



# ***Community Planning for Solar Toolkit***

## **Community-Informed Proactive Solar Siting and Financing in Massachusetts**

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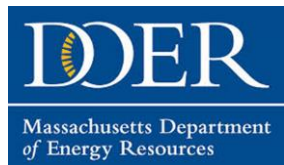
Northampton, MA

October 21, 2022

UMass**Amherst**

Clean Energy Extension

# UMass Clean Energy Extension



Established in 2015, with support from MA Department of Energy Resources, to help meet the state's energy and climate goals.

Expanded UMass extension services under the Center for Agriculture, Food and the Environment (CAFE).



## Key Roles and Activities

- Outreach and applied research
- Renewable energy and energy efficiency
- On-going technical assistance services
- Current initiatives
  - Offshore Wind Professional Certificate
  - Cumulative impacts on wildlife of wind development
  - Energy storage
  - Clean Energy Corps
  - UMass Carbon Zero
  - **Community-driven solar siting and financing**
  - **Pollinator-friendly solar PV certification**
  - **“Dual-use” solar PV and agriculture**

# Community Planning for Solar Project Funding and Objectives



**SOLAR ENERGY  
INNOVATION  
NETWORK**  
U.S. DEPARTMENT OF ENERGY

Solicitation: *Solar in Rural  
Communities, 2019*

UMass project completion  
May 2022

## Objectives

- ✓ Prepare rural municipalities and constituents for solar development activity
- ✓ Provide tools for communities to evaluate solar development aligned with local preferences for siting and installed capacity
- ✓ Inform communities about solar ownership financing options – and comparative benefits and risks accruing locally

# Project Team

## Core Research Team

UMass Clean Energy Extension  
UMass Department of Environmental Conservation

## Local Municipal Partners

Three Pilot Towns – Blandford, Wendell, Westhampton  
Pioneer Valley Planning Commission  
Franklin Regional Council of Government

## Regional Resource Partners

UMassFive College Credit Union  
Co-op Power  
PV Squared (Worker-Owned Cooperative)  
Northeast Solar (Certified B Corp)  
Western MA Community Choice Aggregation

## State Partners

Massachusetts Clean Energy Center  
Massachusetts Department of Energy Resources  
Massachusetts Department of Agricultural Resources

Team was assembled to examine

- challenges and perspectives in rural towns
- applicable state policies and programs, and
- local resources to support municipal interests and replicate and disseminate findings.

