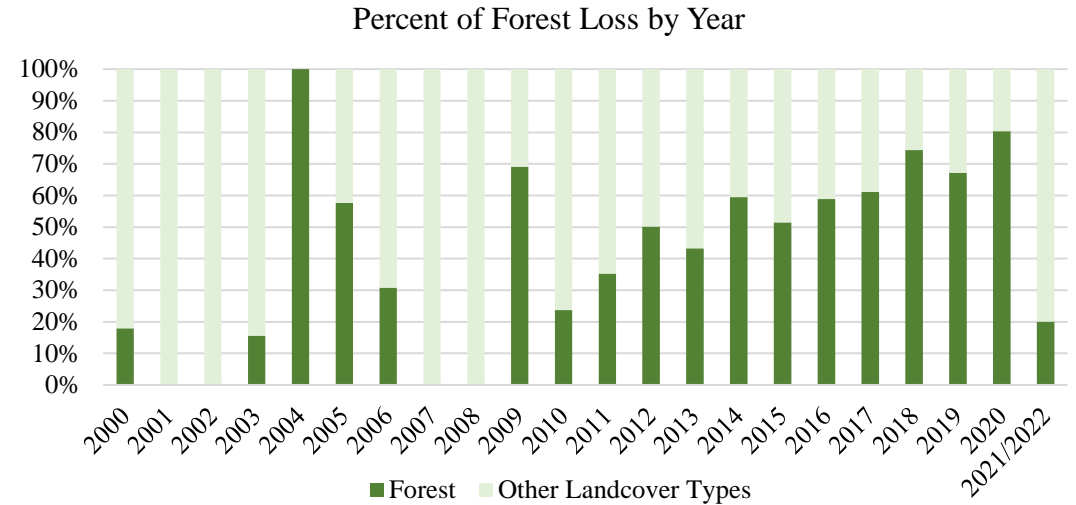
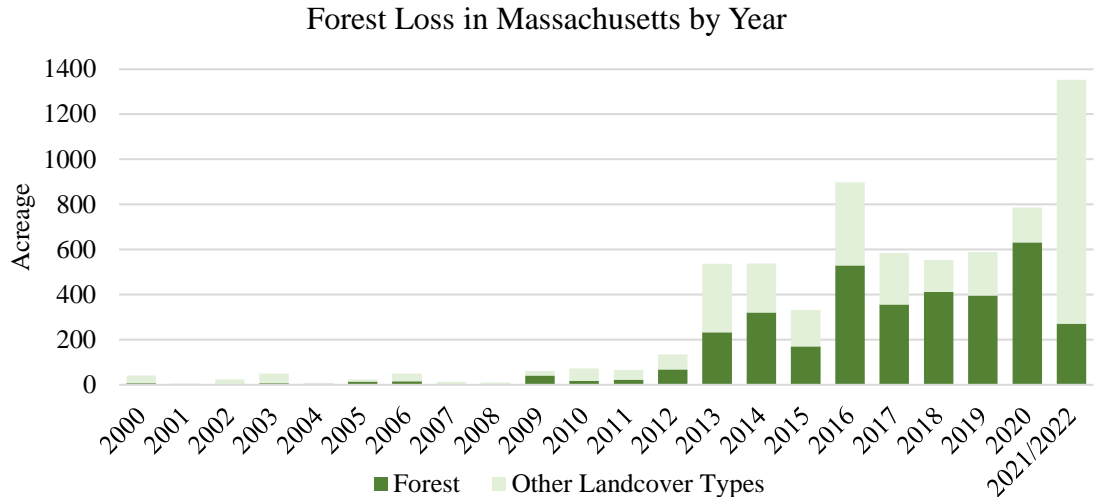
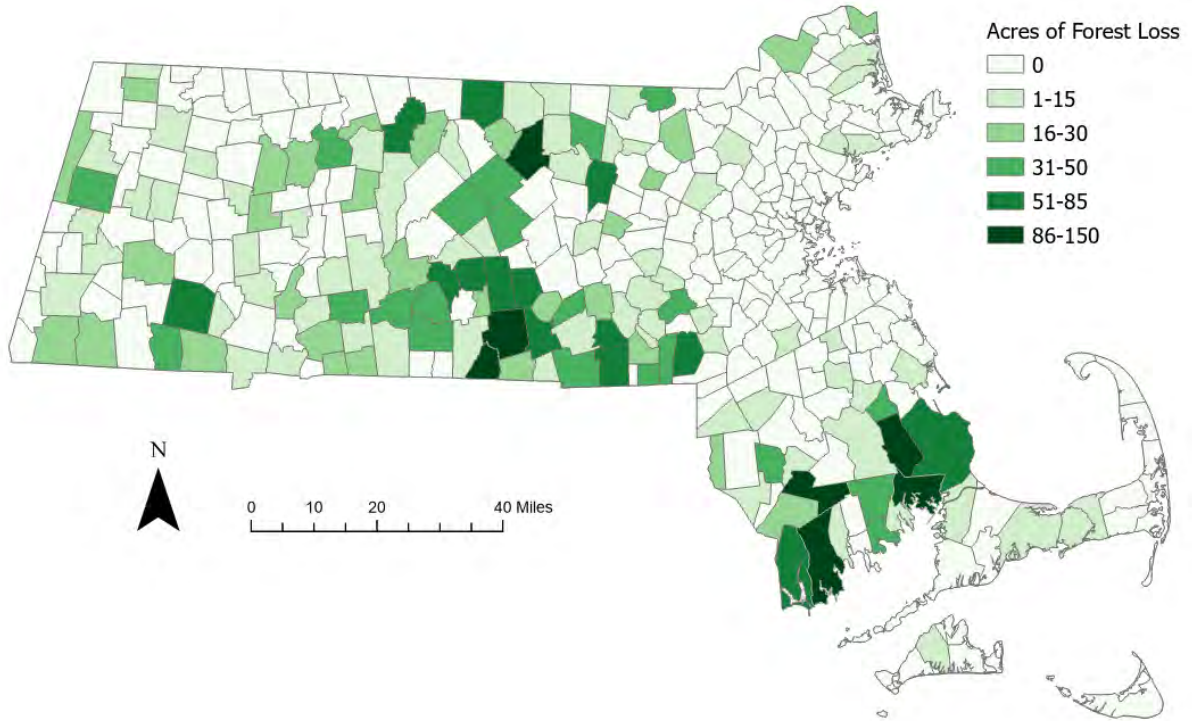
Top 10 Towns

Acreege by Land Use



Forest Loss Due to Solar Installations

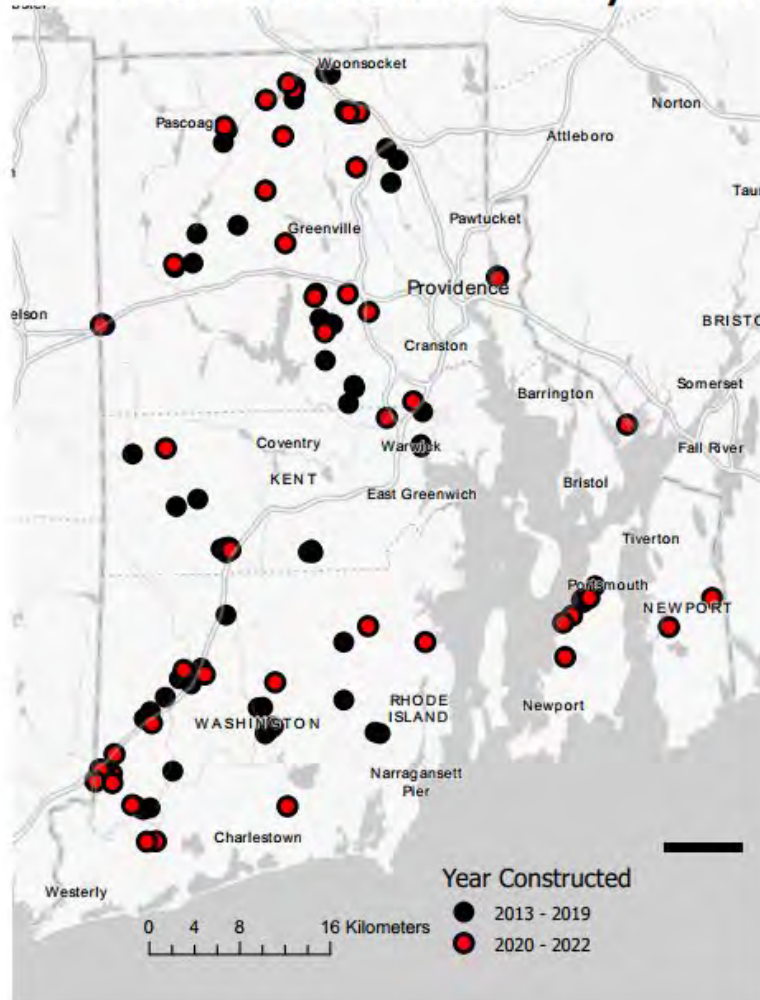
- The charts (right) compare the acreage and percentage of forest loss due to solar compared to the other landcovers each year.
- The map (below) displays the total acreage of forest loss due to solar in each town.



