Guide

Understanding and Evaluating Solar Financing and Ownership Options

Community Planning for Solar

UMassAmherst

Clean Energy Extension

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The *Community Planning for Solar* project team included UMass Clean Energy Extension (CEE), the UMass Department of Environmental Conservation, Colby College Department of Environmental Studies, the Massachusetts Department of Energy Resources (DOER), the Massachusetts Department of Agricultural Resources (MDAR), the Pioneer Valley Planning Commission (PVPC), the Franklin Regional Council of Governments (FRCOG), the Western Massachusetts Community Choice Energy Task Force, UMassFive College Credit Union, Northeast Solar, PV Squared, Co-op Power, and the Massachusetts towns of Blandford, Wendell and Westhampton.

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The outline below summarizes the *Community Planning for Solar* steps and associated documents. For more information, please visit our website at ag.umass.edu/solarplanning.

Community Planning for Solar: Toolkit Steps and Documents

1. Gather your planning team and set goals

- **a. Guide**: Community Planning for Solar - Toolkit Overview
- **b. Fact Sheet**: Forming a Collaborative Community Solar Planning Team

2. Conduct a solar resource and infrastructure assessment

- **a. Fact Sheet**: The Electric Grid, Distributed Generation, and Grid Interconnection
- **b. Guide**: Conducting a Solar Resource and Infrastructure Assessment
- **c. Template**: Solar Resource and Infrastructure Summary
- **d. Example**: Solar Resource and Infrastructure Report

3. Evaluate solar financing and ownership options

- **a. Guide**: Understanding and Evaluating Solar Financing and Ownership Options — You Are Here
- **b. Fact Sheet**: Solar Financing and Ownership Options
- **c. Financial Tool**: Solar Financing and Ownership Options: Cash Flow Model

4. Assess community preferences regarding solar development and financing

- **a. Guide**: Defining Realistic Solar Development Options
- **b. Example**: Realistic Solar Development Options
- **c. Fact Sheet**: Assessing Community Preferences Regarding Solar Development
- **d. Guide**: Conducting Focus Groups for Solar Planning
- **e. Guide**: Conducting a Community Solar Survey
- **f. Template**: Community Solar Survey

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

- **a. Guide**: Compiling a Community Solar Action Plan
- **b. Example**: Community Solar Action Plan

6. Keep your *Community Solar Action Plan* current

- **a. Fact Sheet**: Monitoring, Evaluating, and Updating Your Community Solar Action Plan