# Toolkit Steps & Documents

## Community Planning for Solar: Toolkit Steps and Documents

### 1. Gather your planning committee, get organized, and set goals



**Guide:** *Community Planning for Solar - User Guide*

**Fact Sheet:** *Forming a Collaborative Community Solar Planning Committee*

### 2. Identify potential solar development alternatives within your community



**Fact Sheet:** *The Massachusetts Electric Grid, Distributed Generation, and Grid Interconnection*

**Fact Sheet:** *Conducting a Solar Resource and Infrastructure Assessment*

**Template:** *Solar Resource and Infrastructure Summary*

### 3. Evaluate solar financing and ownership options for your community



**Guide:** *Understanding and Evaluating Solar Financing and Ownership Options*

**Fact Sheet:** *Community-Focused Solar Ownership Options: Local Benefits and Risks*

**Financial Tool:** *Solar Ownership and Financing Options: Cash Flow Accruals to Recipients and Local Economy*

### 4. Assess your community's preferences for solar development and financing alternatives

**Guide:** *Defining Solar Development Options*

**Fact Sheet:** *Purpose and Design of Stakeholder Engagement*

**Guide:** *Conducting Focus Groups for Solar Planning*

**Guide:** *Conducting Surveys for Solar Planning in Your Community*

**Template:** *Community Solar Survey Template*

### 5. Develop a Community Solar Action Plan to guide solar decision-making and development

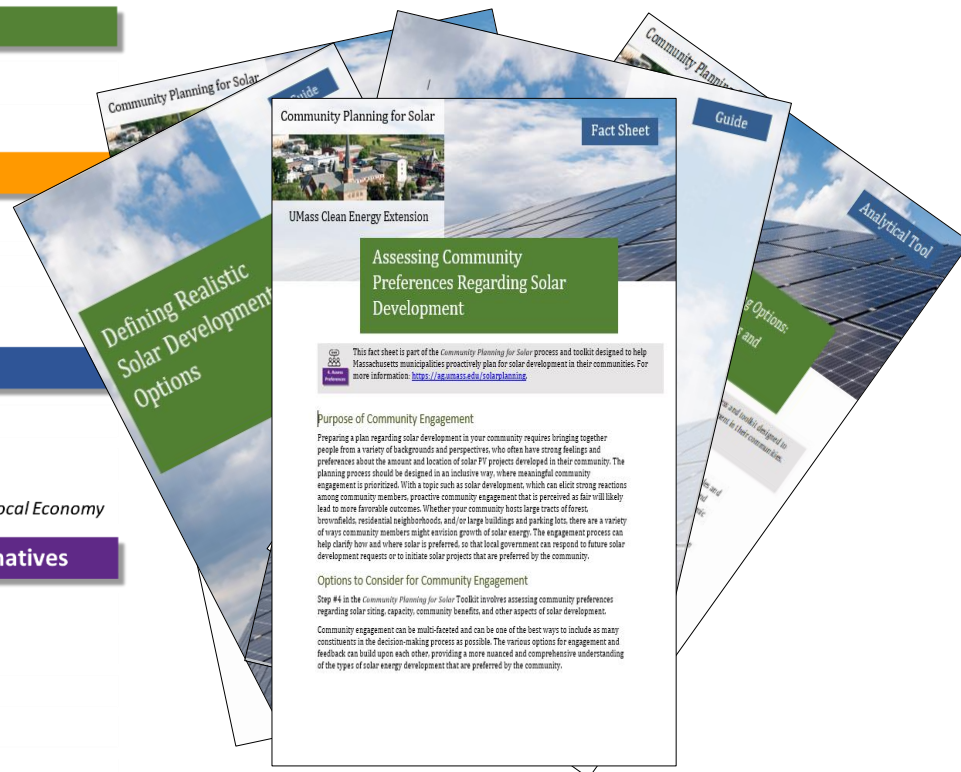


**Guide:** *Compiling a Community Solar Action Plan*

### 6. Keep your Community Solar Action Plan current



**Fact Sheet:** *Monitoring and Updating Your Community Solar Action Plan*



Toolkit materials and guidance  
on CEE website:

<https://ag.umass.edu/clean-energy/research-new-initiatives/solarplanning>

# Gather Information and Form Planning Committee

- Review municipal zoning bylaws
- Review community planning documents
- Conduct a brief survey of municipal representatives
- Access publicly-available data regarding:
  - Electricity grid infrastructure
  - Renewable energy facilities
  - Businesses and farms
  - Households and tax parcels
- Access and map publicly-available geospatial data layers, including:
  - Tax parcels
  - Building roofprints
  - Streets and other impermeable surfaces
  - Protected land
  - Land of conservation value





# Identify Solar Siting Resources & Infrastructure

## Assess Development Alternatives

### *Desktop/GIS Analysis*

- Areas available for development on:
  - Residential rooftops and properties
  - Medium to large-scale rooftops
  - Parking lots
  - Landfills and brownfields
  - Other previously developed sites
  - Farms
  - Undeveloped land suitable for commercial development

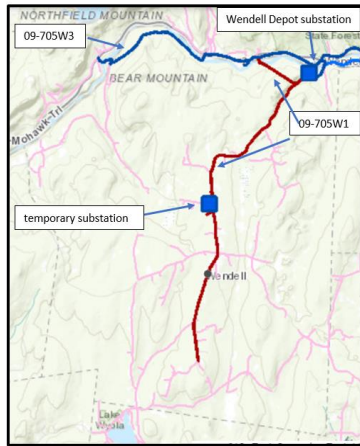


DOER's statewide  
*Technical Potential  
of Solar Study* will be  
helpful here!