*Not compared to total forest loss, just the acreage taken over by solar

Rhode Island Solar Installation Count and Acreage (2013-2022)

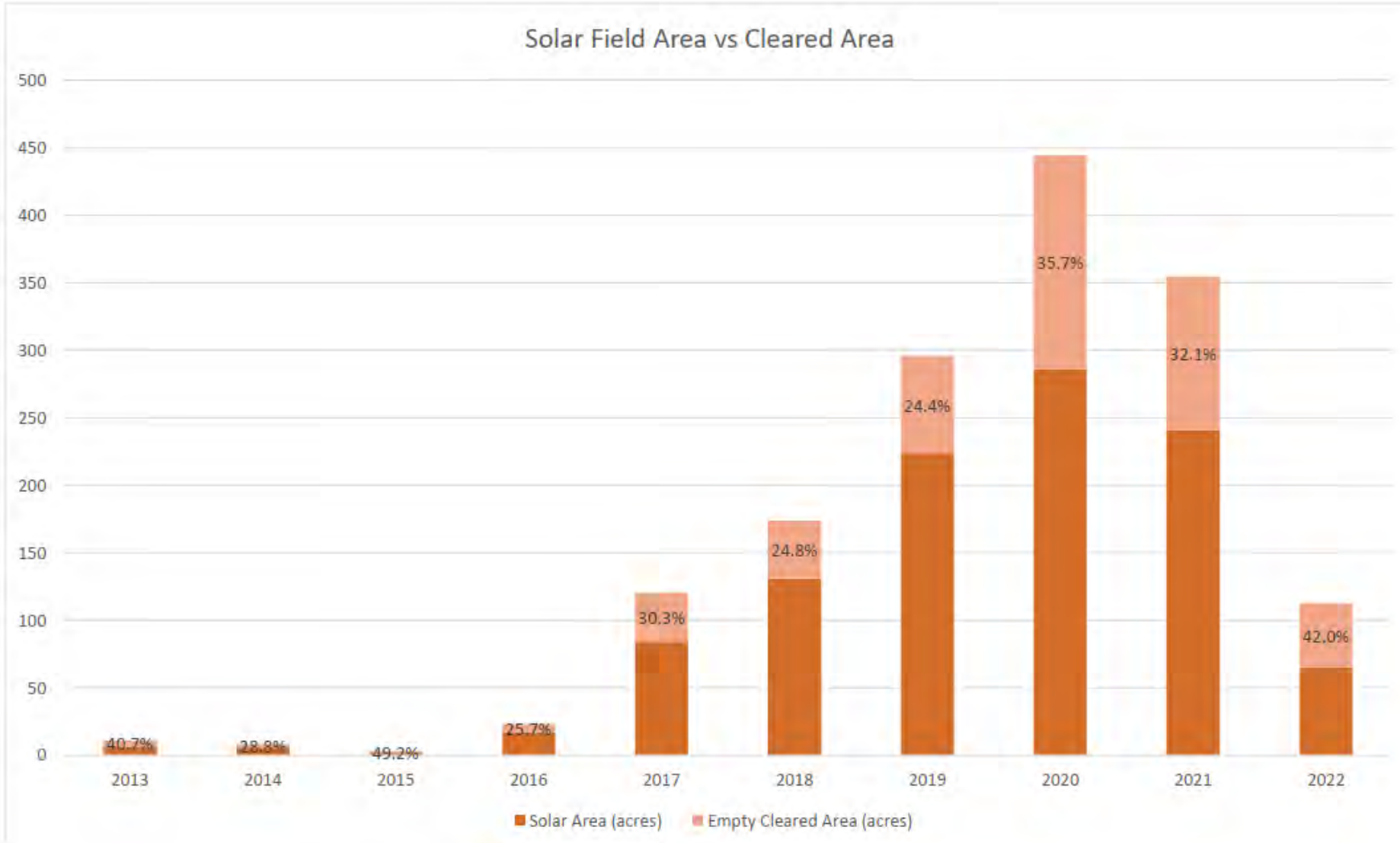
RI Solar Installations by Year



- There are **116** solar installations as of summer 2022 in Rhode Island
- Between 2019 and 2022, **77** new solar fields were built.
- The cleared area of solar fields totals to **1,548 acres** as of 2022 with a gain of **1,208 acres** since 2019.
- The mean cleared area of solar fields is **13.3 acres** and the median is **6.6 acres**.
- Some solar installations comprise multiple discrete solar fields (example below)

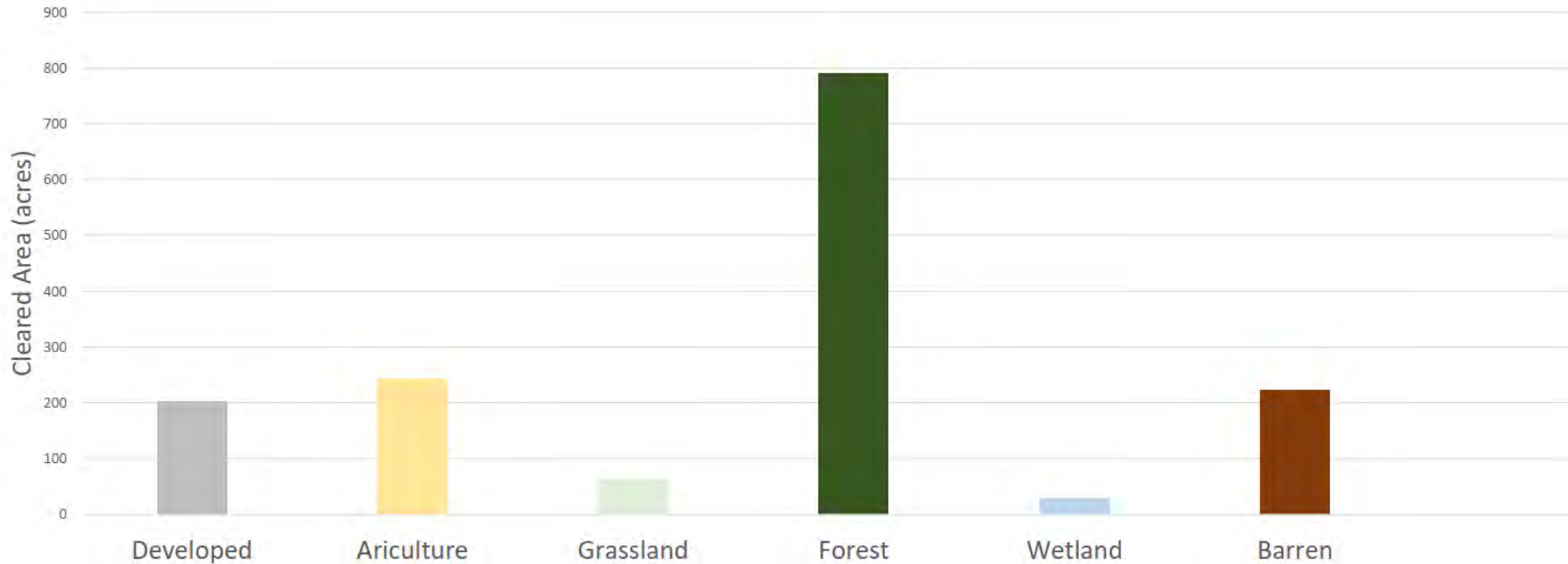


Solar Installation and Cleared Area (2013-2022)