TERM	MEANING
Photovoltaic (PV)	Photovoltaic (PV) systems are solar arrays composed of panels that generate electricity from sunlight. These panels are a different type of technology than the types of panels used in "solar hot water" or "solar thermal" systems.
Capacity	Capacity of a solar array is a description of the instantaneous power output of the panels at top production (i.e., in full sun). It is typically measured in kilowatts (kW) or megawatts (MW). A residential-size solar system is typically 5-10 kW in capacity. Large, ground-mounted solar arrays in Massachusetts are often 1 MW or greater in size.
Annual Generation or Annual Energy Production	The annual generation or annual energy production (AEP) of a solar array is a measure of the yearly electricity output produced by the panels. It is typically measured in kilowatt-hours (kWh) or megawatt-hours (MWh). In New England, annual generation is approximately equal to the array's capacity (in DC) *14% * 8,760 hours per year.
Voltage	Voltage of an electric power line can be thought of as the equivalent of pressure in a water line. The voltage of transmission and distribution power lines is typically measured in kilovolts (kV). One kilovolt is equivalent to 1000 volts (V). In residential use in the United States, electrical wires within a household carry electricity at 120 V.
Three-Phase vs. Single-Phase Power Lines	Distribution lines are either three-phase lines or single-phase lines; the "phase" describes the distribution of power across them. Single-phase lines typically have one line that carries power and one neutral line. Three-phase lines have three wires which are all carrying power out of phase with each other, exactly 120 degrees apart; in some configurations, there is also a fourth neutral and line and ground. The practical implication is that three-phase lines provide a more consistent source of electricity and are better able to handle higher electricity loads. They typically are used to serve commercial and industrial buildings and can power large industrial electric motors. Single-phase lines are suitable for serving residential lighting and heating loads. Three-phase lines can also accommodate larger inputs of energy from distributed electricity generation facilities (such as solar arrays) than single-phase lines.
Abbreviations & Acronyms	
AC	AC is the abbreviation for *alternating current*, the type of electricity flowing into the grid from a solar array, after it has gone through an inverter.
CEE	UMass Clean Energy Extension
DC	DC is the abbreviation for *direct current*, the type of electricity produced by solar panels. The DC capacity of a solar array is a good indication of its size, and footprint on the landscape.
DOER	Massachusetts Department of Energy Resources
kV	kilo-volt, a standard unit of voltage
kW	kilowatt, a standard unit of solar PV capacity
kWh	kilowatt-hour, a standard unit of electricity production or consumption
MDAR	Massachusetts Department of Agricultural Resources
MVP	Municipal Vulnerability Preparedness plan, a municipal planning document
MW	megawatt, a standard unit of solar PV capacity, equal to 1000 kw
MWh	megawatt-hour, a standard unit of electricity production or consumption, equivalent to 1000 kwh
NREL	National Renewable Energy Laboratory
OSRP	Open Space and Recreation Plan, a municipal planning document
SEIN	Solar Energy Innovation Network, a program of the National Renewable Energy Laboratory, funded by the U.S. Department of Energy's Solar Energy Technologies Office
sf	square feet

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Intended Audience and Purpose of Guide

This guide is intended for town officials and constituents to provide a high-level understanding of how solar development can be owned and financed. The guide particularly highlights solar project cash flows of costs and benefits, how they accrue over time between local and non-local project participants, and how financial risk is appropriated. This guide introduces the associated *Solar Financing and Ownership Options* fact sheet (ag.umass.edu/solarplanning3) that further summarizes the basic structures and pros and cons of ownership models to the local community. It also introduces the spreadsheet *Solar Financing and Ownership Options: Cash Flow Model* (ag.umass.edu/solarplanning3) that takes user input on project specifications and local conditions and calculates the accrual of solar project cash flows to local and non-local financial participants and compares them across ownership structures.

How to Use this Guide

This guide can be read as a standalone document to familiarize oneself with solar financing and ownership structures. It also provides a reference guide to support the Related Documents (below) by providing users further insights into current solar financial practices and explanation of financial terms and ownership options.

The guide is meant to offer a high-level understanding of the financing and ownership options and is not a substitute for professional financial services that a town or community participants will need to engage for project-specific analysis and investment decisions.

Related Documents

Solar Financing and Ownership Options fact sheet (ag.umass.edu/solarplanning3): This one-page fact sheet provides a summary and overview of solar financing and ownership options that are presented in this guide. The Fact Sheet is a useful primer for local community groups and decision makers to assess the overall characteristics of these options.

Solar Financing and Ownership Options: Cash Flow Model (ag.umass.edu/solarplanning3): This user-friendly Excel spreadsheet tool enables local communities to evaluate and compare the magnitudes and distributions of cash flows associated with solar PV 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.

General Introduction to Solar Financing and Ownership

Developing solar projects with capacities greater than residential scale – generally projects over 25 kW to several MW in capacity – requires substantial planning, investment capital, and administrative oversight. Many solar development companies are available to help communities navigate these steps toward installing these systems – but potentially at a significant cost.

Business as Usual Solar Development

For commercial-scale projects, substantial investment capital is needed, and often solar developers sell the projects at the end of the development process to nationally based tax equity financial firms that manage a large portfolio of solar investments. These equity firms access the important value of the federal tax incentives, take on risks and responsibilities for project operation and maintenance, and contractually agree to provide payments to towns and landowners, and may provide discounted electricity to local and regional ratepayers through net metering arrangements.