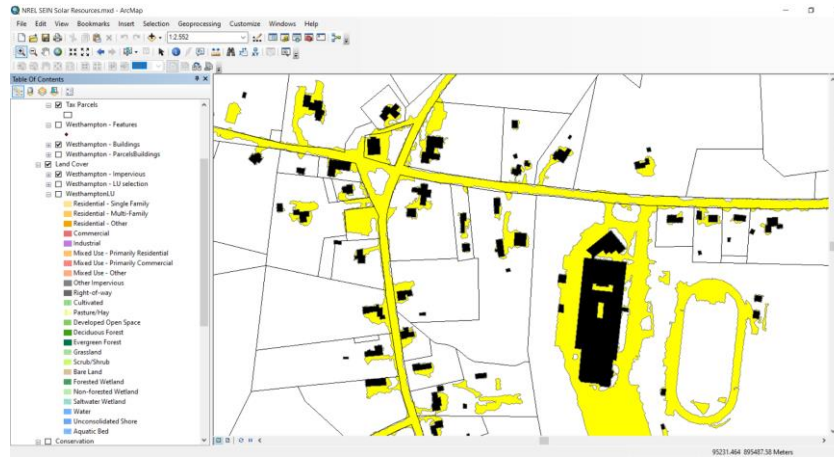


# Solar Resource & Infrastructure Assessment

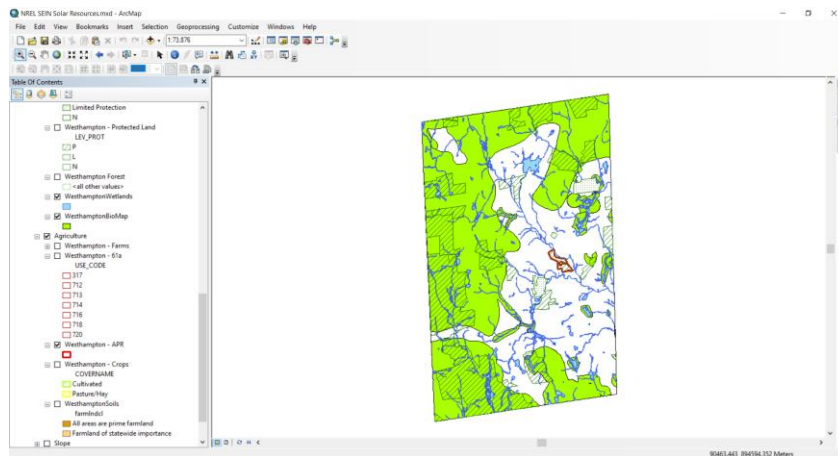
## Grid Infrastructure



## Building Rooftops



## Land Parcels



## Outcome: Sample Summary of Solar Siting Resources

RESOURCE TYPE	AVAILABLE RESOURCES	ESTIMATED TECHNICAL POTENTIAL
Residential-Scale Solar	<ul style="list-style-type: none"> <li>- Estimated 248,300 sf of small building roof space suitable for solar</li> <li>- Estimated 636 buildings (67%) could support some solar</li> <li>- Estimated 318 buildings (34%) could support at least 1.75 kW of solar</li> </ul>	At least 1.7 MW, if 67% of households can install a roof or ground-mounted system
Medium to Large Scale Roofs	-Estimated 67,700 sf of roof space suitable for solar	Estimated at 1.1 MW
Parking Lots & Impervious Surfaces	<ul style="list-style-type: none"> <li>- 1.85 paved acres on municipal property (Swift River School, Highway Garage, Town Offices)</li> <li>- 1.75 acre lot at Scott's Garage</li> <li>- 2.7 gravel or paved acres at <u>Diamond Farm</u></li> <li>- 3.3 paved acres at <u>Kemsley Academy</u></li> </ul>	-TBD -Potential for 80 kW system at Swift River School, based on on-site evaluation
Landfills and Brownfields	- two landfill properties, 12.6 and 21 acres respectively	Maximum of 6.6 MW
Agricultural Resources	<ul style="list-style-type: none"> <li>- Multiple active farms</li> <li>- Barns with large roofs</li> <li>- Estimated 491 acres in agricultural production</li> <li>- Approximately 57 acres in Chapter 61a program for agriculture</li> </ul>	Dependent on project type
Undeveloped Land	<ul style="list-style-type: none"> <li>- 74 large land parcels have at least 5 acres that are not protected, meet current state solar incentive criteria, municipal slope requirements, and do not have a structure worth more than \$25,000 on the property = 1,444 acres</li> <li>- development of most large land parcels would require significant forest clearing</li> </ul>	Approximately 1 MW per 5 acres: 1,434 acres = 287 MW  <i>It is not expected that all undeveloped land available would be built out for solar development.</i>