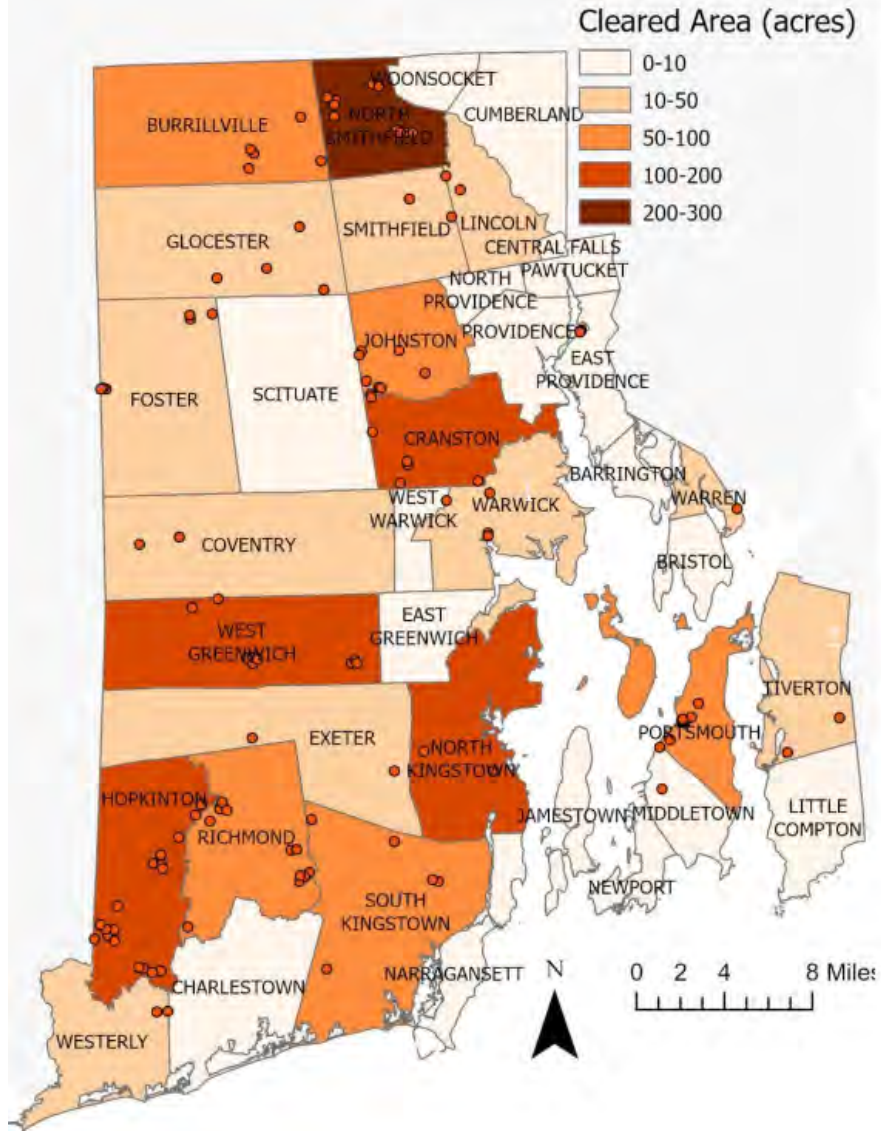
- Solar field installations peaked in total acreage in 2020.
- The cleared area surrounding is defined as the mowed area around the panels themselves.
- As seen in the figure to the left, **the cleared area takes up a large portion of the total area covered.**
- Since 2013, the area surrounding solar panels has been **approximately 30%** of the total area taken over by the solar installation.

Solar Installations and land Cover (2013-2022)



- Baseline landcover maps were used to establish the land cover type prior to the solar installation.
- Solar fields have predominately taken over forested regions of the state at approximately **51% of the total landcover and 790 acres.**
- Cropland and pastures are the second most abundant land cover class at **15% and 240 acres.**
- Finally, barren or dirt ground is the third most abundant land cover class at **14% and 222 acres.**

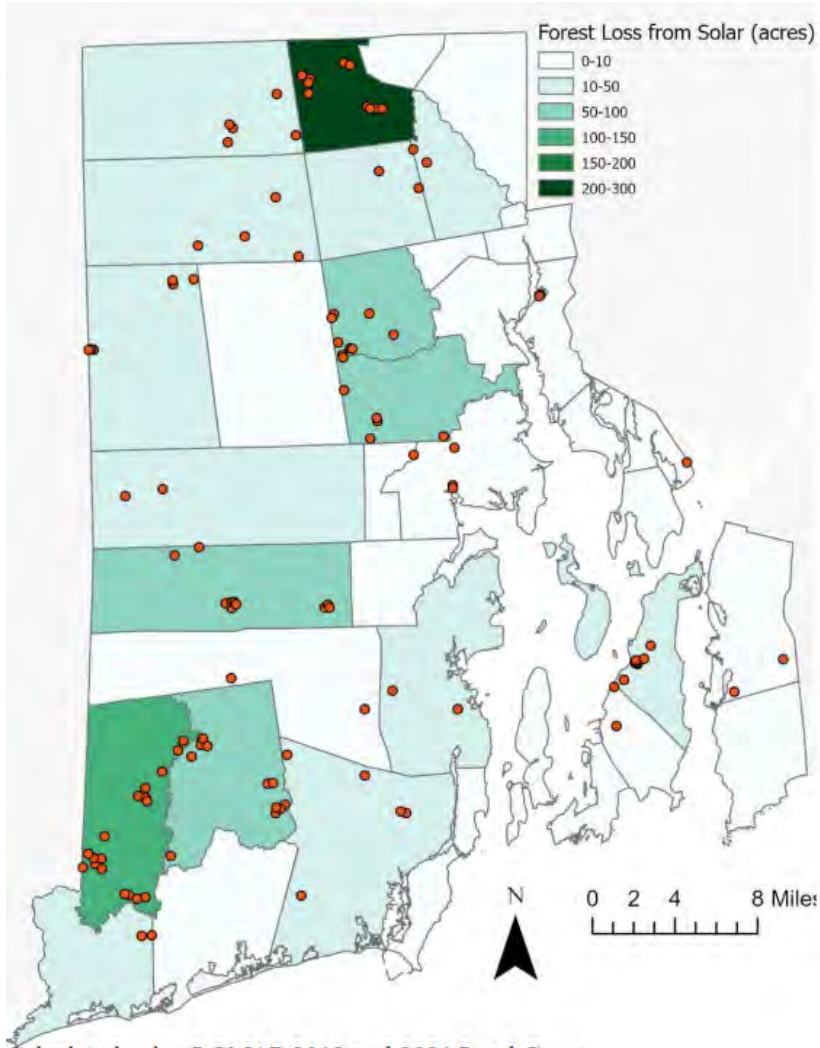
Solar Installations and Municipalities



- The map to the left shows area cleared for solar in each municipality in Rhode Island.
- The chart below shows area cleared for solar in each of the top 10 municipalities

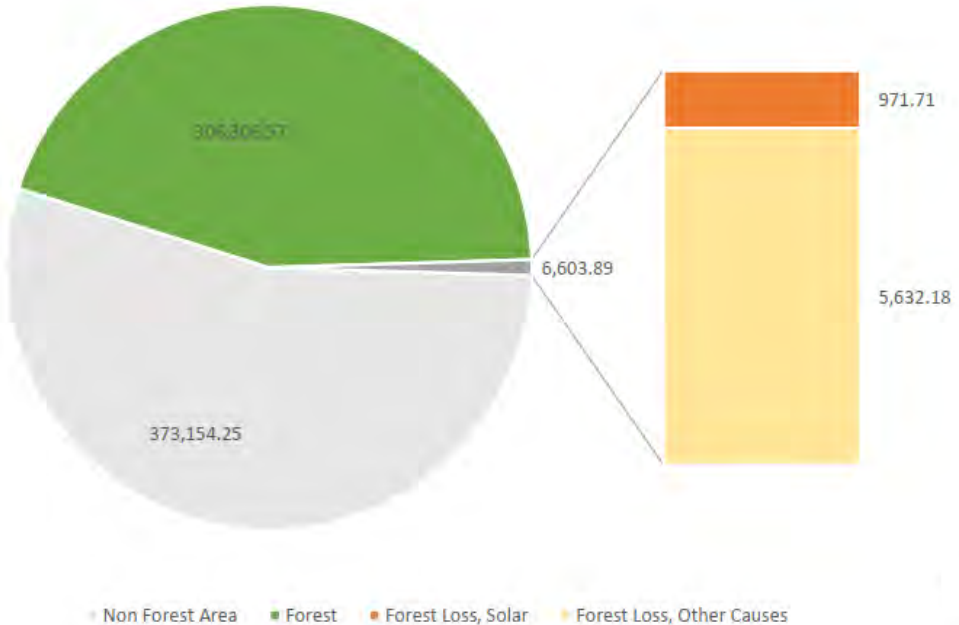


Solar Installations and Forest Loss



- The chart below shows persistent forest, non forest area, forest loss due to solar, and forest loss from other causes over all of Rhode Island.
- The map (left) displays the total acreage of forest loss due to solar in each municipality

Forest Change in Rhode Island, 2012-2022, acres



Calculated using LCMAP 2012 and 2021 Land Cover

Summary

Solar Installations in Massachusetts and Rhode Island

- Approximately 1000 solar installations covering 7,000 acres
- Approximately 116 solar installations covering 1548 acres
- At the state, county, watershed, and town level, solar installations have predominantly impacted forested land
- Conversion of forest has declined in the last two years
- Conversion of forest for non-solar is extensive and the dominant form of forest loss in Rhode Island and Massachusetts





