



Smart Solar in Connecticut

FARMER SURVEY FINDINGS & INITIAL RECOMMENDATIONS

AMERICAN FARMLAND TRUST | AGRISOLAR CONSULTING

JANUARY 2023



ABOUT AMERICAN FARMLAND TRUST

American Farmland Trust (AFT) is the largest national organization dedicated to protecting farmland, promoting sound farming practices, and keeping farmers on the land. AFT unites farmers and environmentalists in developing practical solutions that protect farmland and the environment. We work from “kitchen tables to Congress,” tailoring solutions that are effective for farmers and communities and can be magnified to have greater impact. Since our founding, AFT has helped to protect more than seven million acres of farmland and led the way for the adoption of conservation practices on millions more. AFT has a national office in Washington, D.C., and a network of offices across America where farmland is under threat.

For more information, visit us at www.farmland.org



ABOUT AGRISOLAR CONSULTING

AgriSolar Consulting was founded to advance sustainable land use, farm viability, and renewable energy through agrivoltaic solutions. Recognizing that global food and energy security require innovative local solutions, AgriSolar Consulting works at the nexus of agriculture and energy to promote synergies that enhance community resilience. To realize practical, integrated climate solutions and progress innovative policies and practices for agrivoltaics in the U.S., AgriSolar Consulting leverages expert experience in social science, energy policy, solar development, horticulture, land use, and 3D modeling. This small, woman-owned, Michigan-based consulting company is devoted to ensuring that the future of renewable energy is shaped by, and benefits, America's agricultural communities.

For more information, visit us at www.agrisolarconsulting.com

ACKNOWLEDGEMENTS

This report would not have been possible without the time and attention of the advisory committee, farmer survey respondents, agency staff, and solar roundtable participants. If the findings and recommendations in this report provide Connecticut with the information and tools it needs to grow renewable energy while supporting the viability of farming in communities across the state, it is in large part thanks to their efforts. Thank you for your insightful comments on this complex and nuanced topic.

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While the individuals, agencies, and organizations mentioned above were essential in making this report possible, American Farmland Trust takes full responsibility for the information and recommendations presented herein. Their inclusion and acknowledgement here is not necessarily an endorsement of AFT findings or recommendations.

SMART SOLAR IN CONNECTICUT

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EXECUTIVE SUMMARY

THE NEXUS OF ENERGY AND AGRICULTURE: CHALLENGES AND OPPORTUNITIES

The American Farmland Trust's (AFT) **SMART SOLARSM**¹ in Connecticut project builds on several years of strategic engagement with solar and agricultural stakeholders in New England and the Northeast. Connecticut's Comprehensive Energy Strategy defines goals to mitigate environmental impacts of energy use, which includes rapidly expanded renewable energy programs through more robust policies, legislative actions, and best practices. Connecticut's Renewable Portfolio Standard currently requires at least 40% renewable power generation, including solar, by 2030. According to the most current industry projections, Connecticut (CT) expects 973 MW of solar installation over the next 5 years, more than doubling existing solar generation capacity.

The expansion of solar energy in CT, both distributed generation and large-scale projects, presents opportunities and challenges for landowners, farmers, local communities, and policymakers alike. As detailed in [AFT's Farms Under Threat: The State of the State's report](#), CT agricultural land is already under pressure from various external forces – 23,000 acres were developed or converted from 2001-2016. Building on that analysis, AFT released a forward-looking report in June 2022, [Farms Under Threat 2040: Choosing an Abundant Future](#). By 2040, based on current trends, 55,000 acres of Connecticut farmland (16% of state total) could be fragmented or converted to non-agricultural uses. Most concerning, CT ranks second in percent of farmland that would be lost in AFT's Run-Away Sprawl scenario. To protect the remaining 347,100 acres of CT farmland and keep farmers on the land, rigorous planning, design, policy, and community engagement is needed. With this in mind, it will be essential to advance solar in a manner that avoids, minimizes, and mitigates impacts to CT's agricultural communities and the future of farming.

A SMART SOLARSM STRATEGY FOR CONNECTICUT

AFT's focus on Connecticut was animated by the Governor's Council on [Climate Change Phase 1 Report](#), published in January 2021. The report's strategy recommendations include taking steps to 1) Evaluate approaches and best practices for siting of renewable and non-renewable energy infrastructure to avoid loss of forests, farmland, and other sensitive lands; and 2) Disincentivize location of solar projects on farmland and incentivize multiple-use projects that allow for solar and agricultural production to co-exist on the same footprint. We hope that AFT's farmer survey and recommendations can inform strategies to achieve these objectives.

Achieving CT's clean energy goals while ensuring protection of the state's most productive, versatile, and resilient farmland will require embracing a strategic, holistic approach to solar development. AFT advocates for Smart SolarSM as a more collaborative and sustainable path forward towards a clean energy transition that also supports farm viability, protects healthy soils, and ensures production of land to grow wholesome food. To advance Smart SolarSM in CT, AFT engaged farmers, farm landowners, solar developers, land trusts, environmental organizations, and government

1. Smart Solar is a trademark of American Farmland Trust.

officials to inform planning and decision making around solar on farmland. Aimed at benefitting farmers and protecting farmland, this engagement was used to explore the potential for policy innovation to promote Smart SolarSM practices.