This "business as usual" ownership and financial arrangement dominates the market in Massachusetts and throughout much of the United States. The arrangement is driven by the ease of access to federal tax incentives and the availability of tax equity capital. This flow of capital and efficiency of these investment markets have been important to the rapid growth of the solar industry. Tax equity financiers are drawn to the solar market by the rate of return on their investment which is substantially weighted towards the first six years of the project as the federal tax benefits are being extracted.

While this "third-party" tax equity ownership is dominant and alleviates the capital formation and risk burden to the local community, it extracts the bulk of the long-term solar financial benefits from the local community, leaving helpful but substantially less value to the community from the contracted annual payments and electricity discounts, which the developer and third-party owner are motivated to minimize in their negotiations.

A Local Ownership Approach

Maintaining ownership of solar assets within the local community, be it by the town itself or a group of residential and business constituents, is an available option with growing interest yet limited market experience. Local ownership typically requires substantially more attention to legal structures, governance, and risk management, and may be constrained by capital availability and competitively disadvantaged if owners cannot access tax incentives. To the extent that local ownership of solar projects is increasingly pursued and achieved, federal tax laws become more accessible, and more innovative business models are demonstrated, these constraints can likely diminish. Regardless, pursuing local ownership requires good tax and legal counsel, and this guide is not offered as a substitute for this professional expertise.

Cost and Revenue Streams

Solar projects require upfront investment from owners through equity (i.e., investment with expected return) and debt (i.e., loans with interest payments). In subsequent years, the project will generate revenues (from the sale of electricity and attributes in the form of renewable energy credits) which are disbursed within and external to the local economy as net metering credits, as loan, land lease, and tax payments, and as returns on investment to the owner. Investment capital needs can be reduced by government grants and investment tax credits available soon after construction. The magnitude and flow of these costs and revenue streams are important considerations for community solar planning and for evaluating economic impacts, and to be better prepared to negotiate contract agreement terms with a solar company.

Solar financing, especially for local ownership structures, is complicated and requires upfront legal and other professional support well beyond the scope of this guide and associated tools. This guide provides an overview and the basics to support initial investigations and pro forma financial analysis. The fact sheet (ag.umass.edu/solarplanning3) provides a one-page summary of attributes of the basic ownership and financing structures. The financial tool (ag.umass.edu/solarplanning3) tracks the magnitudes and timing of these cash flows to recipients under different ownership structures with user-input on the solar project specifications, financing terms, and local market conditions. Table 1 below identifies and describes primary cash flows associated with solar project investment, revenues, and costs, and how these flows are distributed across recipients within and outside the local economy.

Table 1. Description of cash flows within and outside the local economy.

<table>
<tr><th colspan="3">Project Cash Flow</th><th rowspan="2">Recipient</th></tr>
<tr><th>Type</th><th>Name</th><th>Description</th></tr>
<tr><td rowspan="3">Investment</td><td>Equity</td><td>Equity investment from outside the local economy (third-party owners) typically comes from national-based financing companies using pooled equity from corporate and individual investors. Local equity can come from the local government or from local constituents individually or as a partnership through a cooperative or limited liability agreement, and potentially through a community choice aggregation[1] program.</td><td rowspan="2">Equity and debt are used directly to purchase the solar array including costs of equipment, construction, interconnection, and project development fees. Payments for solar “hardware” go to global solar suppliers, and interconnection costs are remitted to the local utility company. Construction and labor payments may go to contractors and crews that “travel” with solar development companies or from local or regional resources. Local ownership and proactive solar planning provide more opportunities to support local solar development companies and job opportunities.

These cash flows to secondary recipients associated with project construction are not explicitly tracked in the Financial Tool.</td></tr>
<tr><td>Debt / Bond</td><td>Debt investment comes from banks, credit unions, and municipal bonds. Externally financed projects typically use debt from national banks. Local debt might target local banks and credit unions or make use of low interest municipal bonds.</td></tr>
<tr><td>Ownership Flip</td><td>The re-sale of third-party owned solar assets is not unusual in the national solar financing markets and can occur without engagement of the local community.