INTO THE WOODS: SOLAR FIELDS IN THE FOREST

Courtney Schmidt
Staff Scientist
Narragansett Bay Estuary Program

A LITTLE ABOUT THE REGION

3 watersheds: Narragansett Bay, Coastal Salt Ponds, and Little Narragansett Bay

Population: ~2 million people

Size: ~2,000 square miles

Towns: 121 towns and cities

Percent Undeveloped Land: 68%

Percent Developed Land: 32%

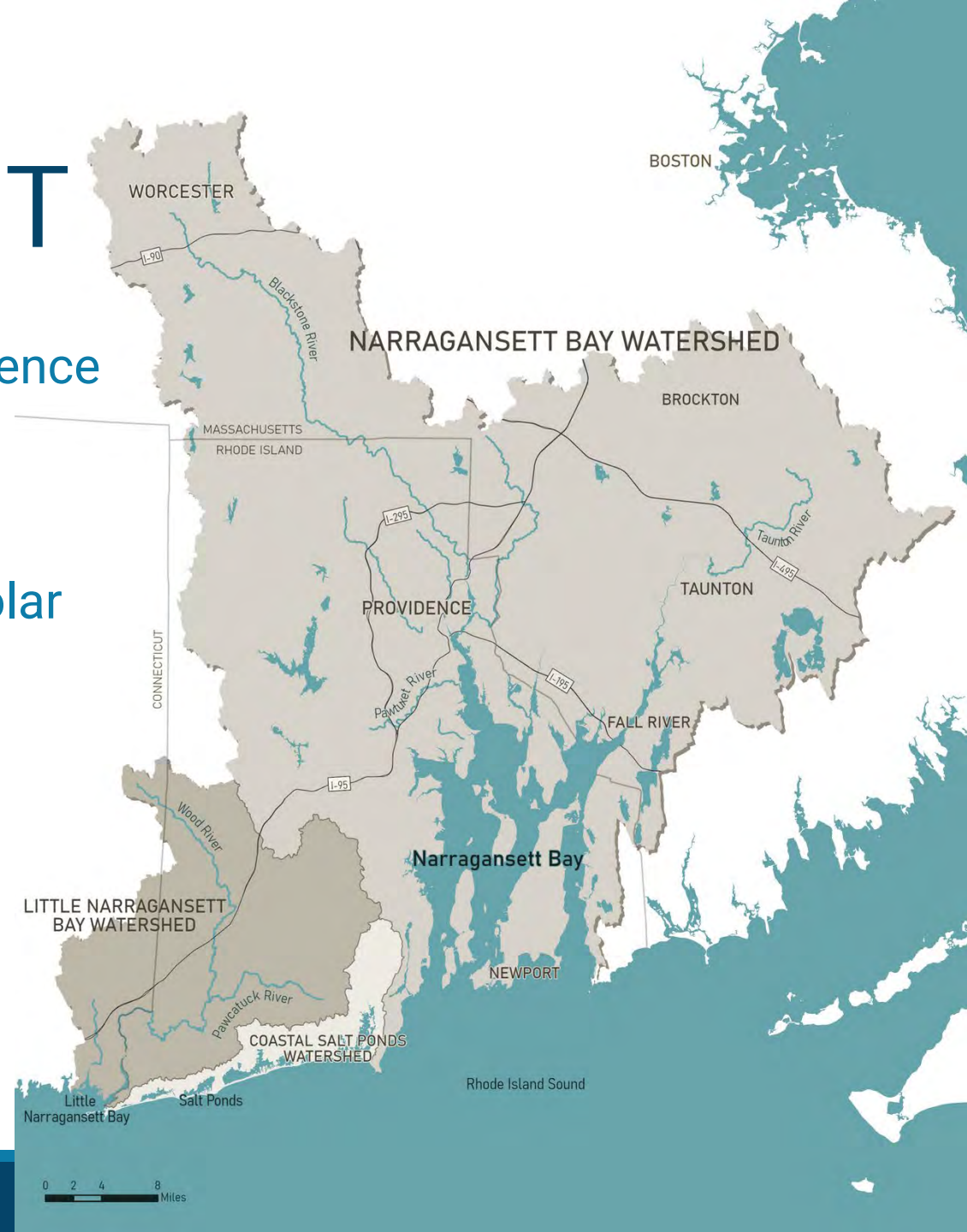


SOLAR IS IMPORTANT

- Reduces GHG and improves energy independence
- Provides job opportunities
- RI, MA, CT: Combined 6,469 megawatts of solar
- Set to add 3,613 megawatts (80% increase)

Solar is necessary for reaching emissions reduction goals

WHAT'S THE TRADEOFF?



FORESTS ARE IMPORTANT

- Protect water quality
 - Create habitat
 - **Capture and store carbon**
 - Provide shade and cooling
 - Provide recreation and enjoyment
- The Region's 603,222 acres of forest store **45 million metric tons** of C and absorb an additional **700,000 metric tons** of C per year
 - ~ annual emissions of 140,000 cars per year

Losing C capture to development including solar



SOLAR FIELDS IN THE REGION

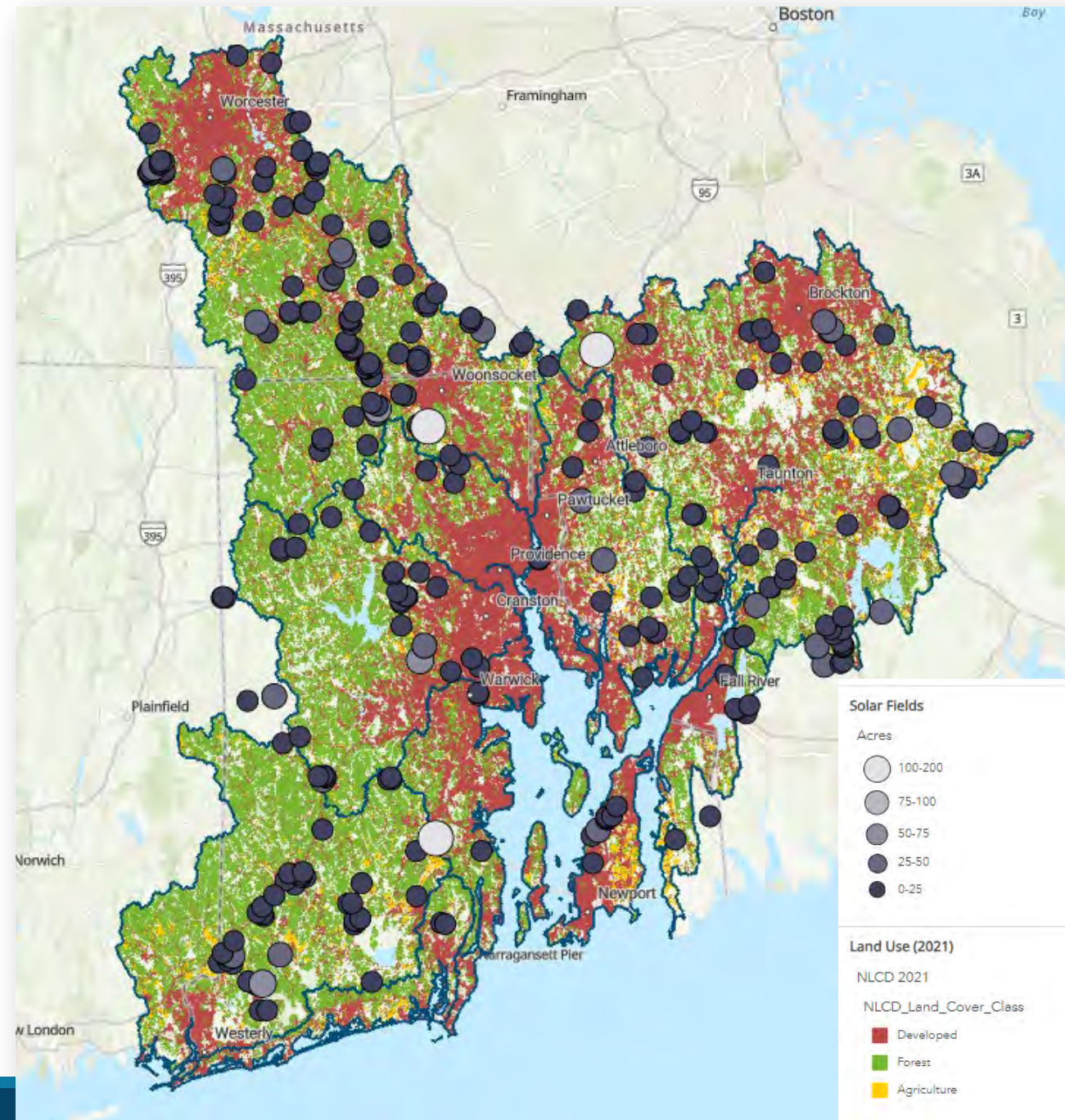
70 OUT OF 121 TOWNS HAVE SOLAR
3,979 ACRES ACROSS 350 FIELDS

MOST ACREAGE

North Smithfield, RI
285 acres across 14 fields

MOST FIELDS

Uxbridge, MA
152 acres across 23 fields



WHERE ARE THE FIELDS?