# Solar Development Goals and Alternatives

- What is town's goal for hosting solar capacity?
- What mix of Development types can meet this capacity goal?
- What are capacity limitations on siting solar on the built environment, and the previously disturbed lands?
- What type of "greenfield" development is most acceptable?
- What are the economic development goals for the town and opportunities to bring community benefits?

# Evaluating Solar Financing and Ownership Options for the Community

- Communities look to solar development to provide economic benefits to the town or community.
- Towns are often uninformed and unprepared to consider options and negotiate to maximize benefits.
- Local ownership in solar project brings more local benefits over the project life – but assume greater risk and have fewer mature business models.



- Local ownership structures take more planning and can be at a competitive disadvantage if the federal ITC is not accessible. **Federal IRA has addressed this inequity.**
- Our tools offer town officials and constituents a fact sheet on solar ownership options and a cash flow model to evaluate local economic benefits and risks.

# Fact Sheet on Community Ownership Options

Community-Informed Solar Financing and Ownership Options: Local Cash Flow Benefits and Risks				
<p>Note: <b>RED</b> shading indicates more limited local cash flow benefits, and <b>GREEN</b> shading indicates opportunities with greatest local cash flow benefits. <b>MIXED</b> shading indicates where the distribution of cash-flow benefits are significantly diminished or countered by risk considerations. <b>YELLOW</b> shading for the Flip model indicates a merge of the Red attributes prior to the ownership flip, and the Green attributes afterwards.</p>				
	Third Party Ownership	Third Party Flip	Community Owned	
			Taxable Entity	Non-taxable Entity
Description	Developer or third party investor provides investment capital and owns solar assets with negotiated agreement with the local host. Investor receives a rate of return sufficient to meet their corporate financial hurdle rate.	Third party investor and local taxable entity engage in financial partnership where third-party investor takes approximately 99% ownership stake for first 6-10 years, and then "flips" this ownership stake at a discounted buy-out price to the local partner. Third party provides investment capital and takes federal tax benefits and early project revenues to gain a rate of return. Local taxable partner may sell or transfer project ownership to non-profit, community choice aggregation, or municipal owner after one year.	Solar assets are wholly financed and owned by local entities. Local owners may or may not be able to access federal tax benefits. For some local owners, projects may be financially acceptable at lower rates of return.	Federal tax benefits are not accessible. Characteristic Owners: Municipality, Community Choice Aggregation, non-profit businesses, faith-based organizations, low income individuals.
Increasing Local Benefits				
Local Economic Benefits	Limited Economic Benefits Lease payment, Payment in Lieu of Taxes (PILOT), or Power Purchase Agreement (PPA) or Net Metering with marginal energy discount.	Delayed Economic Benefits Similar benefits for Third Party Ownership for first 6-10 years, followed by full benefits of Community Ownership.	Maximum Economic Benefits Ownership investment leads to full (or near full) project cash flows and rates of return accruing within the local economy and associated economic multiplier.	
Other Benefits	No investment costs. Transactional simplicity for community.	No initial investment cost, and significantly reduced investment for buy-out. May provide community with more decisionmaking in project development.	Ownership provides more local control over siting decisions, site design, job creation opportunities, and electricity offtakers.	
Risk Allocations	Risk of project development and asset ownership is on third party for full project life. Local constituents risk the opportunity cost of the site alternative usage.	Asset ownership risk transfers from original third party owner to second owner when ownership changes. Local partner may lose any costs incurred during project development and financing if project does not go forward.	Risk of project development and asset ownership, including operation and maintenance (O&M), is on local constituents for full project life. Solar equipment warranties and incentive-based O&M contracts may mitigate risks.	



