

Draft Community Solar Action Plan

for

the Town of Colrain



Photo Credit: *Greenfield Recorder*

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Completed using the *Community Planning for Solar* Toolkit available at
<https://ag.umass.edu/solarplanning>

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NOTE: The Plan has been reviewed, edited and updated by the Colrain Ad Hoc Solar Committee and the Colrain Energy Committee to coincide more closely with the actual resources in Colrain - March, 2024.

Terms, Abbreviations, and Acronyms used in the Plan

The following terms, abbreviations, and acronyms are used in this report.

Terms

Photovoltaic, or “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.

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 kilo-volts (kV). One kilo-volt is equivalent to 1000 volts (V). In residential use in the United States, electrical wires within a household carry electricity at 120 V.

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. Commercial-scale solar arrays are typically 1 MW or greater in size. An average 1 MW array would cover approximately 4-5 acres of land.

Annual generation of a solar array is a measure of the yearly energy 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% * 8760 hours per year.

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.

AC is the abbreviation for alternating current, the type of electricity flowing into the grid from a solar array, after it has gone through a transformer.

Ratio of DC:AC capacity: In the absence of energy storage, the typical ratio between the solar capacity of a facility as expressed in DC compared to AC is roughly 1.25 MW DC: 1 MW AC. This reflects the loss of energy associated with converting from one form of energy to another through an inverter. However, with energy storage, the ratio of the DC capacity to the AC capacity of a solar facility as “seen” by the grid is closer to 2 MW DC: 1 MW AC. This is because up to half of the energy generated by a solar array during the day can be stored (as DC power) by batteries or other energy storage, and then released into the grid during the night, when the panels are not generating electricity. From a grid interconnection perspective, the AC capacity is therefore lower, because at maximum output, the amount of electricity flowing into the grid is less than the total being generated by the system.

SMART is the abbreviation for the current state solar energy incentive program (the Solar Massachusetts Renewable Target program). This program replaced earlier solar incentive programs, commonly known as “SREC” programs, in November of 2018, and was further updated through an emergency regulation in April 2020. The SMART regulation includes incentives for projects up to 5 MW AC in size. Additional incentives are available for projects located on buildings, parking lot canopies, landfills, brownfields, and “dual-use” solar and agriculture projects, as well as certain types of projects that benefit public entities, like municipalities. The updated regulation places restrictions on what types of large, ground-mounted projects can receive incentives, if they

are sited on undeveloped land designated as BioMap2 Critical Natural Landscapes or Core Habitat, by the state MassWildlife Natural Heritage and Endangered Species Program.

Abbreviations & Acronyms

CEE - UMass Clean Energy Extension

DOER - Massachusetts Department of Energy Resources

FRCOG - Franklin County Regional Council of Governments, the regional planning authority for Franklin County, MA

kV - kilo-volt

kW - kilowatt

kWh - kilowatt-hour

MDAR - Massachusetts Department of Agricultural Resources

MVP - Municipal Vulnerability Preparedness plan, a municipal planning document

MW - megawatt

MWh - megawatt-hour

OSRP - Open Space and Recreation Plan, a municipal planning document

PV - photovoltaic, the type of solar panels that generate electricity from sunlight

PVPC - Pioneer Valley Planning Commission, the regional planning authority for Hampden and Hampshire Counties, MA

sf - square feet

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1. INTRODUCTION

1.1 Purpose

The intent of this *Community Solar Action Plan* is to help guide future solar development, municipal bylaw amendments, and solar permitting decisions within the Town of Colrain. This plan also includes recommendations regarding specific activities to develop solar on municipal properties, campaigns to promote solar on residential or commercial properties, approaches to involve town residents in discussions and decision-making, and next steps to encourage solar development on locations preferred by the community. Additional actions to reach a goal of community energy self-sufficiency from solar generation are also discussed.

1.2 Planning Process

This draft *Community Solar Action Plan* was composed for the Town of Colrain by UMass student Paige Kelley and UMass Clean Energy Extension staff, as part of a two-semester, service-learning class at the University of Massachusetts Amherst, in which UMass undergraduates partnered with local communities to conduct a proactive, community-oriented solar planning process.

The draft *Community Solar Action Plan* developed through this project is the result of a thorough planning process, which included 1) an assessment of community solar resources and infrastructure, 2) development of town-specific alternative solar development alternatives, 3) distribution of a community solar survey and analysis of survey results, and finally, based on these activities, 4) development of this draft *Community Solar Action Plan*. This process followed the steps outlined in the *Community Planning for Solar* Toolkit which is available on the UMass Clean Energy Extension website (<http://ag.umass.edu/solarplanning>).

Before the *Community Solar Action Plan* is finalized, it will undergo review by municipal representatives involved in the project through the Solar Planning Committee, as well as members of other relevant municipal boards (e.g. Select Board, Planning Board, Conservation Commission). It will be presented to community residents at a community forum, with the opportunity for residents to provide feedback. These review processes are expected to result in revisions which will improve the clarity, content, and implementation of the plan. The planning process was initiated in September 2022, the community survey was conducted in March-May 2023, and the community forum is expected to occur in late summer or fall 2023.

Because Colrain is one of the first towns to complete this planning process via collaboration with UMass students and staff, **we welcome and encourage comments not only on the town-specific content contained within this draft *Community Solar Action Plan*, but also on the scope, organization, and readability of information contained within this plan.** This more general feedback will help us to develop final deliverables and examples that provide greater clarity and utility for municipal representatives and community residents in towns across the state.

1.3 Community Goals & Plan Structure

100 residents responded to the solar survey. The largest group of respondents, 38%, were between 65 and 74 years of age. Of respondents, 40% already have solar panels installed at their homes, and 60% do not.

According to the *Infrastructure Report*, there are 83 residential-scale (<25kW) solar arrays in the town of Colrain, and 740 total households. Thus, around 11% of households have solar arrays. This shows that people with solar already installed were much more likely to answer the survey, likely because they are more interested in solar. Furthermore, in general, residents with strong positive or negative attitudes about solar may have been more likely to respond to the survey, as they are more likely to want their opinions to be heard.

Colrain respondents in general are strongly motivated to combat climate change and supportive of solar development. In the *Community Solar Survey*, 98% of respondents reported they are “extremely” or “moderately” concerned about climate change, and 90% indicated they have a “positive” or “very positive” attitude towards solar development.

Colrain survey respondents are most supportive of solar development on already developed spaces like roofs and parking lots - 81% indicated support for a municipal goal of developing on all municipal available roofs, parking lots, and previously disturbed lands for solar to meet electricity needs. Many respondents were also supportive (80%) or neutral (16%) regarding a goal of solar development sufficient to meet community needs. There was less support for solar development to meet anticipated regional (58%) or state (52%) needs, although a majority of respondents supported these goals. Only 56% of respondents feel positively towards large, ground-mounted solar in the town. Colrain respondents are concerned about conservation of undeveloped natural and agricultural lands within town and showed little support for developing these landscapes for solar – a majority of respondents indicated they would prefer to see little or no natural or agricultural lands developed for solar.

With these results in mind, this Plan focuses on strategies and actions designed to aid in development of currently developed spaces and disturbed lands for solar, as well as exploring additional solar development necessary to meet a goal of community self-sufficiency or aid in meeting regional solar energy goals. Based on our analysis, community self-sufficiency might ultimately require approximately 13 MW of solar development in Colrain, 15x the current amount of solar installed. This estimate is based on future projections of energy use by 2050, including a transition from fossil fuel-powered vehicles to electric cars, and from traditional heating sources to renewable sources. Our estimates suggest this might require development of 10-45 acres of undeveloped land. To help support electricity needs for the 4-county Western Mass region (Franklin, Hampshire, Hampden, and Berkshire counties), Colrain would need to develop roughly 1.25% of its land area, or about 345 acres. This would equate to 70 MW of solar, 85X Colrain’s current solar capacity. *[Note that these are estimates based on rough projections of future electricity needs and electricity sources. Future technological advances, land use decisions, and changes in population, community infrastructure, or energy use can be expected to lead to modifications to these estimates. It is anticipated that this plan and the calculations included herein will be revisited and updated regularly.]*

Meeting a goal of community self-sufficiency or supporting regional electricity needs will require active efforts to deploy solar on developed spaces, disturbed lands, and other sites acceptable to the community. This plan is designed to help guide these efforts.

Discussions of solar development options are divided into five categories – residential, municipal, local business/institution, on-farm, and large, ground-mounted solar on private land. Within each category, we discuss the current status of existing solar capacity, needs, and community perspectives, the future potential for solar development and needs, potential next steps, and specific action items.

Following the sections addressing solar development options is a section addressing the existing solar bylaw and how the bylaw and permitting processes could be updated to better reflect community attitudes expressed in the solar survey.

Finally, the plan concludes with a summary of action items and the anticipated timeline for when this plan will be revisited and revised.

1.4 Planning Process Documents

The final *Community Solar Action Plan* will be made available on the UMass Clean Energy Extension website.

The *Community Solar Action Plan* will also be made available on the town website. Additional documents developed as part of the planning process (e.g. the *Solar Resource & Infrastructure Assessment*, the *Community Solar Survey Results Summary*) will also be made available on the town website.

2. MUNICIPAL SOLAR

This section addresses solar on municipal building rooftops, municipal parking lots, and municipal properties, including public schools located within the community and the regional high school located elsewhere in the district.

2.1 Current Status

Existing Infrastructure & Electricity Use

Colrain has nine municipal buildings which are currently listed in the town's Mass Energy Insight (MEI) account. The largest electricity users, from highest to lowest, are Colrain Central School, the Fire Station, the Highway Garage, the Town Office, the Town Library, the Transfer Station, the Salt Barn, and the Fiber Hut. Additionally, street lighting uses small amounts of electricity.

The town of Colrain uses, on average, 233,700 kWh of electricity per year to supply municipal buildings. A solar capacity of 180 kW would be required to supply this amount of electricity annually.

Colrain is a part of the Mohawk Trail Regional School District and shares responsibility for energy use at the high school; however this energy data is not included in Colrain's MEI account.

The town of Colrain currently has no municipally owned solar arrays. The School Committee for Mohawk Regional High School recently voted to approve installation of solar panels on the school's roof. These will be owned by a third party but provide discounted electricity to the school.

Current Regulatory Status under Town Bylaw

There are no requirements specific to solar development on municipal properties within Colrain's zoning bylaw. Subsequent sections of this Action Plan describe Colrain's zoning bylaw requirements for roof-mounted and ground-mounted solar systems.

Community Perspectives

Colrain respondents showed strong support for solar development on municipal buildings and properties. In the *Community Solar Survey*, 81% of respondents indicated they felt the town should invest in solar development on municipal buildings and parking lots to meet municipal needs. In addition, 35% believe that the ideal type of ownership of solar in the town should be town-ownership, with the biggest attributes considered being benefits to the town budget.