BLACKSTONE RIVER WATERSHED

1,432 ACRES ACROSS 133 FIELDS

MOST ACREAGE

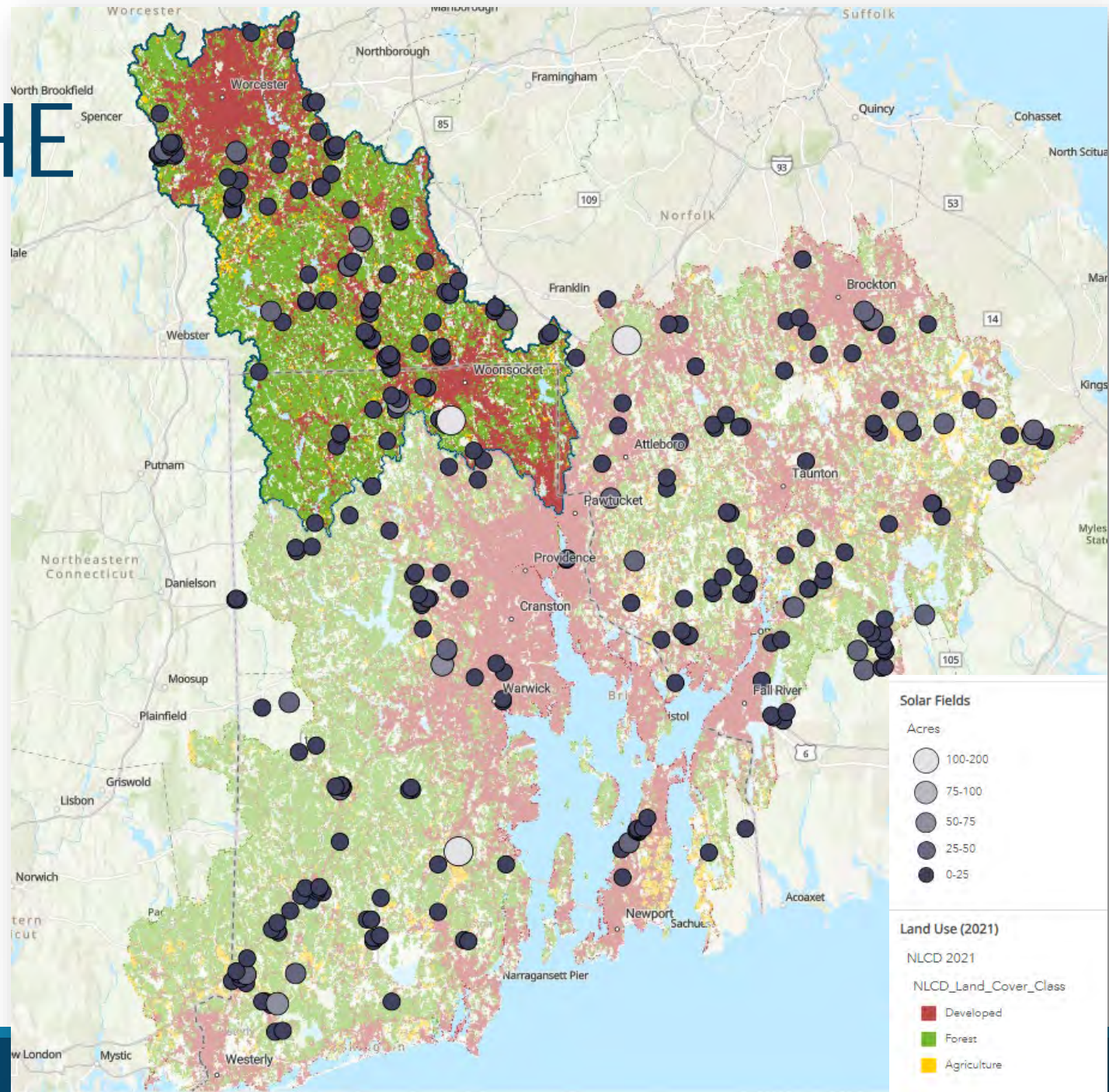
North Smithfield, RI

285 acres across 14 fields

MOST FIELDS

Uxbridge, MA

152 acres across 23 fields



WHERE ARE THE FIELDS?

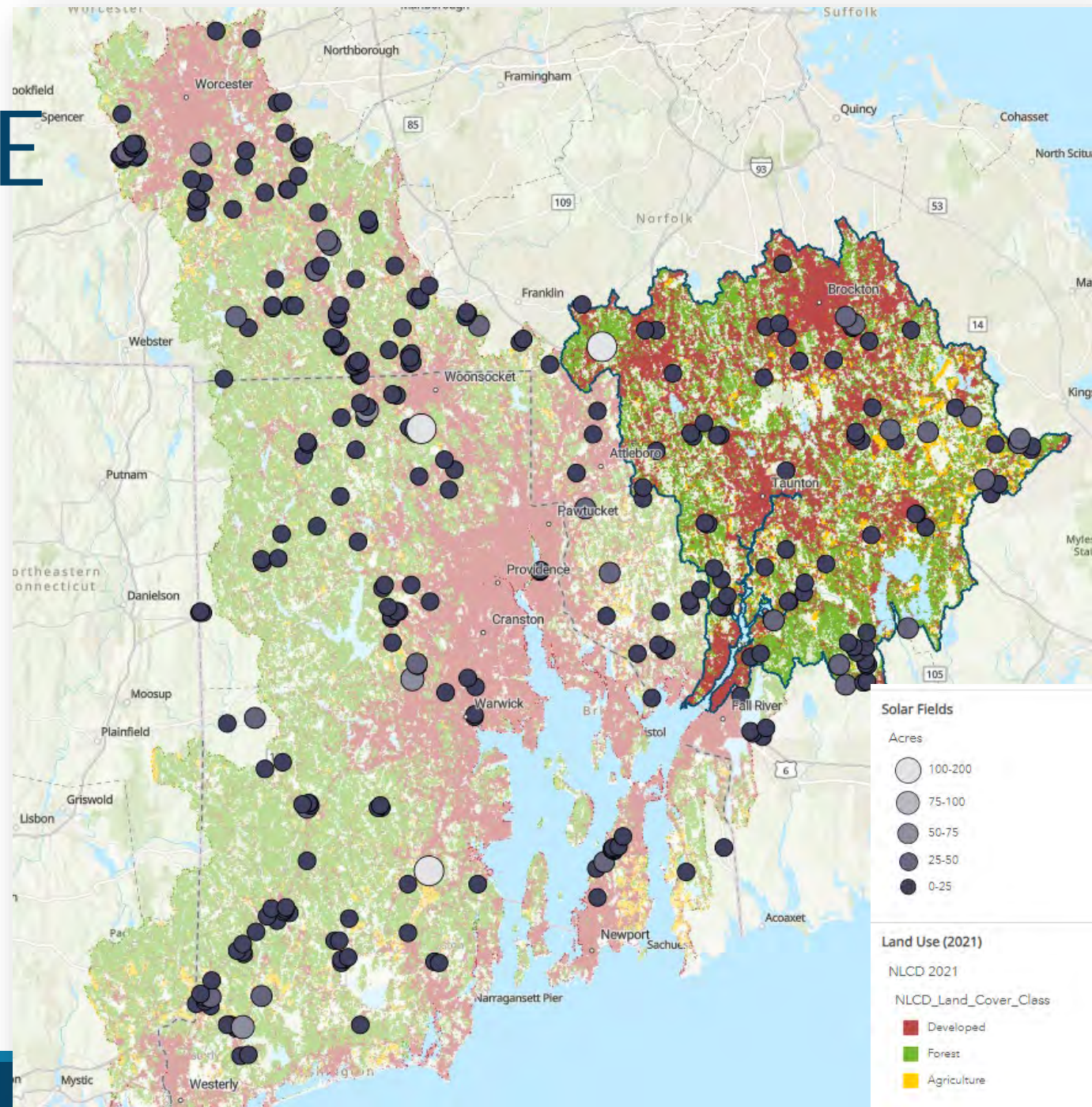
TAUNTON RIVER WATERSHED

1,169 ACRES ACROSS 99 FIELDS

MOST ACREAGE & MOST FIELDS

Freetown, MA

188 acres across 17 fields



WHERE ARE THE FIELDS?