Solar Ownership and Financing Options:  
Cash Flow Accruals to Recipients and Local Economy



This analytical tool is part of the *Community Planning for Solar* process and toolkit designed to help Massachusetts municipalities proactively plan for solar development in their communities. For more information: <https://ag.umass.edu/solarplanning>.

Intended Use of this Spreadsheet Model Analytical Tool

This spreadsheet model enables local communities to evaluate and compare the magnitudes and distributions of cash flows associated with available solar photovoltaic project ownership and financial options. Cash flows are tracked to recipients that are located within the local economic region of interest, and to those outside.

*Disclaimer: This financial model provides pro forma cash flows for a representative solar installation under representative market conditions and offers high-level insights for solar planning by a local economy. Results are only suggestive of financial viability. For any investment decision, detailed financial analysis is necessary, especially for municipal or innovative local financing, to adequately estimate cash flows and project viability.*

Summary Description of Financing/Ownership Scenarios

The set of scenarios that are considered in this pro forma financial model are representative of primary Ownership/Financing structures available. However, the third-party flip and community owned structures are more limited and still emerging in today's marketplace. Further explanations and attributes of these scenarios are provided in the Related Documents.

Scenario	Description
<b>Third Party</b>	Developer or third party investor provides investment capital and owns solar assets with negotiated agreement with the local host. Investor receives a rate of return sufficient to meet their corporate financial hurdle rate.
<b>Third Party Flip</b>	Third party investor and local taxable entity engage in financial partnership where third-party investor takes approximately 99% ownership stake for first 5-10 years, and then "flips" this ownership stake at a discounted buy-out price to the local partner. Third party provides investment capital and takes federal tax benefits and early project revenue to gain a rate of return. At flip, local entity finances buy-out and takes over project cash flows until the end of project life.
<b>Community Owned</b>	<p>Solar assets are wholly financed and owned by local entities. Depending on the tax status and liability of the local entity, local owners may or may not be able to access federal tax benefits.</p> <p><b>Taxable Local Entity (and with sufficient tax liability)</b> Federal tax benefits are accessible. Characteristic Owners: Local businesses, for-profit cooperative, individuals or LLC with tax appetite, etc.</p> <p><b>Tax-Exempt Local Entity</b> Federal tax benefits are not accessible. Characteristic Owners: Municipality, Community Choice Aggregation, non-profit businesses, faith-based organizations, low income individuals.</p>

# Solar Ownership Options

## Cash Flow Accrual to Local Community

Outside Economy
Original Owner - Outside
Offtakers Outside Economy
Lender Outside Economy
Local Economy
Original Owner - Local
Local Owner after Flip
Offtakers Local Economy
Lender Local Economy
Community PILOT / Lease