To overcome the barriers of capital formation and access to federal tax benefits, local ownership can be achieved, albeit delayed, through an Ownership Flip arrangement. In this case, the community engages a specialized, mission-aligned third-party investor to establish co-ownership, where the first 6-10 years the third-party owns around 99% of the asset and local partner owns 1%, and then these proportions “flip” at some negotiated buy-out price. The local partner in this arrangement must</td><td>Under an Ownership Flip, both the original investment and the buy-out require the formation of capital through equity and debt as described above. Buy-out costs offer substantially lower capital formation needs for local communities.</td></tr>
</table>

[1] A Community Choice Aggregation (aka Municipal Aggregation) is a process in Massachusetts where municipalities can aggregate the electrical load of customers within their borders to procure competitive supply of electricity. A CCA may be administered by the municipality or a non-municipal entity established by the municipality for this purpose. Some other states have similar provisions and may extend beyond municipal boundaries.

Project Cash Flow			Recipient
Type	**Name**	**Description**	
		be a taxable entity, though a year after the flip the project could be re-sold to a tax-exempt entity. This arrangement enables the first primary owner to extract tax benefits and a sufficient rate of return during the early life of the project – and flip long term ownership benefits to the local community at a highly discounted buy-out price.	
Revenues	Federal Investment Tax Credit (ITC) and Depreciation	The federal government provides an Investment Tax Credit (ITC) and an accelerated five-year depreciation schedule to reduce tax payments and provide cash inflow to the project. Only entities that pay sufficient taxes can claim these credits and depreciation allowances. The ITC provides a credit equal to 26% of the solar project cost through 2022; the ITC declines to 22% in 2023, and 10% in 2024. The extension, magnitude, and accessibility of the ITC is often revised by federal policy.	The tax reductions afforded by the federal ITC and depreciation allowances accrue to the original solar project owner if that owner has sufficient tax liabilities. National solar financing is tied to tax-equity investors well positioned to take full advantage of the benefits. Local individual or business owners with sufficient tax appetites can also access all or some of these credits, though local government, non-profits, and many low-income constituents cannot.
Revenues	Energy and Attributes	In Massachusetts, under the current solar program SMART, a solar project owner is paid a tariff ($/kWh) for all energy generated. This tariff is set by the state program and depends on the project size, siting, design, net metering or PPA offtaker, and timing within the program. The tariff is a fixed rate for 20 years and compensates the investor for both the energy and attributes (Renewable Energy Credits, or RECs) generated[2]. After the tariff term, the system owner continues to receive the market-based values for the electricity sold/displaced and for the Class I RECs sold.	These revenues accrue to the system owner, be it within or outside the local economy. The owner uses these revenues to pay on-going project and financial costs (described below), and to achieve a rate of return.

[2] For more information on SMART and tariff rates, see https://www.mass.gov/solar-massachusetts-renewable-target-smart and https://masmartsolar.com.

Project Cash Flow			Recipient
Type	**Name**	**Description**	
Costs	Debt Service	Assuming debt was a part of the investment capital for the original owner or the buy-out owner, the debt will be repaid to bank or credit union lenders or municipal bond holders. These payments will cover the debt principal and interest payments and are paid back over the term of the loan or bond.	Debt principal payments replace borrowed cash assets and are not newly generated economic value generated by the solar project. Hence these payments are not explicitly tracked in the Financial Tool. Debt interest payments are new cash value accrued by lenders (the cost of borrowing) and are tracked in the Financial Tool. These payments can remain local if debt is arranged with local banks, credit unions, or municipal bonds with local buyers.
	Operation and Maintenance	Solar project financing needs to consider annual and periodic costs for project operation and maintenance. Annual costs can include equipment inspections, ground maintenance, standard repairs, and even escrow payments for project decommissioning. Third-party and local owners can contract for these services from regionally based or nationally dispatched firms that provide such services to the solar market. The primary periodic cost associated with solar operations is for an inverter replacement around every 10 years. Inverters are needed to convert and regulate the direct current (DC) coming from the solar panels to alternating current (AC) for the electric distribution grid or host (behind-the-meter) power consumption.	Third-party owners typically have contract arrangements with an established stable of electric and landscaping companies serving a regional market. Local ownership or community solar planning may direct such contracts to qualified local contractors to enhance local solar economic benefits. The periodic inverter replacement is primarily equipment costs that go to suppliers outside the local economy.
	PILOT and Land Lease	Payments in Lieu of Taxes (PILOTs) are agreements between third-party or local solar owners and the municipality which typically involve an annual payment over the project lifetime to the town based on the capacity of solar installed or the annual electricity generation. Though no standards exist, a PILOT needs to be ratified by the town and approved by the MA Department of Revenue.	Regardless of ownership structure, PILOT payments are received by the local government and land lease payments accrue to local private landowners or the local government for municipally owned land.