CT FARMER SURVEY AND SOLAR INDUSTRY INTERVIEWS – ASSESSING GOALS, INTERESTS, AND PATH FORWARD FOR SMART SOLARSM

Through a statewide survey, AFT captured the interests, priorities, needs, and concerns related to solar on farmland from nearly 200 farmers and farmland owners in CT. The voices elevated in this report represent the diversity of CT agriculture – each of CT's eight counties yielded survey responses from small to large-scale farm operators producing everything from dairy products to specialty crops and swine. AFT assessed attitudes toward solar development on farmland based among a diverse cross-section of survey respondents: respondents indicated 47% support, 27% opposition, and 26% conditional support for solar on farmland. Context matters a great deal to farmers: the size and location of the solar array, the ability to leverage it for dual-purposes, and the scope of economic benefit were identified as the key factors influencing support for solar on farmland in CT.

AFT explored the full range of farmer attitudes about solar to ensure that they are heard and shared with policy makers, the solar sector, and state agencies. We measured opposition to solar development on different types of CT farmland, finding that survey respondents expressed preference for the most productive farmland (USDA Prime and soils of statewide importance), actively farmed land, and farm-owned forest land to be safeguarded from development. Further, impacts on farmland preservation, land prices, land access, and farm productivity were identified as most concerning to farmers and farmland owners – highlighting that protecting quality farmland and minimizing negative community impacts are key priorities that should shape future solar development practice in CT.

Farmers and farmland owners in CT expressed interest in farm-compatible solar that maintains two key priorities: the continued use of land for agriculture and support for farm viability (both supplementary income and satisfied on-farm energy demands). Survey results indicate the greatest levels of support for solar projects on farmland that serve a dual-purpose (i.e., agrivoltaics), satisfy host farm energy demands, create a pollinator habitat, and generate additional revenue for the landowner. Interest in solar installations that enhance farm viability while mitigating impacts to land most suitable for farming indicates strong potential for Smart SolarSM to address concerns and deliver opportunities for farmers in CT.

The potential for Smart SolarSM in CT was further defined through solar industry engagement efforts. AFT identified solar developers working in CT who are seeking to include dual-use/agrivoltaics in their project design and operations. We then convened one-on-one interviews and a roundtable with select solar developers to understand the barriers and opportunities to advance farm-compatible solar. Solar sector participants discussed their interest and willingness to design dual-use solar projects for CT farmers, noting they perceive the dual-use approach can create more rural economic opportunity, mitigate conflict with farmland, and nurture vital cross-sector relationships. Early-stage efforts to advance dual-use in CT indicate that regulatory gaps and complexity, a lack of clear permitting standards and guidelines, and higher capital costs are precluding broader deployment across the state. Addressing these implementation challenges will help farmers and the solar sector to maximize the potential for Smart SolarSM to create more value for more agricultural stakeholders and farm communities in CT.

RECOMMENDATIONS TO ACHIEVE SMART SOLARSM IN CONNECTICUT

AFT's recommendations are a synthesis of findings from the statewide farmer survey, solar developer interviews and roundtable, and discussions with other key stakeholders in CT. We also consulted the project advisory committee and convened agency briefings with DoAG, DEEP, and PURA staff. Based on this information, to achieve Smart SolarSM in CT AFT recommends:

1. Maintain and expand state funding and programs designed to support farmland protection, climate smart-agriculture, and incorporate Smart SolarSM principles.
2. Direct development away from high quality farmland and implement a Farmland Mitigation Fee.
3. Institute a cross-sector working group and boost agency capacity to tackle farmland-solar issues.
4. Explore market-facing strategies, such as bid preferences, in the annual state renewable portfolio standard procurement process that rewards projects implementing bona fide dual-use, ecosystem services, and farm viability practices and applications.
5. Develop financial incentives and market mechanisms for dual-use/agrivoltaics.
6. Establish clear standards and strengthen enforcement authority to support Smart SolarSM methods.
7. Invest in and support UConn Extension as a key hub for farmland-solar research, farmer and stakeholder engagement, dual-use demonstration projects, and ongoing technical assistance for climate-smart agricultural practices.

With Smart SolarSM policies and continued investment in farmland protection, Connecticut can guide expansion of renewable energy installations in ways that minimize negative impact on the state's best farmland, which plays a critical role in addressing climate change. Pressure from utility-scale solar development compounds the already severe "competition for land" in CT and New England, underpinning the need to advance strategies for solar development and grid infrastructure. Done right, Connecticut can be a regional leader in advancing clean energy while reinforcing conservation of the state's most productive farmland and other natural resources.

To protect CT's most productive farmland, AFT recommends design and implementation of a statewide Farmland Mitigation Fee for projects with significant impacts on agricultural resources. A Farmland Mitigation Fee, such as the agricultural payments required for certain projects exceeding 30 acres of impact to high quality soils in New York state, encourage development on disturbed sites and less productive agricultural areas. The resulting funds should be dedicated to municipal or state programs that protect farmland and be invested in actions that support farm viability. CT should also explore the feasibility of municipal-wide or statewide caps on farmland conversion due to utility-scale solar, as recently enacted in New Jersey.

To inform dual-use standards in CT, a cross-sector Smart SolarSM working group is recommended to represent farmers, developers, land trusts, and regulator perspectives. Expanding the expertise

of CT DEEP and CT Department of Agriculture to ensure adequate coordination and innovation across agencies is critical to supporting both farmers and developers interested in low-impact solar development and incentives for dual-use. To this end, AFT recommends legislative support and funding to enable greater state agency capacity to focus on farmland-solar issues.