### Project Cash Flow Participants

### Model Inputs

Ownership Scenario				Solar Project Specifications and Federal/State Incentives									
Project Ownership and Financial Scenario	Initial Owner - Location in Economy	Tax Status and Benefits for Initial Project Owner	Solar Installed Cost	Solar Array Capacity	Federal ITC	State Solar Income Tax Credit	Electricity Avoided Retail Rate (Year 1)	Electricity Retail Annual Escalation Rate	Solar Tariff Rate	Solar Tariff Term	REC Price (post tariff)		
			\$/DC	kWDC			per kWh		per kWh	years		per MWh	
Inputs in this Row will copy to each Scenario. User can override common inputs by entering inputs specific to each Scenario in its Row below.			\$2.10	1000	26%	\$0	\$0.15	2.0%	\$0.20	20	\$25.00		
Third Party	Outside Economy	Taxable (ITC/MACRS/Debt)	\$2.10	1000	26%	\$0	\$0.15	2.0%	\$0.20	20	\$25.00		
Third Party Flip													
Community Owned (taxable)													
<b>Net Metering and Local Agreements</b>				<b>Loan and Flip Information</b>									
				<b>First Owner Loan</b>				<b>Second Owner Loan</b>					
Electric or Net-Metering Off-Taker Discount	Percent of Offtakers in Local Economy	PILOT Payment Agreement	Land Lease Payment Agreement	Percent Project Cost (after ITC reduction) Financed w/ Cash	Loan Annual Interest Rate	Loan Term	Local Lender	Ownership Flip Year	Flip Buy-Out % of Initial or \$	Percent Project Cost Financed w/ Cash	Loan Annual Interest Rate	Loan Term	Local Lender
		annually, per MW				years	Yes / No	=0 if no flip			years	Yes / No	
				40%	6.0%								
10%	20%	\$12,500	\$12,500	40%	6.0%	15	No	0					
10%	60%	\$12,500	\$12,500	40%	6.0%	10	No	10	25%	40%	6%	\$10	Yes
25%	100%	\$5,000	\$5,000	40%	6.0%	15	Yes	0					
15%	100%	\$5,000	\$5,000	40%	6.0%	15	Yes	0					

# Local Economy Solar Cash Flow Model – Output for Representative 1 MW project

	NPV of Cash Flow to Local and Outside Recipients	Lifetime Cash Flow to Local and Outside Economy	LOCAL Economy Benefit & Risk				OUTSIDE Economy Benefit & Risk		
			NPV of Cash Flows (including Investment)	Investment Risk (Debt + Equity)	Initial Owner Rate of Return	Flip Owner Rate of Return	NPV of Cash Flows (including Investment)	Investment Risk (Debt + Equity)	Initial Owner Rate of Return
Third Party	<ul style="list-style-type: none"> <li>Original Owner - Outside</li> <li>Offtakers Outside Economy</li> <li>Lender Outside Economy</li> <li>Original Owner - Local</li> <li>Local Owner after Flip</li> <li>Offtakers Local Economy</li> <li>Lender Local Economy</li> <li>Community PILOT / Lease</li> </ul>	<p>Third Party</p> <p>Cumulative Cash Flow, millions</p> <p>Local Economy (green line), Outside Economy (blue line)</p>	\$211,000				\$1,105,000	\$1,554,000	15.1%
Third Party Flip	<ul style="list-style-type: none"> <li>Original Owner - Outside</li> <li>Offtakers Outside Economy</li> <li>Lender Outside Economy</li> <li>Original Owner - Local</li> <li>Local Owner after Flip</li> <li>Offtakers Local Economy</li> <li>Lender Local Economy</li> <li>Community PILOT / Lease</li> </ul>	<p>Third Party Flip</p> <p>Cumulative Cash Flow, millions</p> <p>Local Economy (green line), Outside Economy (blue line)</p>	\$778,000	\$525,000		41.6%	\$474,000	\$1,029,000	9.2%
Community Owned (taxable)	<ul style="list-style-type: none"> <li>Original Owner - Outside</li> <li>Offtakers Outside Economy</li> <li>Lender Outside Economy</li> <li>Original Owner - Local</li> <li>Local Owner after Flip</li> <li>Offtakers Local Economy</li> <li>Lender Local Economy</li> <li>Community PILOT / Lease</li> </ul>	<p>Community Owned (taxable)</p> <p>Cumulative Cash Flow, millions</p> <p>Local Economy (green line), Outside Economy (blue line)</p>	\$1,395,000	\$1,554,000		11.7%			
Community Owned (non-taxable)	<ul style="list-style-type: none"> <li>Original Owner - Outside</li> <li>Offtakers Outside Economy</li> <li>Lender Outside Economy</li> <li>Original Owner - Local</li> <li>Local Owner after Flip</li> <li>Offtakers Local Economy</li> <li>Lender Local Economy</li> <li>Community PILOT / Lease</li> </ul>	<p>Community Owned (non-taxable)</p> <p>Cumulative Cash Flow, millions</p> <p>Local Economy (green line), Outside Economy (blue line)</p>	\$1,096,000	\$2,100,000		7.3%			