Project Cash Flow			Recipient
Type	Name	Description	
		In addition to a PILOT, a land lease agreement involves an annual payment over the project lifetime to the landowner for the use of the land typically based on acreage.	
	Power Purchase Agreement (PPA) and Net Metering Credits	Massachusetts SMART and net metering policies direct most solar projects to sell the energy generated to a host behind-the-meter customer through a power purchase agreement (PPA), or to regional ratepayer as "virtual" net metering credits under a "Schedule Z" agreement. In both cases, participating ratepayers benefit from savings on their utility electricity bills through effective discounts provided in the PPA or net metering agreements.	A PPA is only applicable for an on-site load so the electricity cost discount accrues to the local electric user. Recipients (or "offtakers") of virtual net metering electricity discounts under Massachusetts policies can include any ratepayer within the electric utility distribution territory where the project is sited. Local community solar ownership and planning can target opportunities to direct net metering discounts to community members to enhance local benefits from the solar project.

Risks – Types, Distribution, and Mitigation

Solar project development, management, and financing is not without risk. With mature local and global solar industries, technical risk of solar equipment failure or underperformance is now well alleviated. But risks remain and are important to understand and manage. The identification and discussion of key risks are provided below.

Project Development Risk

Solar developers typically expend business resources to identify and secure project site locations, design and engineer the project, acquire all state and local permits, complete interconnection studies, market and acquire net metering offtaker subscribers, secure supply chains of equipment and labor, and plan for construction. A project which fails to move all the way to construction and operation, will leave developers unable to recover the expended development costs. Solar developers typically recapture these risk-adjusted costs when they sell the construction-ready projects to investors.

Project development risk is borne by the project developer and may not be a direct concern of local community constituents. However, community solar planning can offer pre-permitting of identified preferred solar development sites and mitigate legal risks associated with securing and defending zoning decisions and local permits. This risk mitigation may reduce the project costs to the original owner, which might be negotiated for better terms for local payments or for the buy-out price under a flip ownership structure.

Opportunity Cost Risk

Although not explicitly considered as part of a solar project financial model, it is important to recognize that solar development extends a risk to the local community in the form of the lost opportunity to use the utilized land for other valued purposes over the project lifetime. Such lost value can include aesthetic value, recreation, environmental and ecological services, or alternative economic enterprises. While portions of these risks are compensated through land lease and PILOT payments, not all values are economically accounted, and these risks are borne by the local community.

Proactive solar planning can mitigate these risks by identifying solar development sites which have lower opportunity costs and are aligned with local preferences. Enhancing local cash inflows through negotiated terms with third-party owners or through local ownership can further compensate the local economy for the lost land use opportunities.