The shared learning resulting from the working group and agency expansion will help to inform and shape mechanisms to support dual-use/agrivoltaics, such as competitive bid-preference criteria. AFT recommends a study to evaluate the feasibility of bid-preferences instituted by PURA to reward developers that incorporate dual-use and/or climate-smart agricultural practices into solar projects. To further stimulate innovation and minimize cost barriers for developers striving to deliver dual-use, market mechanisms, such as a tariff-based incentive program or preferential financing from Connecticut Greenbank, should also be explored.

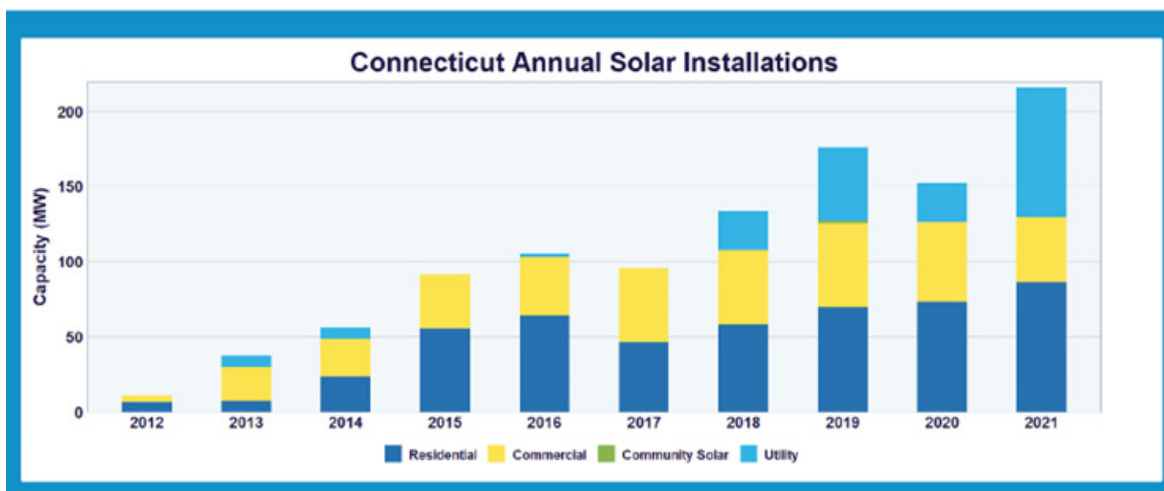
To ensure farm viability is supported in the long term, inter-agency enforcement authority and methods should be established to measure and maintain performance over the lifetime of farmland-solar projects. AFT recommends accountability and compliance with dual-use criteria that are promulgated by PURA and enforced by the Connecticut Siting Council. As administrator of energy programs in CT, it is recommended that PURA solicit input for rigorous standards and guidelines from the Smart SolarSM working group and incorporate these when formulating specific solar energy procurement targets and project review by the Connecticut Siting Council.

Lastly, AFT advocates for the University of Connecticut Extension to serve a key role in shaping dual-use in CT by funding regionally relevant crop trials, soil impact assessments, and demonstration, as well as instituting a technical assistance program and driving farmland-solar workforce development. Other land-grant institutions such as University of Massachusetts Clean Energy Center, Rutgers University Agrivoltaics Program, and Cornell's Sustainable Solar research program can serve as models for UCONN.

In conclusion, Connecticut's clean energy goals are a key state priority that must also be well aligned with state farmland preservation goals and thriving agricultural communities. Reconciling trade-offs between critical land uses and achieving Smart SolarSM goals will demand creative and proactive effort, with cross-sector engagement and inter-agency coordination. AFT is enthusiastic about the potential for a Smart SolarSM approach supported by research and policies designed to avoid, minimize, and mitigate impacts of solar development on farmland while enhancing farm viability. Applying the Smart SolarSM strategies proposed in this report will help maximize the economic and environmental opportunities associated with solar development, while safeguarding Connecticut's agricultural heritage and rural communities.