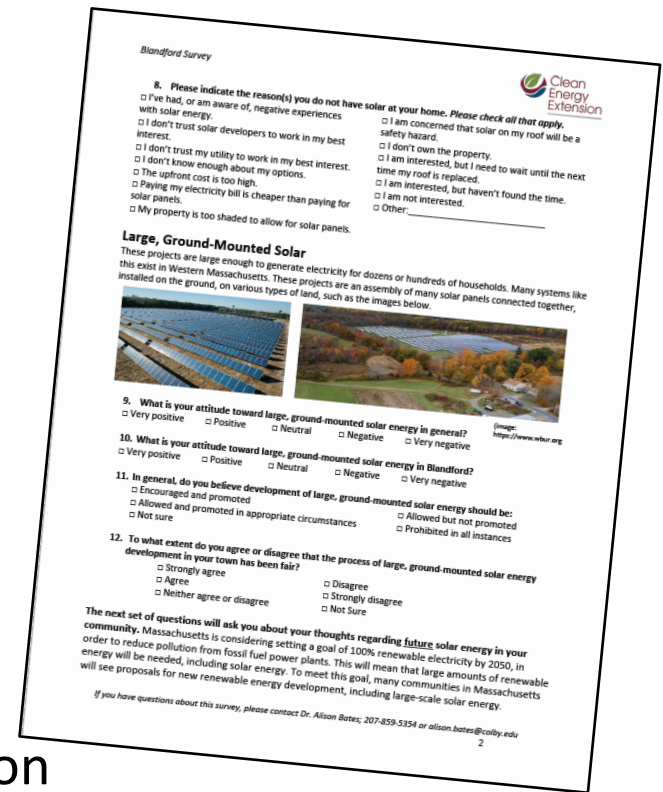
# Assessing Community Preferences

## Approach:

- Working group of community partners (Solar Planning Committee)
- Community-based focus groups
- **Community Solar Survey** open to all town residents

## Goals:

- Understand the community's experience with solar development to date
- Use focus groups to better understand common perspectives in the community, questions that arise, knowledge gaps, and terminology
- Use the survey to canvas the town as a whole



# Develop Community Solar Action Plan

## **Bring together data from:**

- Solar Infrastructure & Resource Assessment
- Financial Scenarios
- Community Solar Survey

## **Identify next steps, actions, and who will carry out these steps:**

*These might include...*

- Updates to solar bylaws/ordinances
- Pursuing specific projects on municipal land or buildings
- Campaigns to promote rooftop solar projects on residences or businesses
- Working with interested private landowners to encourage development on locations preferred by the community

# Toolkit Principles

- **Accessible**
  - Lay language, graphically oriented
  - Downloadable from CEE website and publicized/distributed through project partners
- **Actionable**
  - Based on latest data related to grid, site evaluations, financing options, incentives



- **Audience-oriented**
  - Outputs tailored to specific audiences (e.g., municipal officials, RPAs, solar developers)
- **Adaptable**
  - Replicable for rural communities across New England and New York
  - More broadly adaptable for use in other states