Only 44% of respondents supported development adjacent to the town center. However, 31% felt neutral towards development in this location. With regards to the potential for solar at the former town landfill, 78% of respondents were supportive of seeing all landfill sites in town developed for solar.

2.2 Future Potential

Future Electricity Use

Based on current fossil fuel use (heating oil, propane) to heat town buildings, we estimate roughly 405 MWh of electricity would be needed to heat municipal buildings with air-source heat pumps. In addition, if all municipal vehicles were to be converted to electric, an additional 165 MWh are estimated to be needed as an alternative to gas and diesel. Under this scenario, municipal electricity use would increase by roughly 2.5x to 590 MWh, necessitating 454 kW of total solar capacity to meet municipal needs.

These totals do not include electricity use by Mohawk Regional High School. Also not included is potential future electricity use by school buses, which are currently run on fossil fuels and owned and operated by a private company. Both the state (<https://www.masscec.com/program/notice-intent-accelerating-clean-transportation-school-bus-actbus>) and federal government (<https://www.epa.gov/cleanschoolbus>) have recently begun providing competitive funding and/or technical support for the deployment of electric school buses. The Mohawk Regional school district applied for funding of electric school buses through the EPA's recent Clean School Bus program lottery, but was not selected in the lottery. However, future funding and technical support options are anticipated.

Potential Energy Storage Locations

The following locations may be of interest for municipal energy storage:

Colrain Central School. The Colrain Central School is located at 22 Jacksonville Road. This building is identified as Colrain's Emergency Shelter. It currently has a backup generator, but could benefit from the sustained power provided by a solar + storage system.

Fiber Hut. The fiber hut (telecommunications hut) is located at 17 Main Road. This location was brought up by the Solar Planning Committee as a possible location for an energy storage site. The fiber hut provides roughly 70% of the town with internet access. In addition, it is located near the town center, in proximity to the Fire Station, Police Department, Library, and Post Office.

Municipal Rooftops & Parking Lots

The largest municipal roofs are on Colrain Central School and the Highway Department. The Fire Station and Library also have relatively large rooftops. However, the only roof that could conceivably have panels installed on it is the roof at the School. Note that if panels were put on the elementary school, that would supply roughly half of the 454 kW of total solar capacity to meet municipal needs. This should be a priority for us.

Structure	Street Address	Total Roof Area (sq ft)	Estimated Rooftop Technical Solar Potential (kW)
Colrain Central School	22 Jacksonville Rd	31,665	130

Table 1 Municipally owned properties with large rooftops available for solar.

Other town buildings include the Salt Barn and Fiber Hut. These sites have smaller rooftops which may not be economically viable for solar production, but which could still be considered in an on-site evaluation of municipal buildings.

Two municipal locations also have paved areas which could be appropriate for solar. These locations are the Town Hall, and Colrain Central School. Parking lots have an average packing density of approximately 263 kW per acre; the estimates provided below are based on this figure.

Location	Street Address	Approximate Area (acres)	Estimated Solar Technical Potential (kW)
Town Hall	55 Main Road	1.10	289
Colrain Central School	22 Jacksonville Rd	0.55	144

Table 2 Municipal properties with large, paved areas available for solar.

Our estimate of total technical potential on these roofs (319 kW) and parking lots (983 kW) is roughly 1,302 kW (1.3 MW). However, this is the *technical* potential. This estimate does not take into account roof condition, driveways, logistics, economic considerations, or other considerations, and hence is likely a *significant overestimate* of actual potential. All of these locations would require on-site evaluations to understand use patterns, available space, and actual solar potential.

Solar arrays over 50 kW in size often must connect to three-phase electricity distribution lines in order to interconnect to the electricity grid safely. Conveniently, the School rooftop in **Table 1** could accommodate an array over 50 kW in size and is located near three-phase lines. The parking lots in **Table 2** which could accommodate a solar array are also located near three-phase lines.

Ground-Mounted Solar

Municipal sites identified as of interest for ground-mounted solar development include the capped landfill at the Transfer Station and an area adjacent to Colrain Central School.

Capped Landfill. This landfill site was assessed by the Colrain Energy Committee in 2019. The capped landfill is located at the Transfer Station and totals 3.17 acres, which would allow for roughly 600 kW of solar potential. The landfill was assessed to have excellent solar exposure. In addition, the three-phase power line is around 400 feet away, allowing for a large-scale project to be feasible. However, the site’s barriers include that the ground penetrations are complex and that a MassDEP permit would be required. There has been no follow-up since this report.

Colrain Central School. In addition, the Colrain Energy Committee conducted its own assessment of the potential for ground-mounted solar at the Colrain Central School. Ground-mounted solar options on this property included two locations: the outdoor area adjacent to the cafeteria and a second location near the kindergarten play area. Both of these locations have good solar exposure and are located near three-phase power lines. However, some concerns brought up in these areas included safety concerns, building on top of septic tanks, and unwanted shaded areas. There has been no follow-up since this report.

Financial Considerations

Development of solar on municipal buildings and land can be simpler in some ways than development on private land because town boards have the greatest control over determining whether these projects proceed. However, towns do not always have funding available to pay for large solar projects.

Financial costs and benefits of municipal solar are dependent on many factors, including system size, system cost, electricity rates, solar incentives, federal and state tax credits, loan amount, and loan terms (interest rate, term). All of these items are site-dependent, and subject to change over time. Historically, municipal governments were unable to receive federal or state tax credits for solar development, which could make these projects more challenging from a financial perspective. However, with the recent passage of the federal Inflation Reduction Act, organizations and individuals that do not owe taxes now are eligible for a “direct payment” option, which can cover 30% of the costs of a new solar installation. This change will make small to medium-size municipally owned solar projects more financially viable. Depending on the size, location, and type of system, new solar arrays may also be eligible for solar incentives through the state SMART program on a fixed \$/kWh basis; this program has a specific additional incentive for “public” projects owned, operated, or benefitting the municipality. Alternatively, the town can earn Renewable Energy Credits for each MWh of solar energy that is generated. Some financial institutions offer loans which can be applied to solar projects or may offer specific solar loans designed to cover the costs of new solar arrays. UMass CEE can assist the town with calculations of the costs and savings associated with specific municipal solar projects.

2.3 Next Steps & Action Items

Potential next steps for municipal solar development include:

- Conduct on-site evaluations of solar potential on the rooftop of the Colrain Central School and over paved areas at the School and the Town Office. Evaluations should include rough quotes for installation cost and identify potential obstacles to development (e.g., roof warranties, roof structure, interconnection). The evaluation at Colrain Central School should include energy storage options to support an emergency shelter in the building.
- Evaluate priorities for back-up power in the town center and whether a solar plus energy storage system could be sited near the Fiber Hut or other critical emergency infrastructure (e.g., Fire Station, School).
- Conduct an on-site evaluation of the potential for ground-mounted solar at the Transfer Station and Colrain Central School.
- Explore potential options to support solar development aside from direct use of town funds (e.g., ARPA funds, MVP grants, solar loans).
- Carry out financial analyses to understand costs and benefits of specific solar options (UMass CEE can assist).

□ Explore potential for electric buses and associated charging needs for Colrain Central School and Mohawk Trail Regional High School.

□ Complete a table to plan for future development, e.g.:

Building	Address	Solar Potential	Rough Cost (\$)	Roof Warranty Information	Roof Structural Needs/ Cost	Energy Storage Needs?	Funding Sources ?	Anticipated Year for Development
Elem. Sch.	22 Jacksonville Rd.	130 kW	\$350,000	OK	???	YES	MVP	2024
Transfer Stn.	7 Charlemont Road	600 kW	?	N/A	N/A	Unsure	?	2025

Action Items

Action	Lead Entity (or Entities)	Supporting Entities	Start Year/ Annually?
Conduct on-site solar evaluations	Colrain Energy Committee	Solar Installer	
Explore solar funding options for municipal projects	Colrain Energy Committee	Finance Committee, FRCOG	
Carry out financial analyses	UMass Clean Energy Extension	Energy Committee, Finance Committee	
Create a timeline for future municipal solar development	Colrain Energy Committee	Finance Committee, Select Board	
Explore opportunities for electric bus use & charging needs at Mohawk Regional High School	Energy Committees of 9 participating towns; School Committee	Superintendent's Office staff; MassCEC, bus companies	

3. RESIDENTIAL SOLAR

This section addresses solar on residential properties, including solar on house rooftops or in residential yards.

3.1 Current Status

Existing Infrastructure & Regulatory Status

Currently, Colrain has 83 residential solar systems, with an average size of 7.5 kW, and representing a total of 622 kW of solar capacity. Roughly 11% of households have a residential solar system.

In Colrain, residential systems fall under the category of roof-mounted or small-scale ground-mounted systems. Roof-mounted and small-scale ground-mounted systems less than or equal to 0.1 acres in area do not require Site Plan Review or a Special Permit. However, they require a building permit and must comply with all other applicable local, state, and federal requirements and laws.

Community Perspectives

In the *Community Solar Survey*, Colrain respondents indicated strong support for solar development on residential roofs and in residential yards – 77% felt “positive” or “very positive” about solar installed on residential rooftops, and 77% felt “positive” or “very positive” about solar installed in a residential yard to serve that household’s electricity needs. For both questions, only 6-9% of respondents felt negative towards these locations.

The two biggest reasons respondents cited for not already having a system installed were upfront cost (23%) and not knowing enough about their options (12%). In addition, other reasons include electricity bill prices, not trusting solar developers, safety hazards, and having a slate roof.

Of respondents who did not currently have a solar array installed at their home, a large percentage were open to the possibility. A total of 55% of respondents said they were interested in having solar panels installed at their home, 35% were not sure, and only 10% were not interested.

3.2 Future Potential

Future residential solar capacity will be dependent on a number of factors, including the amount of small rooftop area suitable for solar, the number and area of unshaded yard spaces suitable for solar, and the affordability of installing systems of a size appropriate to meet current or future residential electricity needs. Also, it is important to remember that the future potential depends on residents' willingness and want to install solar at their homes.

Solar Potential on Residential Rooftops & Yards

Potential residential solar capacity in Colrain can be estimated through several different methods. If solar were installed on all small building roofs in town, the total technical potential would be 8.8 MW. However, installing solar on many roofs may not be technically or economically feasible, due to shading, roof structures, and economies of scale (i.e.,

installing scattered, small systems on very small roofs may not make financial sense). Based on estimates of shading on residential properties, it may be more reasonable to assume about 75%¹ of residential properties in Colrain have roofs or unshaded yard space available for solar (see *Solar Infrastructure and Resource Assessment* for more details). Currently, the average size of a residential solar PV system in Colrain is 7.5 kW. If 75% of homes were to install a solar PV system of this size, it could provide about 4.4 MW of solar capacity. This would be equivalent to about 33% of the electricity generation capacity anticipated to be needed in the future to support 100% of the community's electricity needs with solar power.