PAWTUXET RIVER WATERSHED

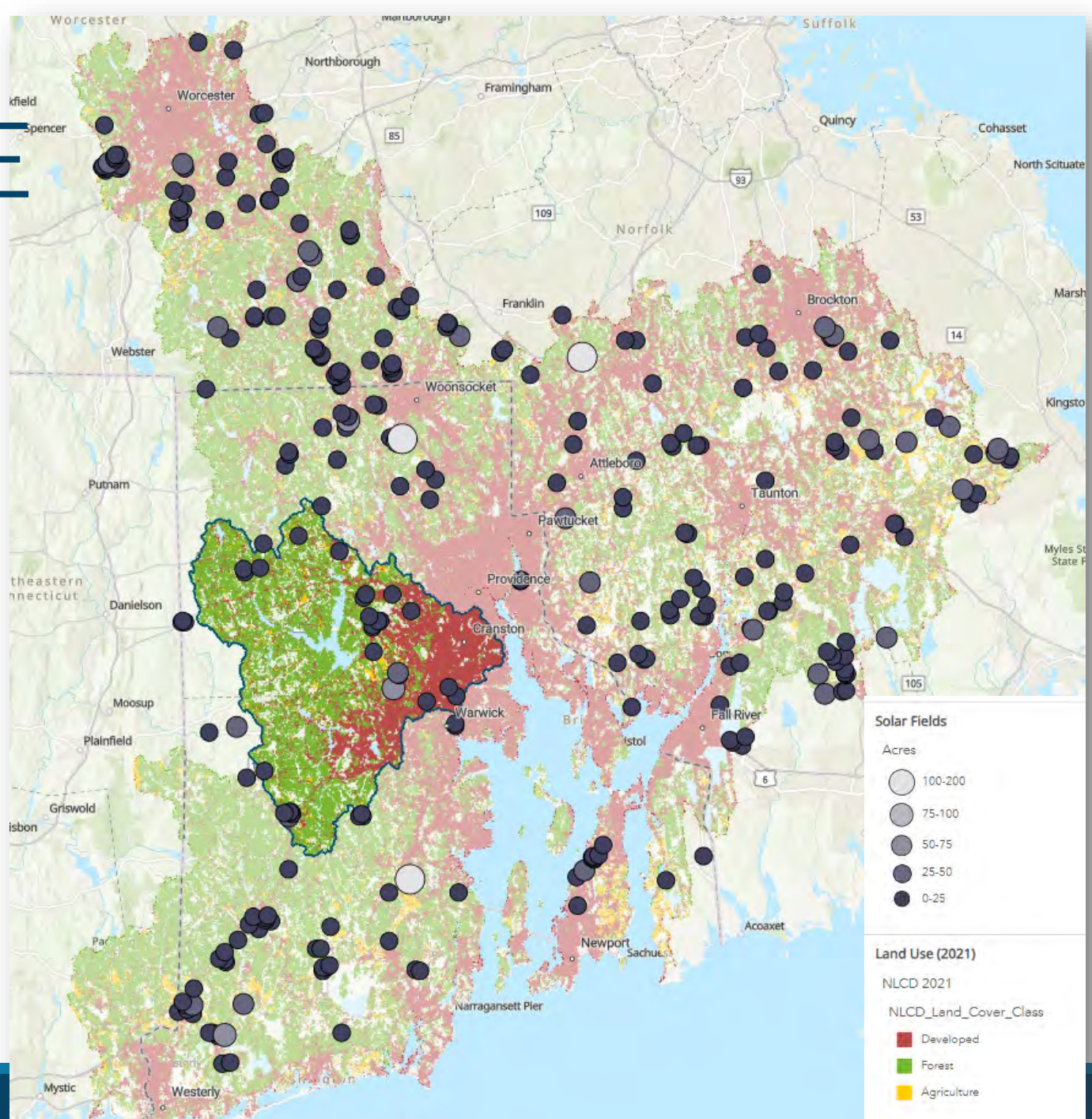
389 ACRES ACROSS 28 FIELDS

MOST ACREAGE

Cranston, RI
142 acres across 5 fields

MOST FIELDS

Johnston, RI
92 acres across 10 fields



WHERE ARE THE FIELDS?