A screenshot of the University of Massachusetts Amherst website. The header includes the university name and navigation links like 'Visit', 'Apply', and 'Give'. The main content area is titled 'Center for Agriculture, Food, and the Environment' and 'Clean Energy Extension'. A search bar is present. The page features a sidebar with navigation links and a main content area titled 'Community Planning for Solar Toolkit'. The main content includes a large image of solar panels in a field and a text block describing the toolkit's purpose: 'Successfully combatting climate change will require significant build-out of solar energy across Massachusetts and around the country over the coming decades. Proactive and inclusive community planning for the siting and financing of solar photovoltaics (PV) can help to facilitate solar PV development in line with community preferences, while balancing other community priorities and maximizing local benefits. Good planning can also reduce time commitments for municipal officials involved in the solar permitting process, minimize conflicts among stakeholders, and reduce solar development costs. CEE and its partners have designed the Community Planning for Solar Toolkit to help municipalities in Massachusetts and throughout the Northeast proactively plan for solar PV development in their communities.'

# Toolkit Delivery

- **Fact Sheets**

- *The Basics of Grid Infrastructure* (for: municipal officials, RPAs)
- *Community Focused Solar Ownership Options: Local Benefits and Risks* (for municipal officials, community members, RPAs)



- **Templates & Examples**

- *Focus Group Design, Protocols, and Discussion Questions* (for: municipal officials)

- **User Guides**

- *Conducting a Community-level Solar Resource Technical Assessment* (for: RPAs)

- **Financial Modeling Tools**

- *User-facing Basic Cash Flow and Financial Analysis of Ownership Options* (for: municipal officials, RPAs, researchers)

Project Ownership and Financial Scenario	Initial Owner Location in Economy	Tax Status and Benefits for Initial Project Owner	Solar Installed Cost		Federal ITC	State Solar Residential Incentive Tax Credit	Electricity Retail Rate (per kWh)	Electricity Retail Rate Escalation Rate	Solar Tariff Rate (per kWh)	Solar Tariff Term (years)	REC Price (per kWh)	Credits in Net Metering OR Offset in Local Economy (monthly \$/kW)	Percent of Credits in Local Economy	PFIOT (Lease Payment Agreement)	Percent Project Cost Financed w/ Cash	Loan Annual Interest Rate
			\$/W	\$/kW (AC)												
Private Party (On-Build-Economy)	On-Build-Economy	Non-Financing	\$2.10	1000	26%	\$0	\$0.15	2.0%	\$0.20	20	\$20.00	10%	20%	\$12,500	40%	6.0%
Third Party (On-Build-Economy)	On-Build-Economy	Non-Financing	\$2.10	1000	26%	\$0	\$0.15	2.0%	\$0.20	20	\$20.00	10%	20%	\$12,500	40%	6.0%
Community Owned/Leasable	Local Economy	Non-Financing	\$2.10	1000	26%	\$0	\$0.15	2.0%	\$0.20	20	\$20.00	25%	100%	\$5,000	40%	6.0%
Community Owned/Leasable	Local Economy	Non-Financing	\$2.10	1000	26%	\$0	\$0.15	2.0%	\$0.20	20	\$20.00	15%	100%	\$5,000	40%	6.0%

# Putting the Toolkit to Work

## ***Clean Energy Living Lab: Community Solar Planning Teams***

Clean Energy Extension has established a project-based learning course, in which students will facilitate proactive community planning for commercial-scale solar development in collaboration with Massachusetts municipalities.

Class will be providing planning service to 9-10 towns this fall/spring.

Ashfield

Leyden

Colrain

Leverett

Deerfield

Montague

Heath

Monterey

Northfield



# Findings/Conclusions

- Rural municipalities in MA are facing growing solar pressures and can be overwhelmed and overpowered by large developers.
- Towns are not homogeneous regarding solar perspectives or goals.
- Toolkit is not to advocate for solar, but to inform communities and enable them to be proactive in planning and managing solar development that meets their preferences.
- Toolkit is accessible for towns, but they will likely need technical assistance in its implementation.
- Local ownership of solar assets brings substantially greater long-term benefits to the community, but requires risk, capital, and financial innovation.
- Communities should work with state and local financial resources to pilot business models that work for local economies – and make solar more appealing to rural towns.

# Thank You!

## Questions/Thoughts?



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