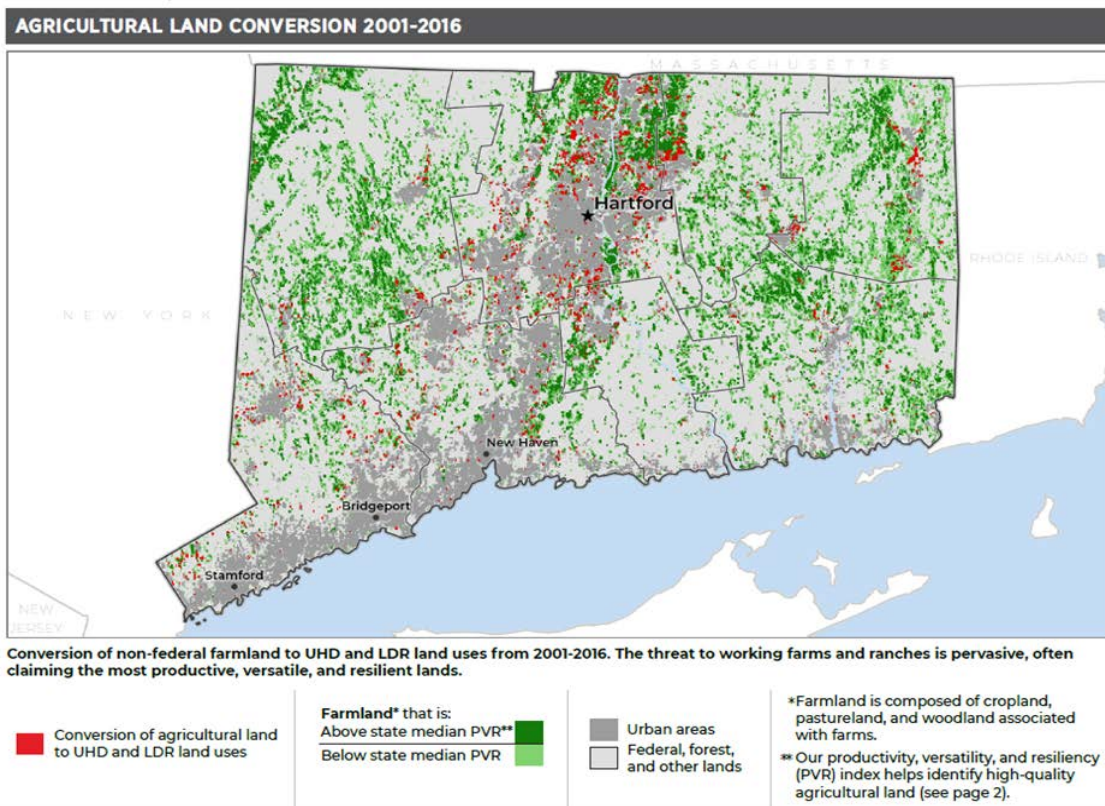
CONNECTICUT ENERGY AND AGRICULTURE: CHALLENGES AND OPPORTUNITIES

Achieving Connecticut's (CT) clean energy goals while ensuring protection of the state's most productive, versatile, and resilient farmland will require proactive, collaborative, and strategic efforts. CT's Comprehensive Energy Strategy defines goals to mitigate environmental impacts of energy use, which includes rapidly expanded renewable energy programs through more robust policies, legislative actions, and best practices. The state's Renewable Portfolio Standard currently requires at least 40% renewable power generation, including solar, which demonstrates an aggressive commitment to expanding CT's solar capacity by 2030. According to the most current industry projections, CT expects 973 MW of solar installation over the next 5 yearsⁱ, more than doubling existing solar generation capacity. Further, the U.S. Department of Energy's 2021 Solar Futures Studyⁱⁱ outlines a pathway to a fully decarbonized electrical grid by 2050. This study forecasts that an average of 450,000 acres of land nationally will be needed to support additional ground-mounted utility-scale solar, per year, for the next 20-25 years. According to this study, 90% of future solar build out is expected to occur in rural communities. The expansion of solar energy in CT, both distributed generation and large-scale projects, presents challenges and opportunities for landowners, farmers, local communities, and policymakers alike.



Source: Solar Energy Industries Association

Pressure from utility-scale solar development compounds the already severe “competition for land” in CT and New England. [AFT's Farms Under Threat: A New England Perspective](#)ⁱⁱⁱ study found that solar has become the largest single type of development on agricultural and forested land, which underpins the need to develop Smart Solarsm practices that combat climate change while reinforcing the conservation of our most precious lands and natural resources. As detailed in [AFT's Farms Under Threat: The State of the State's Report](#)^{iv}, CT agricultural land is already under pressure from various external forces – 23,000 acres were developed or converted from 2001-2016. Building on that analysis, AFT released a forward-looking report in June 2022, [Farms Under Threat 2040: Choosing an Abundant Future](#)^v. By 2040, based on current trends, 55,000 acres of Connecticut farmland (16% of state total) could be fragmented or converted to non-agricultural uses. Most concerning, CT ranks second in percent of farmland that would be lost in AFT's Run-Away Sprawl scenario. To protect the remaining 347,100 acres of CT farmland and keep farmers on the land, rigorous planning, design, policy, and community engagement is needed to advance solar in a manner that avoids, minimizes, and mitigates impacts to CT's agricultural communities and the future of farming.



Advancing Smart Solarsm to Boost Renewable Energy and Farm Viability

To ameliorate tradeoffs between solar energy deployment and resilient farmland in the U.S., AFT has developed **Smart Solarsm** principles that aim to advance three main, equally important goals: (1) accelerating solar energy development, (2) strengthening farm viability, and (3) safeguarding land well-suited for farming and ranching. AFT advocates for Smart Solarsm as a more collaborative and sustainable path forward towards a clean energy transition that also supports farm viability, protects healthy soils, and ensures production of land to grow wholesome food. Smart Solarsm assures that solar projects are built using best practices that protect soil and agricultural potential, provide infrastructure and financial support to operating farmers, and give a much-needed boost to farm viability.