Residential solar PV systems are typically sized to generate enough electricity to cover current household electricity needs. A 5.5 kW residential solar PV system can generate what works out to an average of 600 kWh of electricity per month (the average household monthly electricity use in Massachusetts), with higher solar generation occurring in summer months and lower generation during the winter. Average monthly electricity use in Colrain is 789 kWh, which is higher than the state average. The average size of a household solar PV system in Colrain is 7.5 kW (average of 813 kWh per month), which suggests current solar systems in town are located on houses with slightly higher than average electricity use or are designed to meet slightly more than current electricity needs.

As personal vehicles and home heating systems are converted to electricity-based systems, we predict average household electricity use in Colrain could roughly double, necessitating a system of roughly 14.4 kW to offset future household electricity demand. Ultimately, if 75% of households were to install a 14.4 kW system to meet future electricity needs, residential systems could contribute 8 MW of solar. This is equivalent to 62% of the estimated 13 MW of solar capacity needed to offset anticipated future electricity demand Colrain.

Financial Considerations

Financial costs and benefits of a residential solar are dependent on a number of factors, including the system size, system cost, electricity rates, solar incentives, federal and state tax credits, loan amount, and loan terms (interest rate, term). All of these items are site-dependent, and subject to change over time. Despite high interest rates and minimal solar incentives, our estimates suggest that residential solar systems are nevertheless currently a financially feasible option for Colrain residents, because the cost of a monthly electricity bill is at this time higher than the cost of a solar loan payment, so a resident with a new solar system installed could pay less per month for electricity than one without, and after the loan is repaid, the solar system will continue to generate free electricity.

For example, UMass Five College Credit Union currently offers solar loans at a rate of 7.24% for 10 years or 7.49% for 15 years. Currently, there is a federal tax credit rebate of 30% of the cost of an installed solar system, in addition to a \$1,000 tax credit available for Massachusetts state taxes. Solar incentives through the state SMART program have dropped to \$0 for residential systems (<25 kW) in Colrain. However, as an alternative to the SMART program, residents can earn Renewable Energy Credits for each MWh of solar energy that is generated; RECs currently can be sold for about \$34 per REC, although that number is expected to decrease over time, and our estimates use an average value of \$22

per REC. With federal tax credits, state tax credits, and solar incentive payments, the monthly payment on a 15-year loan on the remaining balance for an 7.5 kW system priced at \$3.59/kW (the Franklin County average according to [MassCEC](#)) is below the monthly cost of electricity generated by a system of that size that would appear on an Eversource electricity bill. For a 10-year loan, there is significant cost to the customer over the first 10 years (\$200-\$500 per year), but the net value is positive due to avoided electricity costs (\$35,000 net savings over 25 years, not adjusted for the opportunity cost of not investing the money elsewhere). The resident would likely need to replace the inverter for the system after about 10-12 years, but would still make money over the course of the PV system lifespan.

The financial balance could be more challenging for low-income residents. However, there are some potentially feasible options available. The nonprofit Capital Good Fund last year began offering “DoubleGreen” solar loans at a fixed rate of 3.1%-4.2% for 25-year terms for low-income ratepayers in Rhode Island, which if offered in Massachusetts could make solar PV systems economical for low-income residents here. Through the passage of the federal Inflation Reduction Act, low-income residents who do not owe taxes are nevertheless eligible to earn a tax credit equal to 30% of the installed cost of a new residential solar system and to sell that tax credit for cash to another taxpayer with tax liability. In addition, low-income residents are currently eligible for an approximately \$0.009 per kWh state solar incentive, or the REC payment of \$34/MWh described above. Affording a solar loan might still be challenging for some low income customers, who are eligible for reduced electricity rates as Residential Low-Income Customers, and who therefore might have difficulty obtaining a monthly loan payment that is lower than their reduced electricity bill. UMass CEE can assist in estimating the specific financial costs and benefits for Colrain residents.

3.3 Next Steps & Action Items

Potential Next Steps

Since there is strong interest in and support for residential solar among the respondents, there is potential for a large increase in solar capacity on residential roofs and in residential yards. The major barriers to overcome appear to be 1) high upfront cost, 2) respondents not knowing enough about their options, and 3) concerns related to roofs (slate roofs and/or concern of a fire hazard).

Public Information Sessions

In order to overcome general hesitancy, address concerns, and increase resident knowledge, Colrain residents could benefit from annual or semi-annual public information sessions about residential solar, highlighting state and federal incentives and solar loan options, addressing safety concerns, and elucidating the range of options available. Some recommendations regarding these sessions include:

Speakers and content. Given some respondents’ lack of trust in solar companies, it would be helpful to have some information presented by a neutral party rather than a company with a vested interest in solar development. It would be helpful to include participation by town residents who have had solar installed, and who could speak to

the benefits and any challenges associated with installing a residential solar array. This session could include specific financial information (see below), as well as opportunities for neighbors to coordinate on solar installations.

Financial analysis of residential systems. CEE is happy to work with Colrain to provide a simple calculator to help residents at a public forum estimate the costs and benefits of a solar system that meets their needs and specifications.

Specific solar loan programs available through financial institutions. CEE plans to compile a list of institutions involved in solar financing around the state, and specific solar loan programs, which could be addressed at the public forum. The state's [Mass Solar Loan](#) program is no longer active. If revived, it would be helpful to include information about this program as well.

Handouts and Factsheets

In addition to information sessions, factsheets/handouts with content similar to that provided at Public Information Sessions could be distributed at annual Town Meeting, the Fall Festival, or other local events.

Assisting Residents with Shaded Properties

Forested residential properties, as are common in Colrain, may not be appropriate for solar. Residents may in some cases choose to cut some trees to provide an opening for solar, but this is not always possible or preferred. Creative approaches are necessary to provide residents of shaded properties the benefits of solar. Solutions to give residents living on shaded properties access to solar include:

Neighbors helping neighbors. Residents with properties that could host solar have the opportunity to install a larger system that meets more than their current needs. There are not clear financial models available at present to have neighbors jointly own a small array and share in tax credit benefits. However, there are straightforward pathways for net metering agreements between community residents to share in the benefits of solar generation. In this situation, a resident with a large roof might install and own a system larger than that necessary to meet their own needs, then net-meter electricity credits over to a different community member's account through a form known as a Schedule Z. It is possible (and common) to establish a legal contract which could guarantee the price per net metering credit - providing the project host/owner a known income each year - and such an agreement could include a commitment to pay a portion of upfront installation costs.

Community solar array. If about one-quarter of residential properties in Colrain cannot host solar, there is likely to be interest for community solar by people who own shaded properties. It is worth considering whether there are properties where a community-owned project on public or private land could be owned by a group of local residents. The town could work to identify locations where a small community solar array could be sited in different parts of town.

Residential Solar Campaign

The town Energy Committee or a committed group of residents could conduct a [Solarize Mass](#)-style campaign to encourage multiple households to install residential solar PV

systems at the same time. The Solarize Mass program is no longer active, but the campaign tools developed as part of the program are still available. The benefits of such a campaign include neighbor support in the purchasing of a solar array and the opportunity to work through challenges together, as well as the feeling of participation in a collective, community effort. In addition, residential solar campaigns can lead to lower installation costs, due to economies of scale associated with the solar installer working on multiple projects in one location.

Specific Next Steps

Based on the above, specific potential next steps for residential solar development include:

- Organize and hold a public information session about solar on a regular basis to discuss options for residential solar development.
- Design and distribute flyers/handouts to explain residential solar development options, highlighting their financial feasibility, and including a description of how to arrange a net metering agreement with a neighbor to share solar electricity generation.
- Research sites in each neighborhood around town which could be potential sites for community-shared solar facilities, possibly incorporating battery storage, so as to allow for an emergency shelter site in each neighborhood during an outage.
- Conduct a residential solar campaign with a goal of recruiting 100 households.

Action Items

Action	Lead Entity (or Entities)	Supporting Entities	Start Year
Organize and hold a public information session about solar	Energy Committee	CEE, Solar Installers, Financial Institutions	2024
Design and distribute a residential solar handout	Energy Committee		2024
Research sites around town which could support community-shared solar facilities	Energy Committee	Selectboard Planning Board Conservation Comm. Agricultural Comm.	2025
Conduct a residential solar campaign	Energy Committee	Ashfield Energy Committee(?)	2025

4. SOLAR FOR BUSINESSES AND INSTITUTIONS

This section addresses solar on commercial and institutional buildings and parking lots.

4.1 Current Status

Existing Infrastructure

Currently in Colrain we know of only one installation. However, there are some large buildings and large paved areas which might be suitable for solar (see *Future Potential*).

Current Regulatory Status under Town Bylaw

Section 3 describes Colrain's zoning bylaw requirements for roof-mounted and small ground-mounted solar systems. There are no specific restrictions regarding solar development on commercial/institutional rooftops or parking lots in Colrain. Some parking lots described below would qualify as Large-Scale Ground-Mounted Solar-Photovoltaic Systems. Large-scale systems that occupy a footprint greater than 0.1 acres but no more than 1 acre are allowed by right with Site Plan Review in all zoning districts. Large-Scale Ground-Mounted Solar-Photovoltaic that occupy a footprint greater than 1 acre are not allowed in Village Districts. They require a Special Permit in other zoning districts (Rural and Commercial-Industrial). Town requirements for Site Plan Review and a Special Permit are addressed briefly in Section 6.1 and detailed in Colrain's zoning bylaw.

Community Perspectives

In the solar survey, 47% of respondents expressed that knowing a business or institution uses solar energy makes them feel more positively towards the organization, with 23% of respondents expressing that it makes them more likely to purchase their goods/services. In addition, respondents expressed strong support for development on developed spaces generally: 82% were supportive of a scenario in which all developed spaces were developed, and roughly 2/3 supported 100% of large roofs and parking lots being developed.

4.2 Future Potential

We identified a number of businesses and institutions which could be approached regarding their interest in installing solar arrays on commercial rooftops or as solar canopies over existing parking lots.

Commercial & Institutional Rooftops

Rooftops can provide roughly 1.5 kW of solar per 100 sf of suitable roof space. On medium roofs (5,000-25,000 sf), about 49% of the roof area is suitable for solar; on larger roofs (25,000+ sf) about 66% of the roof area is suitable for solar.

There are a total of six medium and large roofs on buildings owned by businesses or institutions in Colrain. These roofs total 101,130 sf in area and 737 kW of technical solar potential. Locations with the greatest potential for roof-mounted solar on businesses or institutions are summarized in Table 3 below. All of these roofs would require on-site evaluations to review the underlying roof structure, identify any shading concerns from

adjacent vegetation, identify roof-mounted equipment that could interfere with the placement of solar panels, and determine actual solar potential.