COASTAL NARRAGANSETT BAY WATERSHED

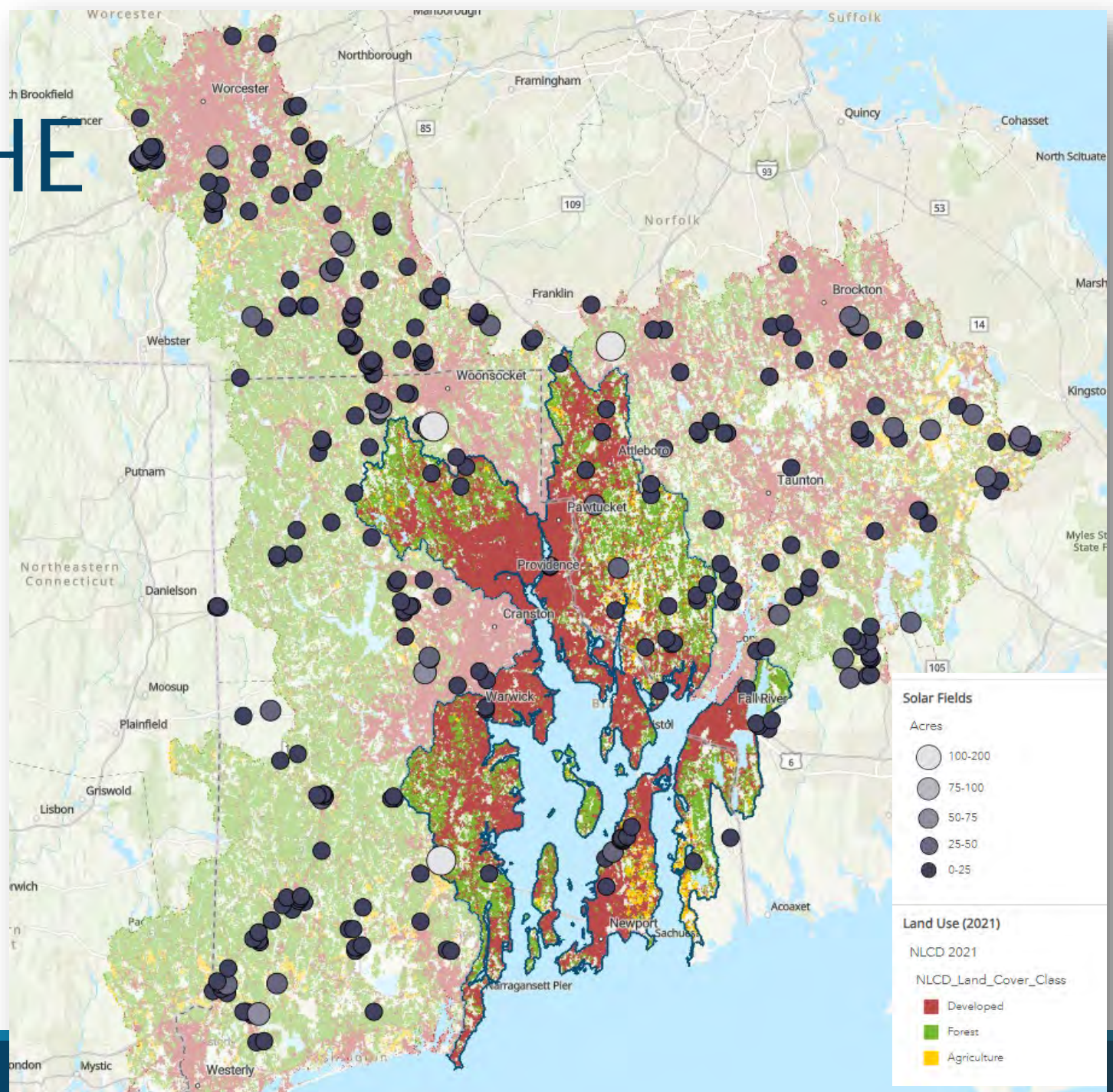
585 ACRES ACROSS 48 FIELDS

MOST ACREAGE

North Kingstown, RI
172 acres across 2 fields

MOST FIELDS

Portsmouth, RI
86 acres across 9 fields

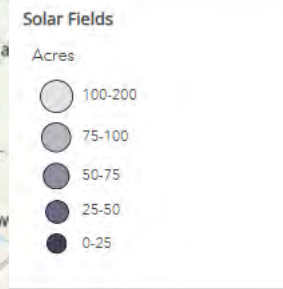
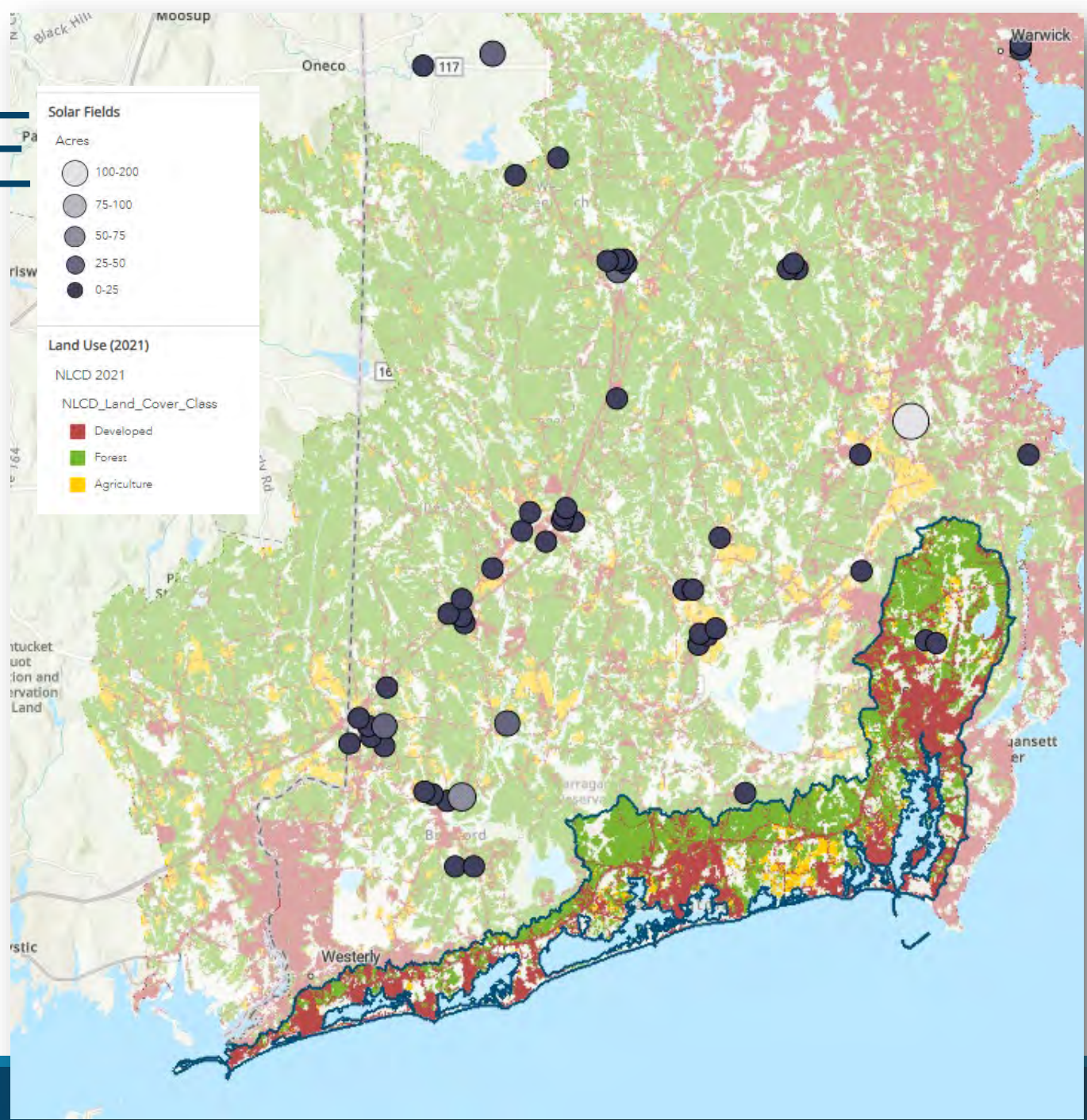


WHERE ARE THE FIELDS?

COASTAL SALT PONDS

27 ACRES ACROSS 2 FIELDS

FIELD LOCATIONS
South Kingstown, RI



WHERE ARE THE FIELDS?