AFT approaches Smart Solarsm on Connecticut farmland with a nuanced understanding of regional farmland trends, state-level energy policy, regenerative soil health practices, and the potential for innovation in farm-compatible solar development. Our CT Smart Solarsm project builds on several years of strategic engagement with solar and agricultural stakeholders in New England and the Northeast. Under the guidance of the project advisory committee, including representatives from UConn Extension, Working Lands Alliance, CT Resource Conservation and Development, CT Farm Bureau, and others, AFT evaluated farmer and solar industry interest in Smart Solarsm and developed farm-centered recommendations for project development across the state. Through our statewide farmer survey and solar industry roundtable discussion, a CT-specific approach to Smart Solarsm was defined that advances the type of planning, collaboration, and innovation needed to achieve CT's clean energy goals while mitigating impacts to farmland. This project effort also yielded important future research priorities, which are offered as an opportunity to accelerate innovation at the nexus of energy and agriculture in CT.

With Smart Solarsm policies and continued investment in farmland protection, Connecticut can guide expansion of renewable energy installations in ways that minimize negative impact on the state's best farmland and core forests, which are features of green infrastructure that are critical to addressing climate change. To that end, this report establishes the framework needed to advance Smart Solarsm strategies in CT. AFT offers these recommendations to shape the way solar is developed on CT farmland – emphasizing farmland protection, farm viability, and vibrant agricultural communities.

AFT's **SMART SOLARSM** Principles

1. Prioritize Solar Siting on Building and Land Not Well Suited for Farming.
2. Safeguard the Ability for Land to Be Used for Agriculture
3. Grow Agrivoltaics for Agricultural Production and Solar Energy
4. Promote Equity and Farm Viability

PROJECT METHODS

In June 2022, AFT administered a statewide survey to capture perspectives about solar on farmland from CT farmers and farmland owners. Numerous organizations, including CT Farm Bureau, CT Farmland Trust, and UCONN Extension, assisted in disseminating the survey to ensure the broadest possible distribution to farmers and farmland owners. Survey responses were collected from 179 individuals across each of CT's eight counties – representing small to large scale farm operators producing everything from dairy products to specialty crops and swine. Our sample of respondents represent younger farmers and larger farms in CT when compared to USDA National Agricultural Statistics^{vi}. Full information about survey respondent characteristics and representativeness can be reviewed in the Appendix. The results are not intended to be statistically generalizable to the entire population of CT farmers and farmland owners. Throughout the report, the number of survey responses is indicated as N or as a percent of total; the number of responses varies or does not total to 100% because not all questions were required by participants.

A **Smart Solarsm** strategy for CT was further defined through solar industry engagement efforts. In August 2022, AFT conducted one-on-one interviews with select solar developers that we identified as actively seeking to include dual-use/agrivoltaics¹ in their project design and operations. We then convened a virtual roundtable dialogue between the developers in September 2022, to assess social, technical, economic, and regulatory barriers and opportunities to advance farm-compatible solar in CT.

The results from the farmer survey and solar industry study were presented to the project advisory committee to solicit additional feedback and input on initial recommendations. A final briefing, inclusive of all research findings, was convened by AFT in November 2022 for the Department of Agriculture (DoAG), the Department of Energy & Environmental Protection (DEEP), and the Public Utilities Regulatory Authority (PURA) staff.

1. Dual-use solar, also known as agrivoltaics or co-location of solar, is the practice of installing solar photovoltaic panels on farmland in such a manner that primary agricultural activities (such as animal grazing and crop/vegetable production) are maintained simultaneously on that farmland. The authors of this report acknowledge nuanced distinctions between the terms “dual-use solar” and “agrivoltaics,” but use them interchangeably throughout this report.

Learn more at: <https://www.farmlandinfo.org/wp-content/uploads/sites/2/2020/08/NE-SSS-Dual-Use-Examples.pdf>



Dual-use research site, University of Massachusetts Amherst
Photo Credit: Alexis Pascaris

To develop recommendations to achieve Smart Solarsm in CT, AFT synthesized and consolidated the results from the statewide farmer survey and the solar industry study, as well as the insights drawn from a series of consultations with the project advisory committee and key stakeholders. This report is intended to outline a pathway for regulators, solar developers, farmers, and decision makers to advance the state's clean energy goals in a manner that minimizes impact to productive farmland and supports farm viability in CT.

SUPPORT FOR FARMLAND-SOLAR: A CONVERSATION ABOUT FARM VIABILITY

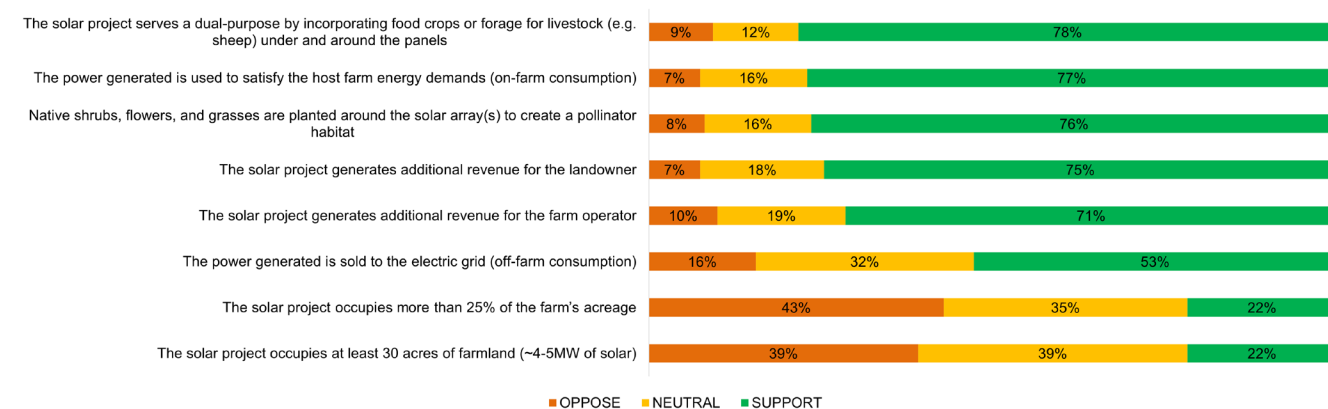
AFT found that survey respondents have mixed perspectives about how land use change associated with solar development will impact the viability of farming in CT. According to the farmer survey, 32% of respondents anticipate negative impacts, whereas 31% expect positive impacts. This nearly equal divide is further emphasized through the 24% of respondents who noted solar will have neutral or mixed impacts on farm viability and provided explanation – the mixed nature of anticipated impacts from solar on farm viability is demonstrated by this quote from a CT farmer:

“Standard ground-mounted solar on agricultural land could have an extremely negative impact on farm viability. Putting solar on existing and future barns and farm buildings, plus raised structures that don’t impede the continued use of agricultural land, could have a very positive impact on farm viability in CT.” – Vegetable farmer in New Haven County

When it comes to farmland-solar, we measured levels of support and assessed factors of importance. Context matters a great deal to farmers and farmland owners – responses indicate support for solar on farmland is nuanced and contingent upon three key identified factors: the size and location of the solar array, the ability to leverage it for dual-purposes, and the extent of economic benefit. Open-ended responses highlight that distinctions between ground-mounted and rooftop installations impact farm adoption of solar. Respondents further discussed support for solar on farmland under the condition that it is sited in a manner that it allows continued farming and that the energy savings

and revenue gains directly enhance the farm operation. Projects that maintain a dual-use and boost farm viability yield the greatest levels of support, as indicated in Figure 1.

FIGURE 1. LEVELS OF SUPPORT AND OPPOSITION ACROSS SOLAR DEVELOPMENT FACTORS (N=161)



We measured 47% support, 27% opposition, and 26% conditional support for solar on farmland across all survey respondents. Interestingly, data did not indicate any statistically significant differences in support across respondent types (e.g., role in farm operation: farmer, landowner, farm-renter). This suggests the survey findings are generalizable across the respondent types, acknowledging a potential response bias (See Appendix for summary of respondent characteristics).

Respondents based in Windham County (17% of total) more often reported opposition to farmland-solar, whereas all respondents based in Middlesex County (12% of total) support siting solar projects on CT farmland. No study participants younger than 35 years of age reported support for solar on farmland, suggesting other extraneous factors not captured in this survey, such as land availability or competition, are impacting young farmer attitudes towards solar.

Do You Support Siting Solar Projects on Farmland in Connecticut?

"In general, yes. This brings in revenue at levels not readily matched by agriculture in a good year. It provides a means of supplementing meager returns from other farming activities and retaining ownership to keep the farms in the family. I do, however, think that they should be located in swamp or other non-productive areas." – Farm owner-operator in Hartford County

"Solar siting should not replace farmland or impede agricultural land use. Solar can be put on barns and farm buildings and can be put in fields with raised structures to allow for livestock grazing and/or crop production (agrivoltaics)." – Mid-scale farm manager

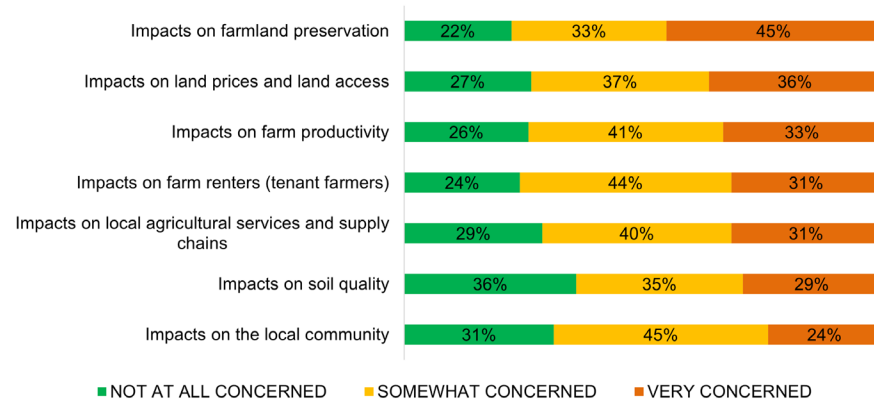
"If there is dual use, including farming, then yes. There should also be a bigger push to utilize other open spaces instead, parking lots etc." – Vegetable farmer in Hartford County

"If a small portion of the total farm plot is used, I would support, but not an entire piece of land being used for solar." – Fruit producer in Tolland County

IMPACTS AND FACTORS OF CONCERN FOR CONNECTICUT FARMERS

AFT explored the full range of farmer attitudes about solar on farmland to ensure that they are heard and shared with policy makers, the solar sector, and state agencies. Impacts on farmland preservation, land prices, land access, and farm productivity were identified as most concerning to farmers and farmland owners (Figure 2). Land price and access issues are already challenging the 23% of famer operators dependent on leased land in CT^{vii}, our survey found that solar development is contributing to these concerns – 13% of respondents reported losing access to rented farmland because of solar, and 16% noted that solar is making farmland more expensive to rent. This indicates greater attention is needed to develop creative solutions for solar to enhance, not challenge, farmland price and access in CT.