Organization	Street Address	Total Roof Area (sf)	Estimated Technical Solar Potential (kW)
Manufacturing building - Barnhardt Manufacturing Co	247 Main Rd	35,573	259
		25,713	187
Industrial warehouse (No longer in use)	237 Main Rd	14,709	107
Bear Truss & Panel/ Component Building Systems Inc/ Slowinski Wood Products	6 Foundry Village Rd	13,959	102
Colrain Community Church	306 Main Rd	5,841	43
Morrell Metalsmiths	207 Greenfield Rd	5,336	39

Table 3 The six largest privately owned roofs, with large areas potentially suitable for solar.

The four largest commercial/institutional rooftops in Colrain could potentially host a solar array over 50 kW in size. Solar arrays over 50 kW in size often must connect to three-phase electricity distribution lines to interconnect to the electricity grid safely. Barnhardt Manufacturing, the Industrial Warehouse, and Bear Truss rooftops are all located near three-phase lines. Solar arrays under 50 kW in size can typically safely connect to single-phase or three-phase electricity distribution lines.

Commercial & Institutional Solar Parking Canopies

Potential sites for solar parking canopies on businesses or institutions are summarized in Table 4. Parking lots can have a packing density of approximately 263 kW per acre, but because the paved areas noted here in some cases include driveways, estimates of technical potential based purely on acreage are likely to be overestimated. These locations would require on-site evaluations to understand use patterns, available space, and actual solar potential.

Organization Name	Street Address	Area of Parking Lot/ Pavement (acres)	Estimated Technical Solar Potential (kW)
Colrain Community Church	306 Main Road	1.28	337
Barnhardt Manufacturing Co.*	247 Main Road	0.91	239

Table 4 Privately owned properties with large areas of parking lot suitable for solar.

*** Barnhardt is closed. Building status is unclear.**

Solar arrays over 50 kW in size often must connect to three-phase electricity distribution lines in order to interconnect to the electricity grid safely. The parking lots in **Table 4** are both located adjacent to three-phase lines.

Financial Considerations

Financial costs and benefits of commercial and institutional solar are dependent on many factors, including system size, system cost, electricity rates, solar incentives, federal and state tax credits, loan amount, and loan terms (interest rate, term). All of these items are site-dependent, and subject to change over time. Currently, there is a federal tax credit of 30% of the cost of an installed solar system, in addition to a \$1,000 tax credit available for Massachusetts state taxes. Through the passage of the federal Inflation Reduction Act, non-profit organizations who do not owe taxes are now eligible for a direct payment equal to 30% of the installed cost of a new solar system. Depending on the size, location, and type of system, new solar arrays may also be eligible for solar incentives through the state SMART program on a fixed \$/kWh basis; alternatively, businesses and institutions can earn Renewable Energy Credits for each MWh of solar energy that is generated.

Some financial institutions offer business loans which can be applied to solar projects or may offer specific solar loans designed to cover the costs of new solar arrays. For example, UMass Five College Credit Union currently offers solar loans for up to a 10-year term. More information about financing and other aspects of solar for businesses and institutions can be found at: <https://www.masscec.com/resources/commercial-solar-information-hub>.

4.3 Next Steps & Action Items

Potential next steps for solar development on business and institution properties include:

- Reach out to Morrell Metalsmiths, Colrain Community Church, the owners of the inactive warehouse, and the Bear Truss & Panel/ Component Building Systems Inc/ Slowinski Wood Products complex regarding their interest in roof and parking canopy solar systems.
- Investigate what the Barnhardt Manufacturing property is going to become and discuss its solar potential with the new owner.
- Conduct outreach to other businesses and institutions to determine their interest in roof-mounted or parking canopy solar systems. Inform these organizations that many survey respondents reported that solar panels make them feel more positively towards the business and/or are more likely to buy their goods or services.
- Assist interested businesses with estimation of costs and rebates.

Action Items

Action	Lead Entity (or Entities)	Supporting Entities	Start Year/ Annually?
Contact local businesses	Energy Comm.		2025
Assist with cost estimates	Energy Comm.	UMASS CEC	2025

5. ON-FARM SOLAR

This section addresses solar on farms, including solar arrays on farm buildings and greenhouses, solar canopies designed to shelter parked farm vehicles, and ground-mounted solar development on land owned by farm businesses or actively farmed.

5.1 Current Status

Existing Infrastructure

Colrain has a number of active farms and significant acreage in agricultural production. Based on Mass GIS Land Cover data, the town has roughly 466 acres in cultivation and 1,263 acres in pasture or hay production. Two-thirds of the agricultural properties in Colrain are protected in perpetuity through an Agricultural Preservation Restriction. In addition, 25,020 acres of land participate in the Chapter 61A program for the purposes of agricultural production (not including productive woodlots).

There is significant rooftop area on barns and farm buildings which could be suitable for solar (see *Future Potential*).

To the best of our knowledge, there are currently no farm or agricultural building properties where PV systems are already installed.

Current Regulatory Status under Town Bylaw

Colrain’s solar bylaw does not include specifications particular to the installation of solar on agricultural land. Instead, these facilities are regulated as ground-mounted systems.

- As noted above, roof-mounted and smaller-scale ground-mounted solar projects less than 0.1 acres must comply with applicable state, local, or regulatory requirements and are allowed by right with a building permit.
- All large-scale ground mounted solar projects greater than 0.1 acres must comply with additional requirements for large-scale systems and undergo a Site Plan Review. Large-Scale Ground-Mounted Solar-Photovoltaic Systems that occupy a footprint greater than 0.1 acres but no more than 1 acre are allowed by right with Site Plan Review in all zoning districts.

- Large-Scale Ground-Mounted Solar-Photovoltaic that occupy a footprint greater than 1 acre are not allowed in Village Districts. They require a Special Permit in other zoning districts (Rural and Commercial-Industrial).

Solar greenhouses are not specifically mentioned in the town’s bylaw but would likely fall under the same restrictions as roof-mounted systems.

Community Perspectives

Colrain respondents were generally not supportive of ground-mounted solar development on farmland or forest. Survey respondents expressed strong opposition to conventional solar development on land currently in vegetable/fruit production (79% oppose) or hayfields/pasture (66% oppose). There was somewhat less opposition to development of fallow farmland not currently in production (44% support/19% neutral/37% oppose).

In addition, respondents responded more favorably to certain types of solar facilities installed on farms. These included:

- Solar panels raised above agricultural land to allow for farming beneath (sometimes known as “agrivoltaics”) (63% support/21% neutral).
- Installations located on the edges of active agricultural land converted to solar (69% support/12% neutral)

5.2 Future Potential

Farms, orchards, and other agricultural businesses identified in Colrain are listed below. Outreach could be conducted to all of these businesses to determine their interest in pursuing roof-mounted projects, solar greenhouses, parking canopies over paved areas or farm equipment storage locations.

- **Bear Meadow Farm** - 248 Greenfield Road
- **Checkerspot Farm** - 30 Jacksonville Road
- **Colrain Dairy Farm** - 201 Thompson Road
- **East View Farm** - 63 Van Nuys Road
- **Fort Morrison Farm** - 198 Jacksonville Road
- **Parson Farm** - 88 Jacksonville Road
- **Pine Hill Orchards** - 248 Greenfield Road
- **Twisted Yields LLC** - 108 W Leyden Road
- **West County Cider** - 203 Peckville Road
- **Winterberry Farm** - 340 Wilson Hill Road

- **Woodlawn Farm** - 152 Wilson Hill Road

Rooftops, Greenhouses, and Parking Canopies

Rooftops can provide roughly 1.5 kW of solar per 100 sf of suitable roof space. On medium roofs (5,000-25,000 sf), about 49% of the roof area is suitable for solar.

There are a total of nine medium roofs owned by farms, orchards, or other agricultural businesses in Colrain. These roofs total 81,300 sf in area and 592 kW of technical solar potential.

Locations with the greatest potential for roof-mounted solar on agricultural buildings are summarized in Table 5. All these roofs would require on-site evaluations to review the underlying roof structure, identify any shading concerns from adjacent vegetation, identify roof-mounted equipment that could interfere with the placement of solar panels, and determine actual solar potential.

Business	Street Address	Total Roof Area (sf)	Estimated Technical Solar Potential (kW)
Hager Brothers - Fruits & Vegetables Growers & Shippers & Syrups Manufacturers	11-14 Merrifield Ln	13,682	100
		11,347	83
		11,142	81
Storage building & business facility on farmland	10 Adamsville Rd	Two roofs: 12,769; 7,358	Two roofs: 93; 54
Pine Hill Orchard	248 Greenfield Rd	12,930	94
DAR Ridge Farm	14 Roberts Lane	6,522	47
(Attached barns) - Handy Lane Farm	90 Jurek Rd	5,557	40

Table 5 The nine largest on-farm roofs, with large areas potentially suitable for solar.

Each of the six largest agricultural rooftops in Colrain could potentially host a solar array over 50 kW in size. Solar arrays over 50 kW in size often must connect to three-phase electricity distribution lines in order to interconnect to the electricity grid safely. All of the rooftops which could accommodate an array over 50 kW in size are located near three-phase lines, except for those at Hager Brothers. Hager Brothers is located several miles from three-phase lines. The size of systems on Hager Brothers' property may be limited to less than 50 kW by local grid infrastructure, or local infrastructure may need to be upgraded to accommodate larger projects. Alternatively, integration of an energy storage system with the solar array may allow a larger solar array to be interconnected to the grid.

Solar arrays under 50 kW in size can typically safely connect to single-phase or three-phase electricity distribution lines.

Ground-Mounted Solar: Agrivoltaic & Conventional Ground-Mounted Systems

Colrain respondents were generally not supportive of ground-mounted solar development on farmland, but did respond more favorably to agrivoltaic facilities and installations on the edges of agricultural fields. Survey respondents had mixed perspectives regarding solar development on currently fallow farmland.

Agrivoltaic Projects

All farms, but particularly those which graze livestock (including dairy cows) or carry out hay production, might be interested in pursuing an agrivoltaic project.

“Agrivoltaic” refers to agricultural production and electricity production from solar PV panels occurring together on the same piece of land. These facilities may also be referred to as agrisolar, “dual-use,” or co-location of solar and agriculture. Rows of solar panels in these systems are generally placed further apart and raised higher above the ground to allow agricultural activities to continue to be conducted beneath them, ensure crops receive appropriate sunlight, and make it possible for farm vehicles to easily access all areas in agricultural production.