Project Performance Risk

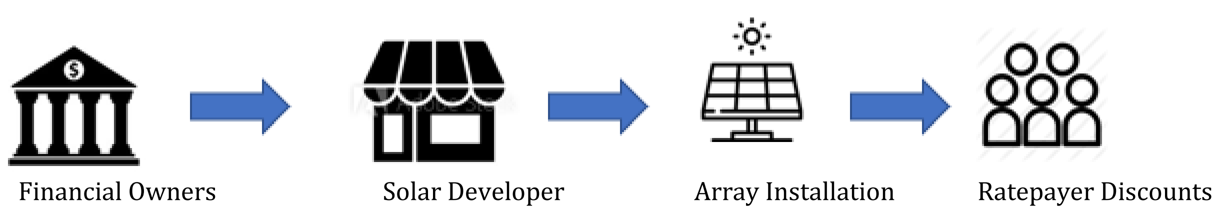
The revenue generated by the solar project by selling electricity and attributes is tied to the system performance. Risk to system performance includes equipment failure or premature degradation, meteorological variations in the annual solar resource, and site vandalism or natural damage.

Performance risk is mitigated through standard performance warranties provided by solar equipment suppliers or manufacturers (panels, inverters, storage subsystems) which typically assure repair or replacement of components that fail or prematurely degrade. Performance risk is also mitigated through operation and maintenance contracts that monitor system performance, inspect equipment, and assure the site is properly maintained and secured. Both third-party and local owners have access to these warranties and contracted services. Additional risk mitigation for project damage or performance may be secured through insurance products, often bundled across a portfolio of solar projects. Community owners and singular projects may have a more difficult time accessing these insurance markets.

Standard Models for Solar Ownership

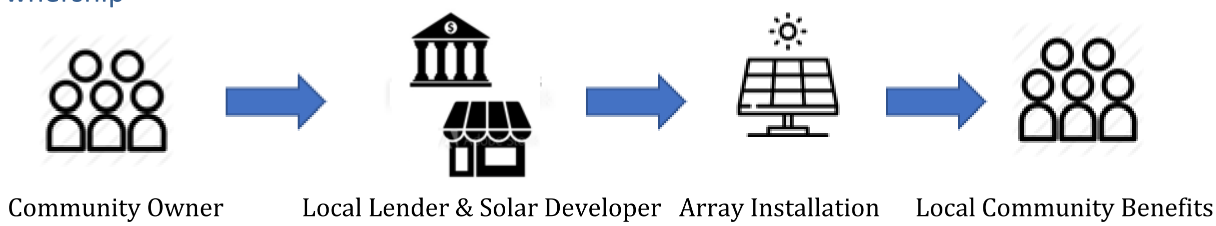
Financial returns from net income cash flows accrue to the solar project owner to pay back the investment and provide a rate of return commensurate with risk and enabled by policy incentives. Generally, sufficient rates of return may be accomplished by investors able to fully extract the federal tax allowances by the first 6 to 10 years of a solar project. Given a typical 25 year or longer lifetime of a solar system, this leaves many additional years of attractive financial value.

Third-Party Ownership



Most of the non-residential solar development in Massachusetts, and other states with restructured electricity markets, is owned by third-party, nationally based solar investors or investment funds. These funds pool capital from tax-equity investors who have established arrangements with national solar developers, and who bundle investments that can be resold to secondary financial markets after tax advantages are extracted. Under the third-party ownership structure, project rates of return accrue to national investors throughout the project life, which accumulates solar wealth to investors that tend towards the higher national wealth distribution brackets.