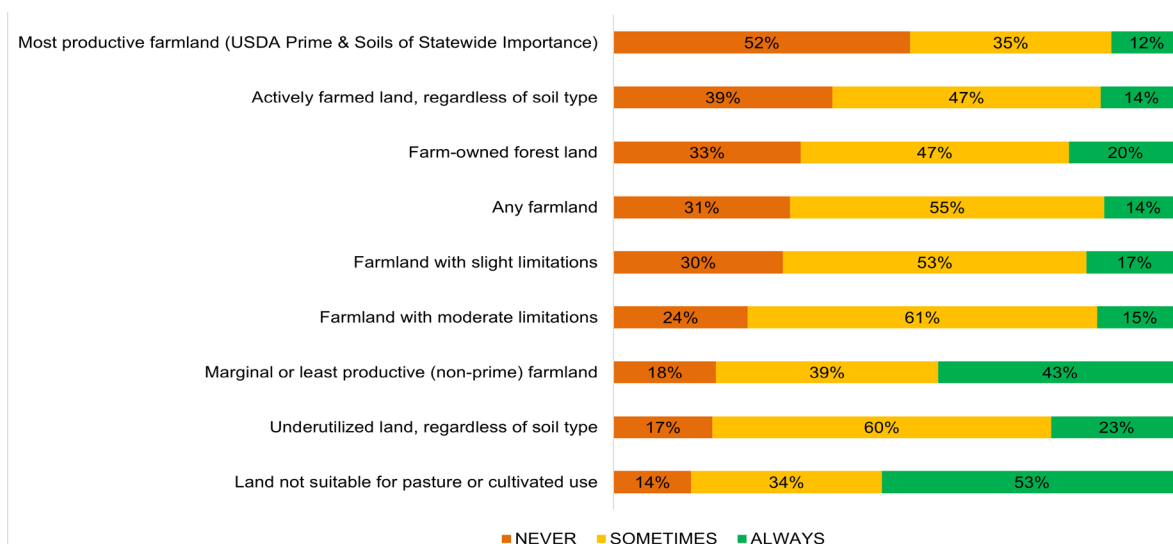
FIGURE 2. IMPACTS OF CONCERN (N=169)



Key concerns about farmland preservation and productivity were further explicated through an assessment of preferences for solar siting based on different types of CT farmland (Figure 3). Survey respondents expressed preference for the most productive farmland (USDA Prime and soils of statewide importance), actively farmed land, and farm-owned forest land to be safeguarded from development. Marginal, underutilized, and land unsuitable for cultivation or pasture are the farmland types most preferred for solar siting among farmers and farmland owners. But existing state policy has greater implications on solar siting based on land type than does stakeholder preference. The CT Department of Agriculture’s Farmland Preservation Program^{viii}, which is among the oldest in the country, has a goal of permanently protecting 130,000 acres of farmland from development. Survey respondents flagged how the provisions around farmland preservation challenge farmland-solar adoption in CT:

“I have non-tillable land that would be excellent for solar panels. Years ago, a solar company presented a plan to put solar panels on pallets not to disturb the land and I would be able to have grazing animals under them. But the state of Connecticut would not allow us to do that because the extra power would be sold back to the grid, and they considered that commercial. I really think that preserved farmland (NOT PRIME TILLABLE) should be able to participate in programs to help us pay the taxes and allow farms to be sustainable.” – Tobacco and corn producer in Hartford County

FIGURE 3. PREFERENCES FOR SOLAR SITING BASED ON FARMLAND TYPE (N=161)



Mitigating Impacts and Concerns – Proactive Planning and Design

Designing projects to allow for continued farming under and around solar panels (i.e., dual-use, agrivoltaics) and holding developers liable for returning land back to a farmable state after decommissioning were identified as the top actions that would help alleviate concerns with solar on farmland. Open-ended responses suggest how key concerns could be addressed through mitigative approaches that prioritize farmland preservation, support continued productivity, and secure land access for future farmers:

“My biggest concern is about decreasing supply of farmland, thereby increasing the barrier to entry for new farmers. There should be a very hefty fee (a large percentage of the rental or purchase price) fed into a fund to support new farmers. Hopefully that would disincentivize solar companies from selecting farmland, and if they absolutely must, new farmers would have ample funds to prepare new land or develop higher intensity farming techniques.” – Small-scale producer and landowner