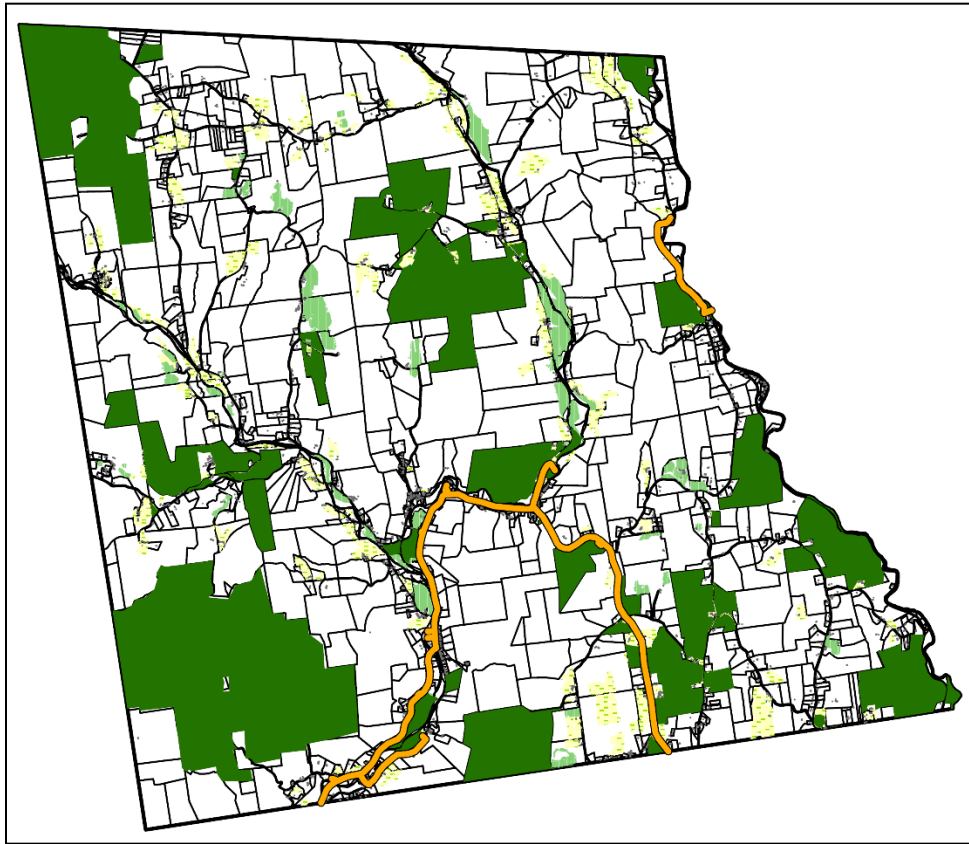
Agrivoltaic systems are still relatively new, and their economic potential in the temperate Northeast is still being explored. There is currently a lack of robust research and information on (1) the agricultural productivity of these systems, (2) the economic impacts of dual-use systems on farms and farmers, and (3) the effect of these systems on the broader agricultural economy. In general, agronomists are relatively comfortable with the idea that pasture and hay fields can be anticipated to produce reasonable yield of hay or forage, but less is known about the appropriateness of these systems for fruit and vegetable production. UMass Extension is currently working with project partners to better study and understand the agricultural yield and economic aspects of these systems (see <https://ag.umass.edu/clean-energy/research-initiatives/dual-use-solar-agriculture/researching-agricultural-economic-impacts-of-dual-use-solar>).

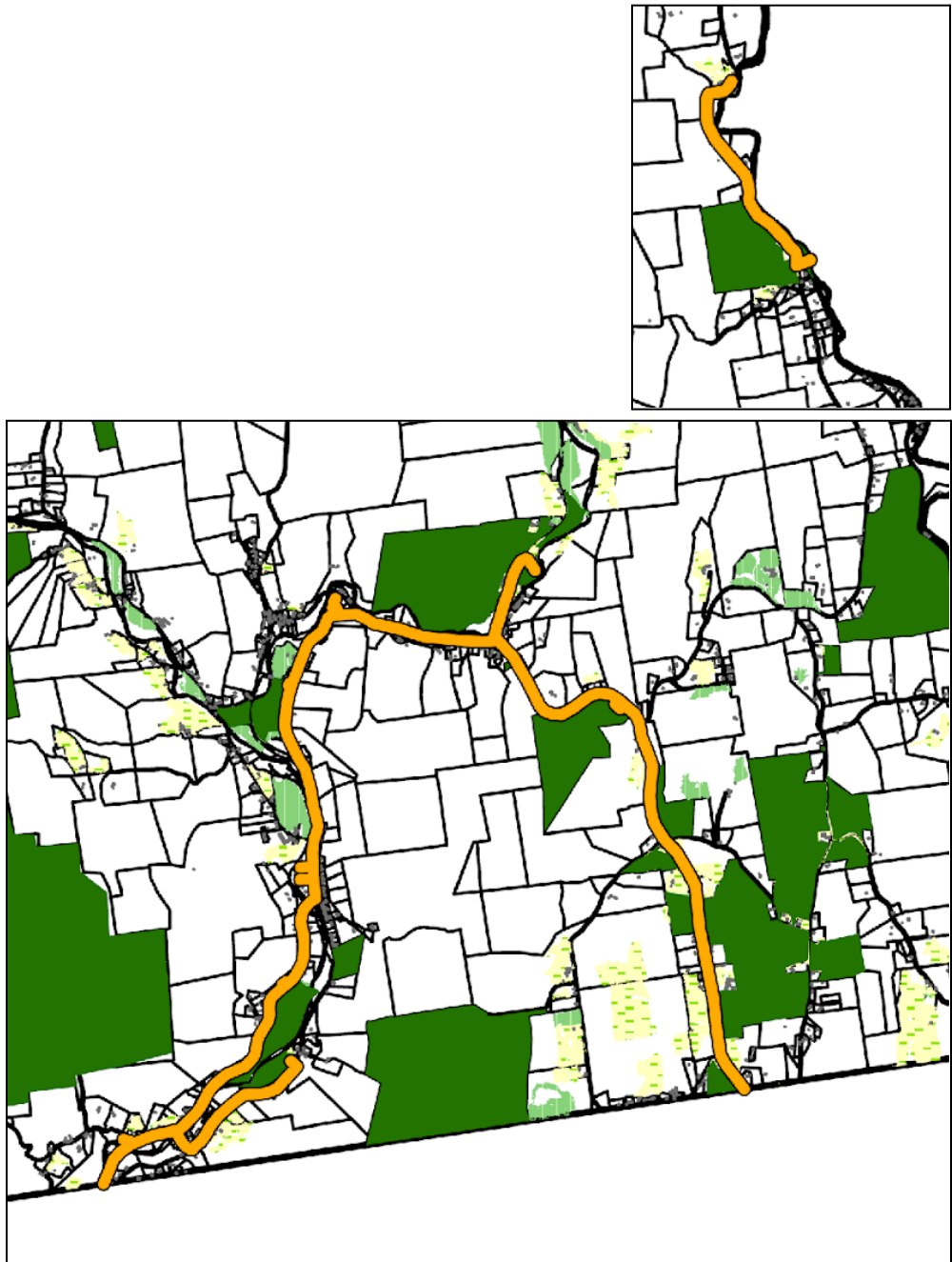
Conventional Projects

respondents expressed strong opposition to traditional solar development on land currently in agricultural production. However, respondents were open to smaller projects installed in the margins of farm fields, and had mixed feelings towards solar arrays installed on fallow farmland.

Locations for Ground-Mounted Systems

Smaller agrivoltaic or conventional solar projects could be interconnected to the grid anywhere in town where distribution lines are present. Currently, larger projects (>50 kW) are likely only feasible in areas serviced by three-phase distribution lines, or areas within roughly ½ mile of those lines. The streets currently serviced by three-phase distribution lines are Route 112, Greenfield Road, and parts of Calls Road. **Figure 1** (next page) shows areas of cultivated land, pasture and hay production, and conserved land relative to three-phase lines.





As apparent from Figure 1, there are some agricultural areas directly adjacent to three-phase lines, particularly in the south-central portion of Colrain. However, many areas along these lines are protected or are in other land uses.

Financial Considerations

Financial costs and benefits of rooftop, greenhouse, or parking canopy solar projects on farms are dependent on many factors, including system size, system cost, electricity rates, solar incentives, federal and state tax credits, loan amount, and loan terms (interest rate,

term). All of these items are site-dependent, and subject to change over time. Agricultural projects are eligible for the same federal and state tax credits as other types of systems. These types of projects are also likely to be eligible for SMART solar incentives (on a fixed #/kWh basis) or Renewable Energy Credits (for each MWh of solar energy generated, RECs are sold at auction). Grants to develop solar PV projects that support on-farm energy needs may be available through the state's Agricultural Energy Grant Program.

Agrivoltaic projects may be eligible for an Agricultural adder through the SMART program. In order to qualify for incentives, these projects must be 25 kW in size or larger. To be economical, these projects are often much larger – the average size of standalone dual-use agricultural projects currently in the state program is roughly 3.2 MW DC (~15 acres), although one Agricultural project of 25 kW (~1 acre) has been constructed.

Conventional, ground-mounted solar projects may also be eligible for SMART solar incentives or RECs. Current SMART program regulations place some restrictions on solar development on agricultural land – some large, conventional developments on recently active agricultural land may not be eligible for incentives.

5.3 Next Steps & Action Items

Potential next steps for solar development on farms include:

- Hold a meeting with farmers and farmland owners to understand their interest/desires/needs regarding solar and determine if their preferences align with the residents' preferences.
- Conduct outreach to Hagers Brothers, Pine Hill Orchard, DAR Ridge Farm, Handy Lane Farm, and the owner of the Adamsville Road property to assess their interest in roof-mounted solar on large building roofs or solar parking canopies.
- Consider outreach to other farm owners/operators to assess their interest in small-scale roof or ground-mounted solar. With interested farms, also explore options for small to medium ground-mounted solar arrays deployed between fields or along field margins.
- Near three-phase lines (see map) on existing pasture land or hayfield, explore landowner and farm operator interest in establishing an agrivoltaic operation.
- Assist interested farms with evaluating and applying to grant opportunities for agricultural energy projects, as well as evaluating costs and benefits of other financing structures.
- Work with Franklin Land Trust to identify at-risk farmland parcels of high agricultural or cultural value near three-phase lines and consider options to preserve them.

Action Items

Action	Lead Entity (or Entities)	Supporting Entities	Start Year/Annually?
Conduct outreach	Energy Comm.	Agricultural Comm.	2025
Assist interested farms	Energy Comm.	Agricultural Comm.	2025

6. LARGE, GROUND-MOUNTED SOLAR ON PRIVATE LAND

This section addresses large, ground-mounted solar development on private land, including solar projects sited on previously disturbed sites (e.g. gravel pits, quarries, right-of-ways, private landfills, brownfields) and those sited on undeveloped land (e.g. forest, meadow, shrubland) not addressed in the On-Farm Solar section.