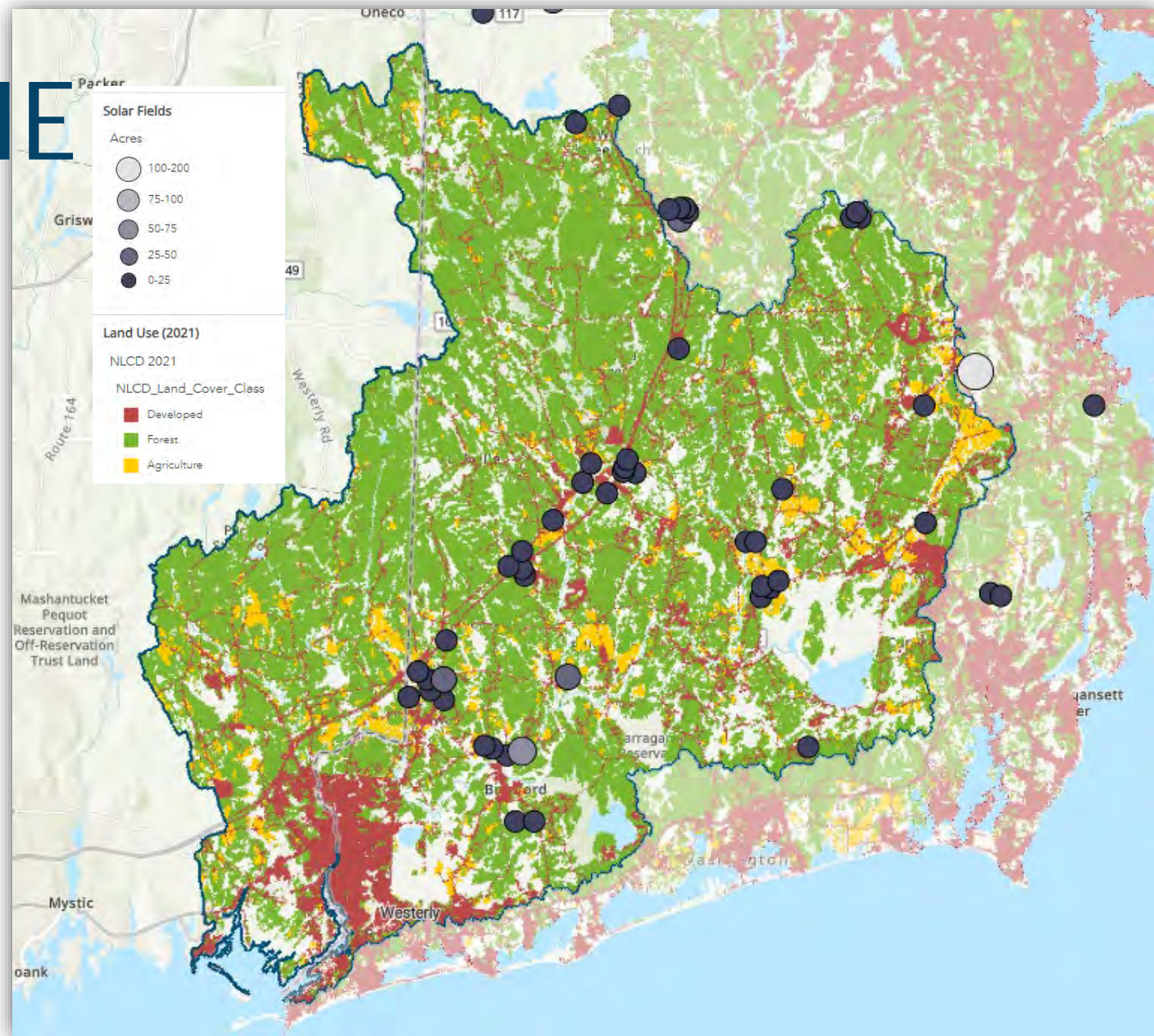
LITTLE NARRAGANSETT BAY WATERSHED

351 ACRES ACROSS 46 FIELDS

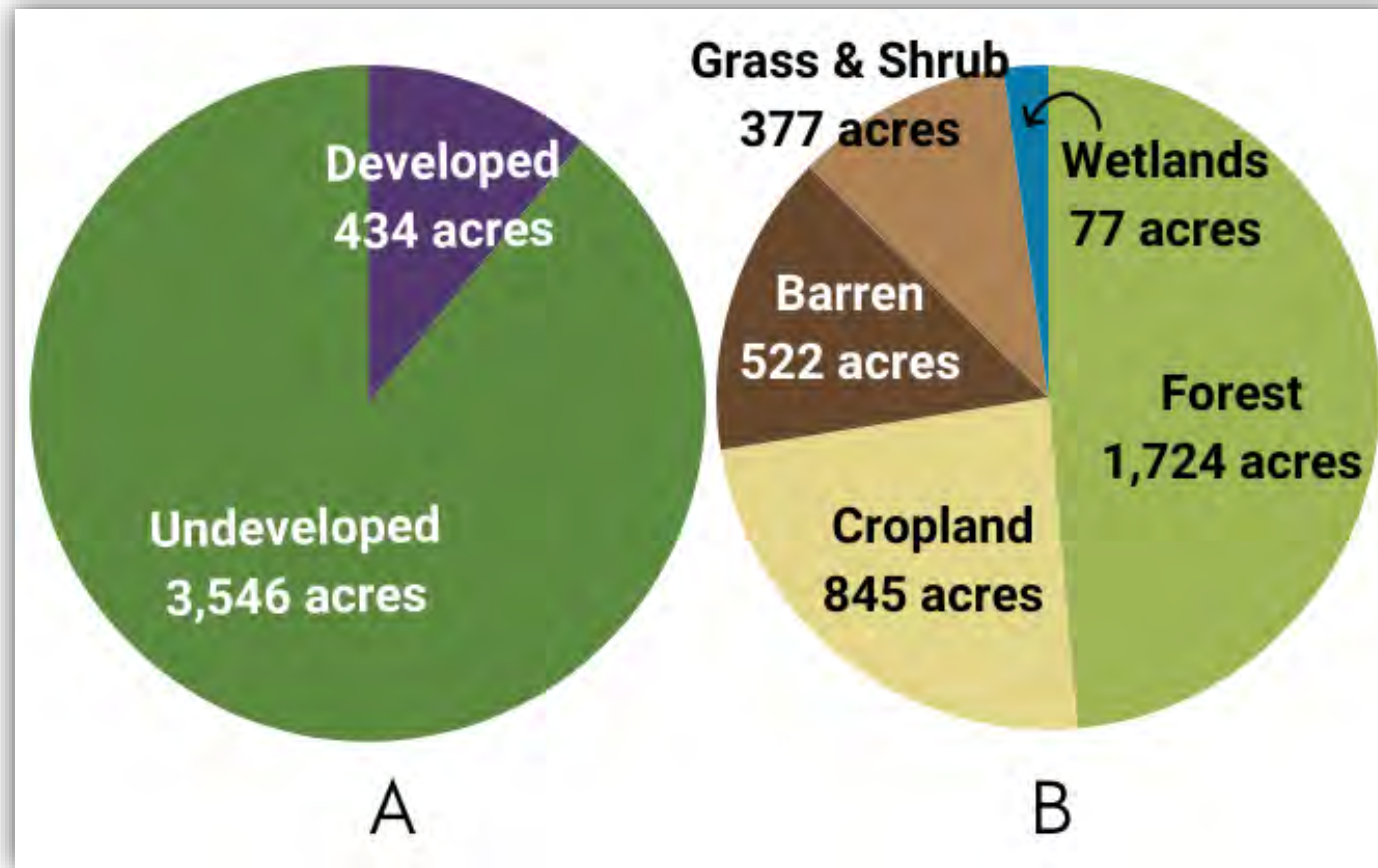
MOST ACREAGE & MOST FIELDS

Hopkinton, RI

152 acres across 20 fields



WHAT WAS THE LAND USE BEFORE SOLAR?



FRAGMENTING FORESTS – CORE FORESTS

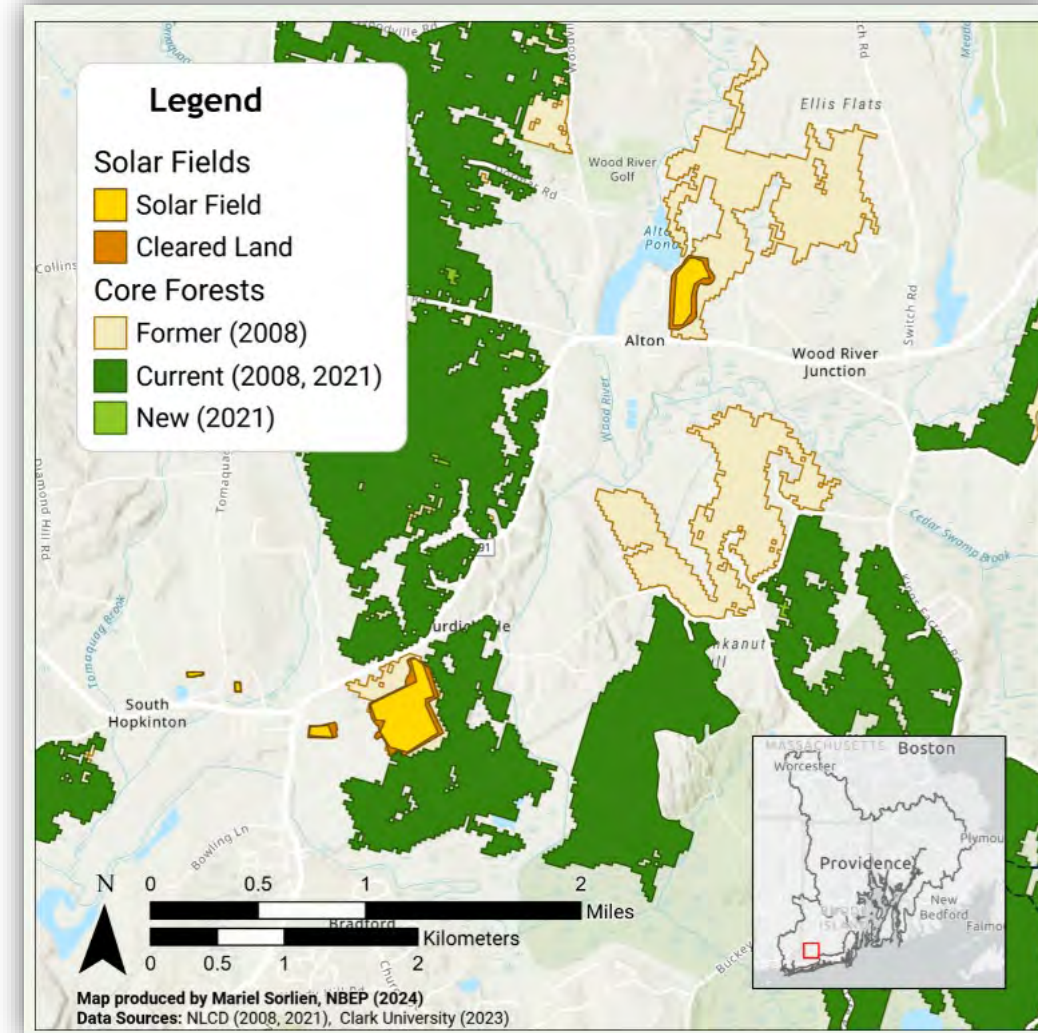
In 2021: 239,333 acres of core forest

- ~40% of forested area in region

In 2008: 265,229 acres of core forest

**Lost 25,895 acres (10% loss)
to development & fragmentation**

- Lost core forests are no longer protected from solar development.
- Lost core forests will not be protected by any future regulation to reduce development



WHAT IS THE BEST USE OF A PARCEL OF LAND?

This is *the* question to be asking

- Renewable energy needs and natural land protection can happen
- Empower municipalities to make ordinance and bylaw changes
- **Bring together data to help planning boards make decisions**
- Incentivize solar on already developed land



WHAT'S NEXT?



- Create a tool for towns/anyone to look up land and understand the water and habitat quality for that parcel
 - near already protected space, water quality, recreation, surrounding land use, etc.
- What data should we include?

Story Map



Clark University

John Rogan
Max Enger
Denys Goodwin
Emily Heltzel
Sreeja Vinod



RIDEM

TeeJay Boudreau
Chuck Horbert
Paul Jordan

MassDEP

Richard Carey
Lealdon Langley

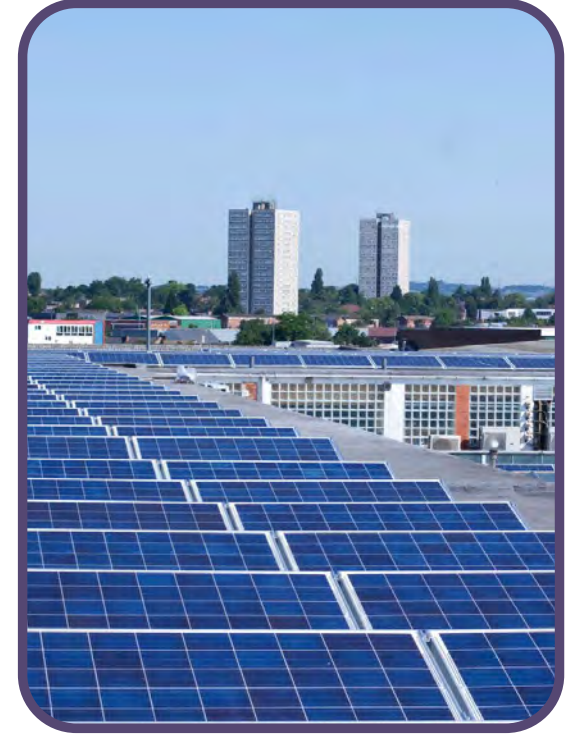
Mass Audubon

Heidi Ricci

NBEP

Mike Gerel
Mariel Sorlien
Darcy Young





Want to move from primarily forests, to already developed land (Brownfields, land that really can't be anything else), and onto rooftops and covered parking

Thank
you!