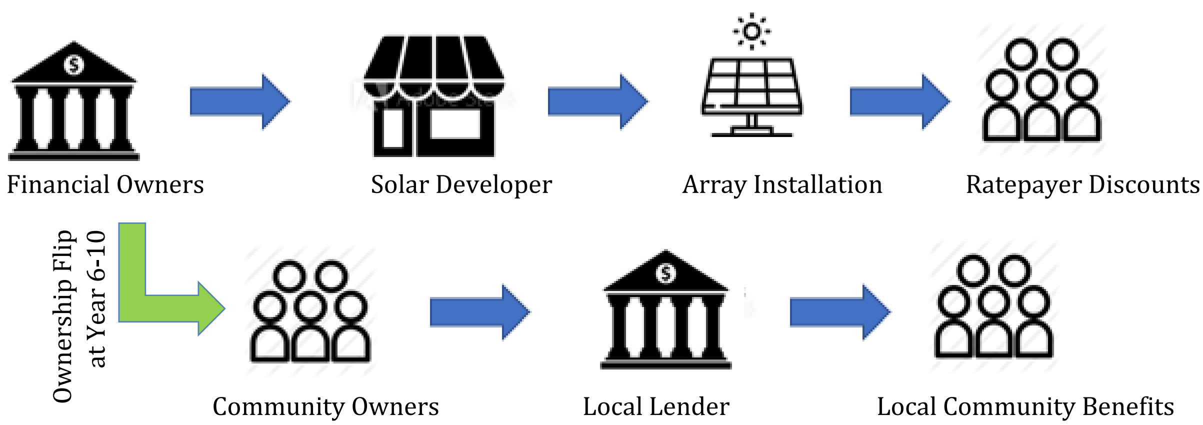
Local Ownership



Local ownership of non-residential solar projects represents a much smaller market and includes solar projects on commercial and municipal buildings or land that are owned by the site or business owner, and a few examples of community shared solar projects owned by an organized community investment group. Local ownership faces barriers in forming sufficient investment capital in accordance with financial securities regulations, creating a legal business structure, and accessing full federal tax benefits. Business model innovation, targeted government programs, extended programs of community choice aggregations, and pilot models and replication will all help engage and scale the local ownership market.

Local investors enable project returns to be maintained in the local economy. For some local investors – notably municipalities, non-profits, and community co-operatives – lower rate of return and longer investment time horizon may enable better project economics and other local project cash flows to be enhanced.

Third-Party to Local "Flip" Ownership



Local ownership barriers can be reduced, but local benefits delayed, by a community-based taxable entity partnering with an original third-party owner that agrees to an ownership flip option after tax advantages are extracted and returns are satisfied, typically after 6-10 years. To enable tax benefits, federal IRS rules prescribe that the original contract terms specify a buy-out price that reflects the asset's fair market value, though the final price at the transfer can be negotiated.

The flip ownership structure is gaining interest in some markets including western Massachusetts with community based solar developers and cooperatives engaged with mission-aligned tax equity investors and funds. The flip model avoids some of the barriers to local ownership at the beginning of the project, reduces the local capital formation needs to the significantly lower buy-out price, and delays but maintains the accrual of long-term ownership returns to local constituents.

Tools and Strategies for Maximizing Local Benefits from Solar Development

Local benefits from solar development can be increased through improved negotiations of financial and contract terms with solar developers and third-party owners, and by proactively engaging in solar planning and preparing for local government or community investment or for solar financing options that include a flip ownership structure.

The fact sheet (ag.umass.edu/solarplanning3) is designed to introduce community officials and constituents to solar ownership options and to the availability of local benefits and risks under the ownership structures. The financial tool (ag.umass.edu/solarplanning3) can be used to assess the magnitude and timeline of the local costs and benefits for specific project and financing inputs. The model results can serve to improve the negotiating stance of the community with third-party developers and owners, and to inform decisions to pursue local ownership.

To capture local benefits, communities should strategically and proactively prepare for solar financing and ownership options so that local or nationally based solar developers have ready partners to engage in community-driven, local ownership options. Communities may consider instituting "rights of first refusals" for local or flip ownership structures as part of a request for proposal or permit with solar developers and local landowners hosting solar projects.

Communities can proactively prepare the legal agreements to establish cooperative or limited liability companies with conditionally committed investment funds from local constituents, prepare local government budgets and bond authorizations to establish solar investment capital, and establish relations with mission-aligned or other tax equity investors offering flip ownership structures. Communities that provide community choice aggregation can prepare the design and implement financial structures to invest ratepayer savings or equity into community owned solar projects that provide electric supply for the aggregation.

Local communities can share information and successful innovations, and articulate legal and financial barriers that policy measures might resolve to enhance local ownership opportunities.