6.1 Current Status

Existing Infrastructure

Current Land Use

According to Mass Audubon's *Losing Ground* report, Colrain ranks 68th in the state in terms of the total amount of protected land, with 6,037 acres (22%) of the town under permanent protection. Only 2% of the land area of Colrain is currently developed for housing, businesses, or other purposes.

Despite having a high percentage of conserved land, the town also has a significant acreage of privately owned forest and other natural habitat that is not conserved, which means the potential for large, ground-mounted solar development on undeveloped land remains.

Colrain also has some previously disturbed lands (see *Future Potential*).

Grid Infrastructure

Colrain has two three-phase power lines; 29R2 primarily runs along Route 112 and Greenfield Road; 22B7 serves small portions of South County and Green River Roads.

There are currently no large-scale solar projects proposed or constructed in the town of Colrain. However, large, distributed generation facilities located in neighboring communities currently limit the ability of Colrain's distribution lines to allow the interconnection of new, large-scale solar development, until grid upgrades are implemented. Circuit 29R2 could allow for small to medium-scale solar array development (up to 200 kW) without significant upgrades to the grid and costs. Circuit 22B7 could allow for an up to 1 MW capacity solar array development without significant upgrades to the grid and associated costs.

Current Regulatory Status under Town Bylaw

As noted above, large-scale ground mounted solar projects greater than 0.1 acres must comply with additional requirements for large-scale systems and undergo a Site Plan Review. Large-Scale Ground-Mounted Solar-Photovoltaic Systems that occupy a footprint greater than 0.1 acres but no more than 1 acre are allowed by right with Site Plan Review in all zoning districts. Large-Scale Ground-Mounted Solar-Photovoltaic that occupy a footprint greater than 1 acre are not allowed in Village Districts. They require a Special Permit in other zoning districts (Rural and Commercial-Industrial).

Site plan requirements include identifying many basic aspects of the project, including locations of Priority Habitat Areas, National Historic Districts, hazardous materials, and plans for operation and maintenance, including storm-water and vegetation controls. In relation to land cover and vegetation, restrictions are discussed in the *Environmental and Safety Standards* section. Strict vegetation screening requirements are imposed. In addition, floodplains and inundation areas must be identified in the site plan, and the Board may reject development on these types of areas. Floodplains can be identified on the Colrain Zoning Map. They run along the main roads in town.

Community Perspectives

In the *Community Solar Survey*, 56% of respondents felt positively towards large, ground-mounted solar energy in general. However, when asked about large, ground-mounted solar energy in the town, 51% of respondents felt positively towards the development. This shows that respondents may feel positive towards large, ground-mounted solar, but feel slightly less positively when it is present in their town. In addition, 60% of respondents believe that development of large, ground-mounted solar should be allowed and promoted where appropriate.

In addition to the preferences regarding solar development on agricultural land discussed above, respondents indicated a strong preference for large, ground-mounted solar development on former landfills/brownfields (86% positive, 9% neutral) and powerline right-of-ways (ROWs) (84% positive, 10% neutral). respondents voiced less support for development on former gravel or sand extraction sites (43% positive, 37% neutral). respondents had mixed views on solar development in meadows or shrublands (23% positive, 34% neutral, 43% opposed), woodlands regularly harvested for timber (27% positive, 24% neutral, 48% opposed), and new growth forest (21% positive, 33% neutral, 46% opposed). For all other types of forested and open natural habitats, 69%-78% of respondents expressed opposition to development. In another portion of the survey, respondents also indicated moderate support for development along major roads (53% support, 32% neutral), which in Colrain would presumably focus along Route 112.

6.2 Future Potential

Constraints on Large, Ground-Mounted Solar Development

Development of large, ground-mounted solar on large private properties in Colrain is likely to be constrained by a number of factors. For all sites, these factors include 1) opportunities for interconnection to the electricity grid, 2) the locations of property owners

willing to lease or sell their land for solar development, 3) potential project scale, and 4) eligibility for state solar incentives. For undeveloped lands, 5) existing conservation restrictions and 6) wetlands protections are also important factors. While factor 2 cannot be determined without direct consultations with specific landowners, factors 1, 3, 4, 5, and 6 can be assessed in some detail.

Interconnection Opportunities. Large solar facilities require three-phase power lines in order to interconnect to the grid, so in the near-term, large facilities are most likely to be proposed in areas of town served by or adjacent to three-phase power. Areas currently served by three-phase power are described in the *Grid Infrastructure* section above.

Existing Conservation Restrictions. As noted above, roughly 22% of Colrain's land area is under permanent protection and ineligible for solar development. Additionally, at least 33% of land is in temporary protection due to participation in the Chapter 61, 61A, or 61B programs. Participation in these programs does not exclude the possibility of solar development, but could make development economically unfavorable if back-taxes are required to remove the land from the program, or may allow the town right-of-first-refusal on any property lease or sale.

Wetlands Restrictions. The presence of wetlands on a property may also limit the extent of development, since solar development is prohibited on wetlands and buffers around a protected wetland are often required. Solar development is regulated within 100 ft of most wetlands and water bodies, and within 200 ft of most perennial streams and rivers.

Eligibility for State Solar Incentives. In addition to the need for interconnection to three-phase lines, in order for solar development to be economically feasible, large-scale projects may need or desire to qualify for state solar incentives. At present, with limited exceptions, the current state solar program (SMART) does not provide incentives for solar facilities sited on land mapped as BioMap2 habitat or for parcels on which more than 50% of the habitat is mapped as BioMap2.

Project Scale. An important aspect of economic viability for solar projects is project scale. Because interconnection costs are high and often fixed, as well as due to economies of scale, the larger the solar project, the more financially feasible it tends to be. With this in mind, the larger the area available for development, the more likely it is to be attractive to solar developers. Large parcels of land (e.g., 5-10 acres or more) are likely to be of greater interest for development, especially if few or no protected land resources are present (e.g., wetlands, water bodies, BioMap2 habitat).

Disturbed Sites

Previously disturbed sites identified in Colrain are shown in Table 6 below. There are two identified brownfields in Colrain. One is owned by American Fiber & Finishing Inc. / Warehouse; the other is owned by North River LLC but is used by Barnhardt Manufacturing. However, Barnhardt Manufacturing is leaving the town, so the future of this location would need to be further explored. In addition, there is a large area of bare soil, however the purpose and ownership of this land needs to be assessed further.

Location Name (if applicable)	Street Address	Total Disturbed Area (acres)	Estimated Technical Solar Potential (MW)	Proximity to Three-Phase Lines
(Brownfield) American Fiber & Finishing Inc / Warehouse	237 Main Road	5.26	1.1	141 feet
(Brownfield) North River LLC / Barnhardt Manufacturing	247 Main Road	5.3	1.1	0
(Bare Soil) Land off New County Road	New County Road	3.13	0.6	1+ mile
Capped landfill at Transfer Station	7 Charlemont Road	3.17	0.6	400 ft.

Table 6 Previously disturbed sites with some suitability for solar.

Solar arrays over 50 kW in size often must connect to three-phase electricity distribution lines in order to interconnect to the electricity grid safely. The two brownfields shown in Table 6 are located near three-phase lines. For the New County Road property, the size of the system may be limited to less than 50 kW by local grid infrastructure, or local infrastructure may need to be upgraded to accommodate larger projects.

Rights-of-Way

Colrain respondents are highly supportive of solar development in transmission line ROWs. Colrain is traversed by a 230 kV transmission line. This transmission line comes from the west border between Colrain and Heath, right below Stone Mountain. The transmission line runs southeast to the southeastern border of Colrain and Shelburne. This right-of-way (ROW) is maintained as a cleared area, and its length is 7.6 miles, estimated width is 216 ft and total area is 197 acres. The total technical potential of this land is 39.4 MW.

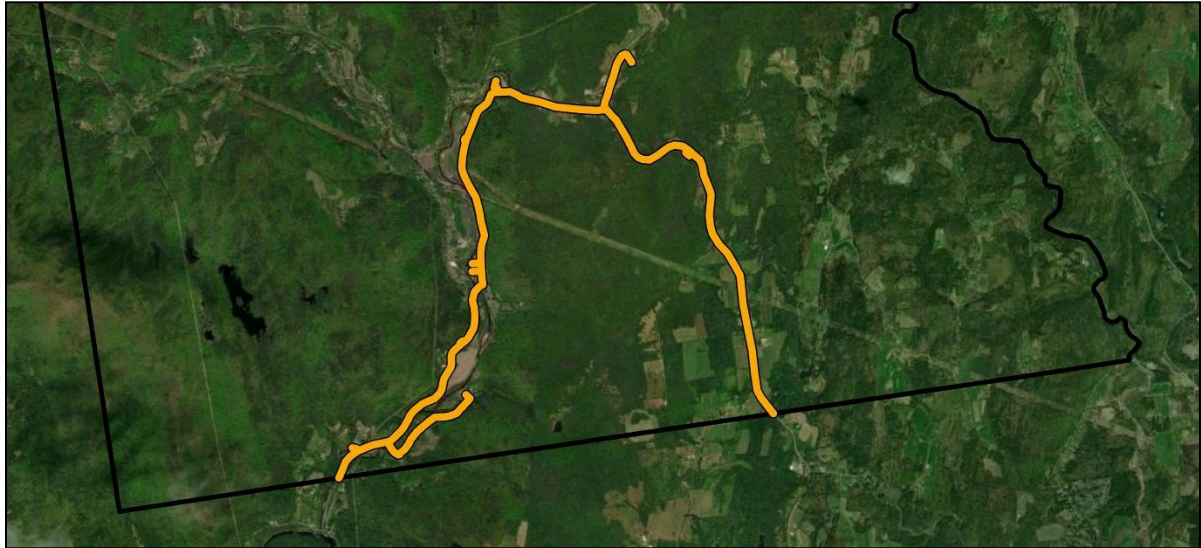


Figure 2. Map showing the transmission ROW running through the southern portion of Colrain. Town borders are shown in black, three-phase lines are shown in orange; the ROW appears in satellite imagery as a pale east-west line.

It is likely that much of this area would not be suitable for solar, due to steep slopes, viewshed considerations in high-elevation portions of the ROW, and bordering trees providing too much shade on the edges of the ROW. The ROW is located immediately under transmission lines, but solar arrays are more typically connected to distribution lines or directly to substations. In Colrain, two small portions of the ROW are located adjacent to three-phase distribution lines. The transmission line passes through the three-phase power line once on Route 112 and once on Greenfield Road. None of the substations that support Colrain are in the town. Therefore, the relevant substation is miles away in another town.

A major challenge in developing ROWs is that there is not a common practice of developing electricity transmission ROWs for solar. Utility companies typically prefer to keep these areas clear to allow for easy maintenance of transmission lines as well as underlying vegetation. However, this land area represents a potentially untapped resource for solar across Massachusetts.

Parcels Adjacent to Major Roads

Route 112 runs from the southern border to the northern border of Colrain. It begins as Main Road and then turns into Jacksonville Road about halfway through the town. Main Road has a three-phase power line running along the route. However, when the major road turns into Jacksonville Road (at its intersection with Greenfield Road), the power lines become single phase. A large majority of Colrain respondents are supportive of or neutral towards development along major roads.

respondents were also opposed to solar development adjacent to wetlands and waterbodies. The North River runs through Colrain along Route 112. The Green River on the eastern border of Colrain also runs for a short way near three-phase lines. Other than a few small brooks, there are no other significant bodies of water near three-phase power lines.

Figure 3 shows parcels adjacent to three-phase lines along Route 112. The North River is also shown in this figure, although smaller wetlands and streams are not pictured, for simplicity. Note that there are some large parcels on the southern side of Route 112 not adjacent to the South River, not permanently protected, and not mapped as important habitat for wildlife.

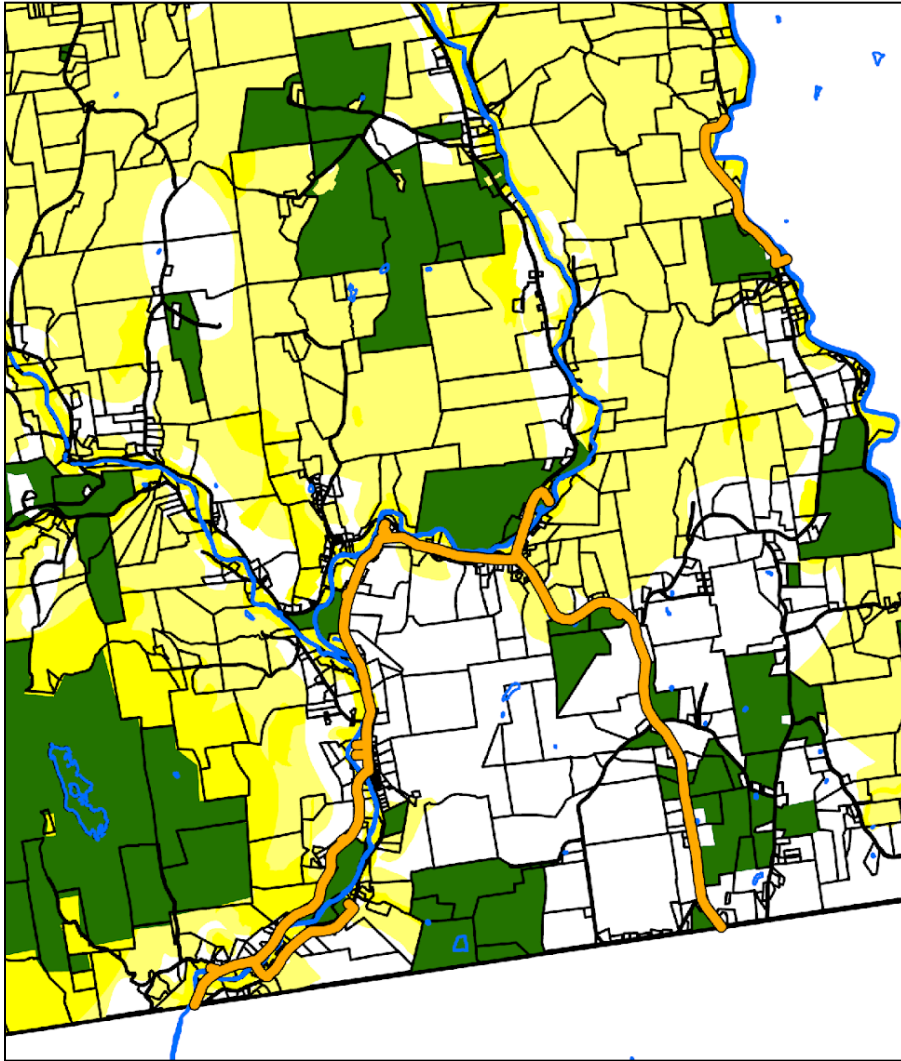


Figure 3. Map showing the southern portion of Colrain, with three-phase lines in orange, BioMap2 core habitat and critical natural landscapes in dark and light yellow respectively, permanently protected land in green, and the North River shown in blue.

Financial Considerations

Financial costs and benefits of solar projects on disturbed sites are dependent on many factors, including system size, system cost, electricity rates, solar incentives, federal and state tax credits, ownership structure, financing, and, importantly, any environmental or liability concerns associated with development of a site with potentially hazardous materials or a landfill cap that should not be penetrated. All of these items are site-dependent, and may be subject to change over time. Solar projects on previously disturbed sites are eligible for the same federal and state tax credits as other types of systems. These types of projects are also likely to be eligible for SMART solar incentives (on a fixed $\$/\text{kWh}$ basis) or Renewable Energy Credits (for each MWh of solar energy generated, RECs are sold at auction).

The Commonwealth of Massachusetts is strongly supportive of solar development on former landfill sites. Projects on former landfills and brownfield sites are eligible for additional SMART incentive “adders” over and above base compensation rates, on the order of 3-4 cents per kWh. The Massachusetts Department of Environmental Protection (MassDEP) also has a website and set of guidance documents related to development of former landfill sites (<https://www.mass.gov/siting-clean-energy-at-closed-landfills>).

6.3 Next Steps & Action Items

Potential next steps regarding large, ground-mounted solar development include:

- Reach out to the owners or operators of the two brownfield sites to consider whether solar development.
- Consider outreach to other owner of land that is currently disturbed (from Table 6), particularly if three-phase power is extended towards any of these areas.
- Work with Franklin Land Trust to identify at-risk parcels of high conservation and recreation value near three-phase lines and preserve them.
- Reach out to owners of large parcels along Route 112 that are not mapped as priority wildlife habitat and are adjacent to three-phase power, in order to explore their interest in large-scale solar development.
- Reach out to Eversource (with CEE assistance) regarding community interest in development of ROWs.
- Organize and hold a community forum regarding any large projects that are being considered in town. *Community Solar Survey* results show respondents highly value the chance to have their input heard regarding large solar development in town.
- Implement bylaw updates in line with resident preferences around development (see next section).

Action Items

Action	Lead Entity (or Entities)	Supporting Entities	Start Year/ Annually?
Implement Next Steps	Energy Comm.	Assorted town committees, Franklin Land Trust, Eversource	2026

7. MUNICIPAL ZONING, BYLAWS, & PERMITTING

7.1 Current Status

State Law regarding Solar Zoning Bylaws

Local zoning laws are regulated by [Massachusetts General Law Chapter 40A Section 3](#). The section relevant to solar zoning states that “*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.*” There has been much debate over what constitutes regulations that are necessary to protect public welfare, and whether this might include restrictions imposed to protect environmental or agricultural resources of value to the general public. In a recent case, *Tracer Lane II Realty, LLC v. City of Waltham*, the Massachusetts Supreme Judicial Court ruled narrowly that the City of Waltham could not impose a restriction that effectively limited large-scale solar development to no more than 2% of the municipality’s area. However, it did not address what would be an area reasonable to exclude from large-scale solar development. This limitation on local zoning is important to keep in mind when reviewing or updating the town’s bylaw. Law firms that commonly work with municipalities recommend basing updates on extensive planning efforts (such as this one) and ensuring that any restriction is grounded in an easily articulated reason related to public health, safety, or welfare. Always check with Town Counsel before implementing any changes.

Municipal Bylaw

Colrain’s zoning bylaws were updated in January of 2020. The solar development bylaw is in section 15 of the town’s bylaws.

The purpose of the current solar bylaw is to regulate the building of Large-Scale Ground-Mounted Solar Systems. It does so by outlining placement, design, construction, operation, monitoring, modification and removal requirements for solar. It addresses public safety, minimizing impacts on scenic, natural, and historic resources, and providing adequate financial assurance for eventual decommissioning.

Solar PV facilities are placed into four categories:

- Building-Mounted Solar Photovoltaic Systems
- Smaller-Scale Ground-Mounted Solar-Photovoltaic Systems (which occupy a footprint less than or equal to 0.1 acre)
- Large-Scale Ground-Mounted Solar-Photovoltaic Systems (which occupy a footprint greater than 0.1 acres but no more than 1 acre)

- Large-Scale Ground-Mounted Solar-Photovoltaic (which occupy a footprint greater than 1 acre)

As seen in Figure 4 below, Colrain is primarily rural (R) zoned land, shown in green. Commercial-industrial districts (in yellow) include Griswoldville West (CI-GW), Lyonsville (CI-L), and Stewartville (CI-S). Village districts (in purple) include Center Village (CV), Griswoldville East (GEV), and Shattuckville (SV). Around the river, there are Flood Plain zones indicated with blue lines.

Zoning requirements for solar PV facilities vary depending on the zoning district. Zoning related to solar development is described below:

- Building-Mounted Solar Photovoltaic Systems and Smaller-Scale Ground-Mounted Solar Photovoltaic Systems less than or equal to 0.1 acres do not require Site Plan Review or a Special Permit. However, they require a building permit and must comply with all other applicable local, state, and federal requirements and laws.
- Large-Scale Ground-Mounted Solar-Photovoltaic Systems that occupy a footprint greater than 0.1 acres, but no more than 1 acre are allowed by right with Site Plan Review in all zoning districts.
- Large-Scale Ground-Mounted Solar-Photovoltaic that occupy a footprint greater than 1 acre are not allowed in Village Districts. They require a Special Permit in other zoning districts (Rural and Commercial-Industrial).

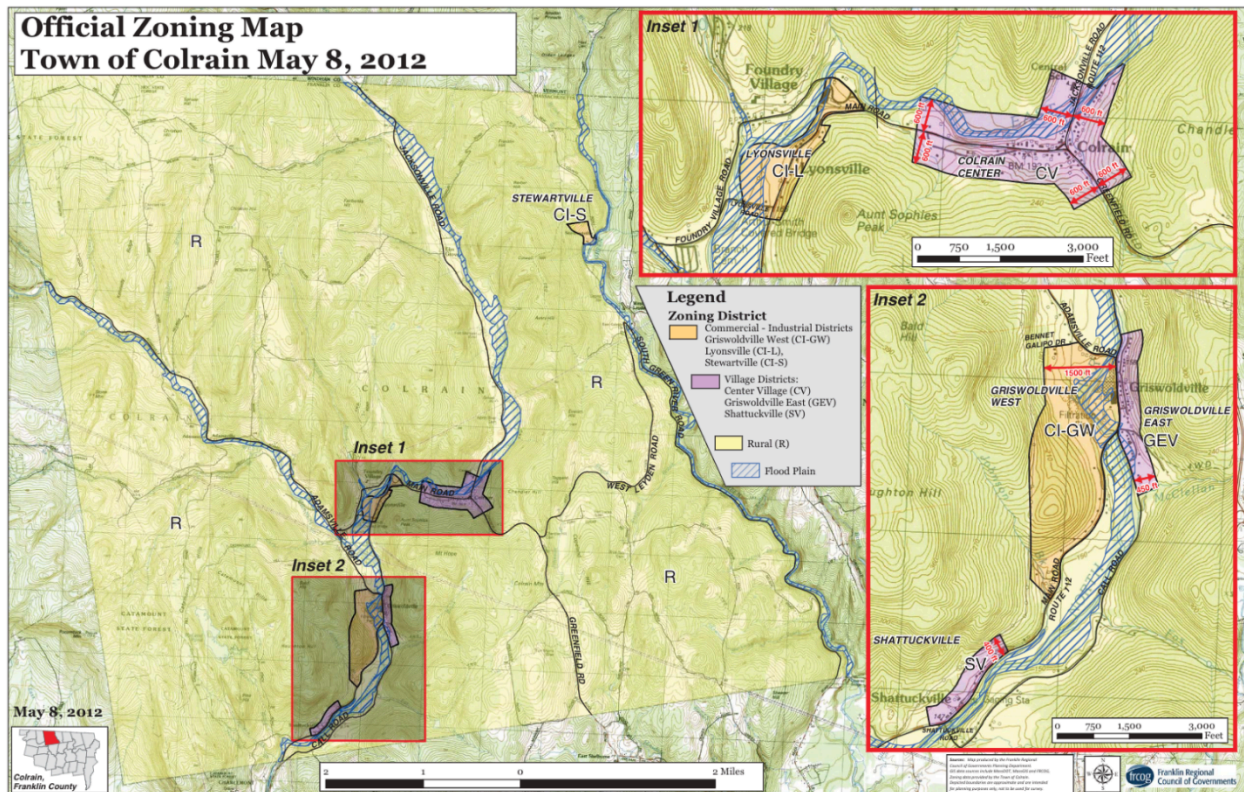


Figure 4. Official Zoning Map of the town of Colrain. Source: Town of Colrain, 2012

Use	Village Districts	Rural Districts	Commercial-Industrial Districts
Large -Scale Ground-Mounted Solar-Photovoltaic System with a footprint greater than 0.1 acres up to 1.0 acres	SPR*	SPR*	SPR*
Large-Scale Ground-Mounted Solar-Photovoltaic System with a footprint greater than 1.0 acres	N***	SP**/SPR*	SP**/SPR*

Table 7 Colrain zoning bylaws related to the development of solar. Source: Colrain Zoning Bylaws, 2018

*SPR- The use is permitted subject to Site Plan Review by the Planning Board

**SP -The use may be permitted if a Special Permit is granted by the Zoning Board of Appeals

***N- No, the use is not permitted in that Zoning District

All Large-Scale Ground-Mounted Solar-Photovoltaic Systems with a footprint greater than 0.1 acres must undergo Site Plan Review by the Planning Board and must also comply with the additional provisions of the bylaw. Site plan reviews require significant documentation,

including zoning district designation, location of Priority Habitat Areas, locations of floodplains, location of local or national historic districts, proof of liability insurance, utility notification, solar array technical drawings, documentation of major systems being used, proof of prospective authority, a list of hazardous materials, a copy of the Interconnection Application, and a plan for operation and maintenance of the site.

The bylaw outlines project design requirements for Large-Scale Ground-Mounted Solar-Photovoltaic Systems with a footprint greater than 0.1 acres, including setbacks, appurtenant structures, lighting, and signage. The systems must have front, side, and rear yard setbacks of at least 50 feet. Appurtenant structures are subject to current zoning regulations concerning the bulk and height of structures, lot area, setbacks, and building coverage requirements. The lighting of the system should be consistent with town laws, should be reasonably shielded, and directed downward. Signage must involve identification of the owner and provide a 24-hour emergency contact phone number.

The solar structure bylaw has environmental and safety hazard standards. Solar-Photovoltaic Systems and any appurtenant structures must be screened from view by a staggered group of planted shrubs and small trees a minimum of fifteen feet wide. There are also regulations involving vegetation control, pesticides, noise, access roads, emergency services, maintenance, and modifications. All solar development and access roads should be constructed to minimize impact to environmental and historic resources.

Community Perspectives

Based on the *Community Solar Survey*, respondents provided the following information regarding their preferences for town permitting policies and processes relative to solar:

- A majority of respondents are interested in information being shared at public meetings. At minimum, preparation for these meetings could include a high level of advertising prior to public hearings regarding specific solar projects as well as proposed solar bylaw changes so that all interested residents are able to attend and participate in the discussion. In addition, respondents show interest in the opportunity to purchase low-price electricity from large-scale solar energy projects.
- Respondents show great interest in the development of solar benefiting the town budget. Large solar projects provide economic value to the community. Economic benefits of interest could include favorable PILOT agreements that provide revenue to town coffers, displacing residential property taxes, or projects that provide reduced electricity rates for residents. The survey did not address what the property tax or electricity rate reduction would need to be for respondents to be supportive of a particular project.

Alignment with Community Preferences

The town's bylaw aligns well with resident perspectives in certain respects:

Residential and small-scale solar – The town's bylaw allows small-scale ground-mounted solar and rooftop solar by right with a building permit, in line with respondents' strong support for these development types.

Vegetation screening – The town’s bylaw stipulates thorough vegetation screening of large-scale solar arrays, in line with community preferences.

Permitting process – The town’s permitting process, in conforming to state Opening Meeting Law, meets respondents’ desires for information sharing at public meetings and an opportunity to comment on siting and design of large solar arrays.

7.2 Next Steps & Action Items

As noted above, a majority of respondents are unsure or unaware of the solar permitting process in Colrain. It would be beneficial to provide information on the town’s website and distribute information about the permitting process, perhaps as a part of sharing information about this solar planning process.

With review by Town Counsel, the town may wish to consider the following updates to the town solar bylaw, to align well with community interests as identified in the *Community Solar Survey*:

Solar Size Definitions: The town’s definition of “large-scale” solar installations that must undergo Site Plan Review and/or be subject to Section XV of the town’s bylaw is somewhat confusing. In Section III (page 3) of the bylaw, small-scale solar is defined as under 0.1 acres, but in Section XV (page 54) it is defined as under 0.25 acres. This definition should be revisited and clarified. In addition, the town may wish to consider ensuring that the process for permitting moderately sized projects (e.g., between 0.25 and 1 acre) through Site Plan Review is not overly restrictive. Currently, such projects are subject to most of the same provisions as larger projects, which could render such projects financially and logistically infeasible.

Village Districts. The town should review its bylaw to ensure that the limitation on ground-mounted solar over 1 acre in village zoning districts would not interfere with solar canopies installed over existing parking/paved areas. There is strong support for solar development on paved areas within the town. If this type of development is restricted, the town may wish to consider excluding parking lot canopies from the general prohibition on large ground-mounted solar in these districts.

Streamlined Permitting at Preferred Sites. The town should consider creation of a solar overlay district or definition for large ground-mounted solar on disturbed sites that includes the town’s capped landfill and parcels noted in Table 6, as well as transmission line ROWs, and which allows development of these sites by right with Site Plan Review (rather than by Special Permit). These areas represent an important resource which could help the town meet community and regional solar goals without developing undisturbed natural areas. The town could consider whether sites along Route 112 should be added to this district.

Siting Restrictions - Agricultural. The town may wish to consider siting restrictions for large (e.g., 5 acres or larger) solar projects on agricultural land, given respondents’ opposition to large-scale solar development on active farmland. The town could consider requiring agrivoltaic projects if large-scale solar is being developed on active farmland.

Siting Restrictions - Forest. The town may wish to consider siting restrictions for large (e.g., 5 acres or larger) solar projects, given respondents’ opposition to large-scale solar development in priority wildlife habitat and core forest. Given that the large majority of town is mapped as BioMap2 habitat, it is not recommended to completely block large-scale solar on this type of land, since this might conflict with state law regarding local solar zoning. However, the town could consider restricting large-scale development in core forest habitat. The exact language for identifying a limited subset of important forest/undeveloped natural habitats for restrictions could be honed through discussions with Mass Audubon, Franklin Land Trust, FRCOG, and UMass.

Wetlands. The town may wish to increase buffers around wetlands and bodies of water to restrict solar development or to restrict development more generally via a wetlands bylaw. *Community Solar Survey* results indicate respondents oppose development near water bodies and wetlands.

Decommissioning. A major concern expressed by respondents addressed what happens to solar structures once they are no longer in use. Although the bylaw already has a section on recycling of solar structures, respondents expressed concern about who is responsible for the recycling, and how shortly after it is out of use it would happen. The town could create additional requirements regarding this issue within the bylaw.

Action Items

Action	Lead Entity (or Entities)	Supporting Entities	Start Year/ Annually?
Vote suggested Bylaw Changes at ATM	Energy Comm.	Planning Board	2024

6. SUMMARY

8.1 Summary

Colrain respondents are most supportive of solar development on previously disturbed and developed sites, but also support sufficient ground-mounted solar development to meet community self-sufficiency goals and help address Western Mass region electricity needs. This action plan calls for outreach to residents, businesses, and institutions to encourage solar development on rooftops, parking areas, and brownfields in the community. This plan also calls for exploration of the potential for larger-scale solar development along Route 112, including exploring conventional development on land not designated as priority wildlife habitat and located away from the North River, agrivoltaic options on hayfields or pastureland, and prioritizing conservation of properties of value to wildlife that might be at risk from solar development. Considering bylaw amendments to allow for expanded solar development on sites favored by the community and limit development on sites opposed by the community is also recommended. Finally, incorporation of a ***solar plus energy storage system at Colrain Central School*** or one of the buildings in the Town Center could save energy costs, generate clean energy, and provide back-up power during a power outage or other emergency.

8.2 Plan Review

This plan will be reviewed and updated in five years by the Energy Committee in consultation with the Planning Board, Conservation Commission, and Select Board. Updates will consider progress made since the original plan was developed, and may require revisiting steps of the *Community Planning for Solar* process, including the *Solar Resource & Infrastructure Assessment* and *Community Solar Survey*.

8.3 Action Items

This section will provide a table of Action Items, summarizing briefly each item, indicating which municipal board, committee, or group of residents is responsible for taking the lead on next steps, and indicating the projected timeline (calendar dates). The table will also include the anticipated timeline for action plan review and revision. This will be completed after town committees and residents have reviewed the plan.