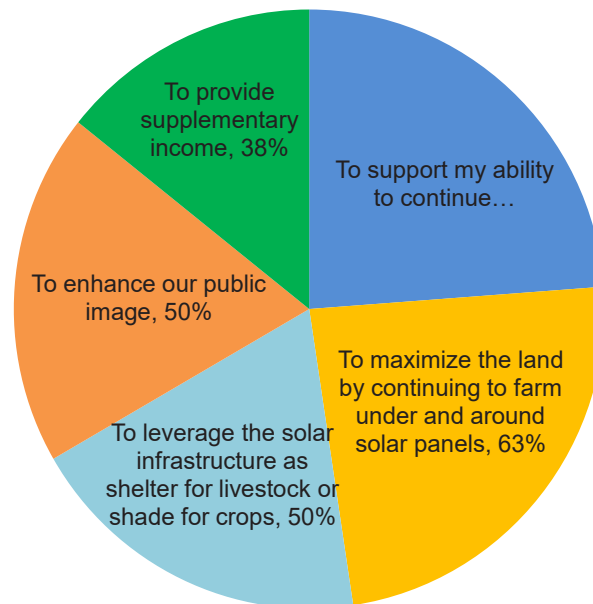
“Solar developers must understand and agree that keeping farmers actively working to provide food, fiber, and agricultural goods now and in the future (including on farmland not currently in production) is an equal or greater priority than the solar development itself is. Solar development on farms and farmland must be a win-win for farmers, the surrounding community, and the state. Any loss of a productive farm or potentially productive farmland to solar development would be a loss and should not be pursued.” – Farm manager in New Haven County

The range of identified farmer concerns highlight that perceived short-term impacts (e.g., farm productivity) and long-term impacts (e.g., land prices) both shape attitudes towards farmland-solar. Decision making around solar adoption is further complicated by farm ownership and succession plans; 42% of respondents noted they have an identified successor working on the farm, while 46% do not – more work is needed to assess what concerns and opportunities CT farmers perceive about solar adoption in relation to farm succession.

SMART SOLAR ON CONNECTICUT FARMLAND: MOTIVATIONS AND OPPORTUNITIES

Many CT farmers and farmland owners are already engaging with solar. Of respondents, 21% produce solar electricity for on-farm energy needs (behind-the-meter), and 8% have leased land for off-farm energy consumption (commercial generation). Respondents involved in lease agreements with solar developers reported leasing from 8%-67% of their farmland for energy generation purposes and disclosed their motivations for doing so. We found the leading motivations for commercial solar adoption are connected to farm viability and land use efficiency (Figure 4). While the proportion of respondents who are already engaged in solar lease agreements (8%) is small relative to the total survey sample, the insight gleaned about motivations inform farmer priorities to be retained in future development.

FIGURE 4. MOTIVATION FOR LEASING LAND TO SOLAR DEVELOPER (N=8)



Dual-use Solar – An Opportunity of Interest to Farmers

AFT explored factors that influence farmer adoption of solar to identify key priorities and opportunities. Both farmers already engaged with solar and those who are not noted key considerations for adoption revolve around the type of land sited, the dual-use of the solar array, and the extent of financial benefit (Figure 5). These considerations mirror the identified factors of importance that impact support for solar on CT farmland, underscoring that these are key farmer priorities to be maintained in the farmland-solar development process. The interest in dual-use solar and the ability of solar to support farm viability was further emphasized by respondents who noted they do not host solar on farm; they identified under which conditions they would be willing: if farming can continue under and around the solar panels; if the project supports continued operation; and if the project provides supplementary income (Figure 6).

"I think there needs to be better designed arrays that farmers can actually use. Shade pens for cows and horses, water collection for animals and storage. Putting out arrays just for solar makes it hard for some farmers to just give up field space." – Landowner in Windham County

FIGURE 5. HOSTING SOLAR ON YOUR FARM – KEY CONSIDERATIONS (N=158)

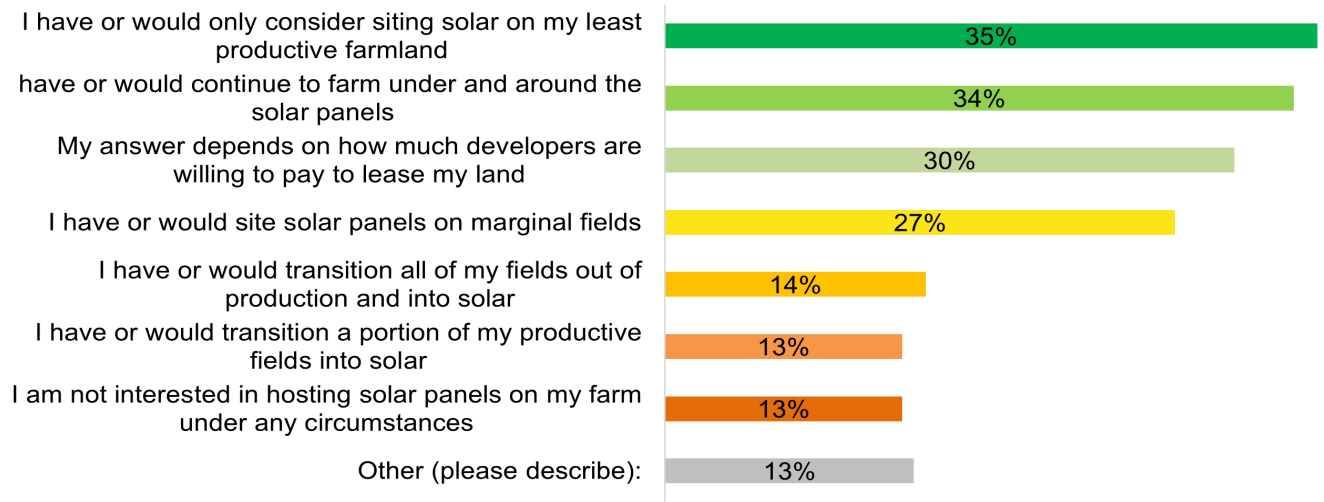
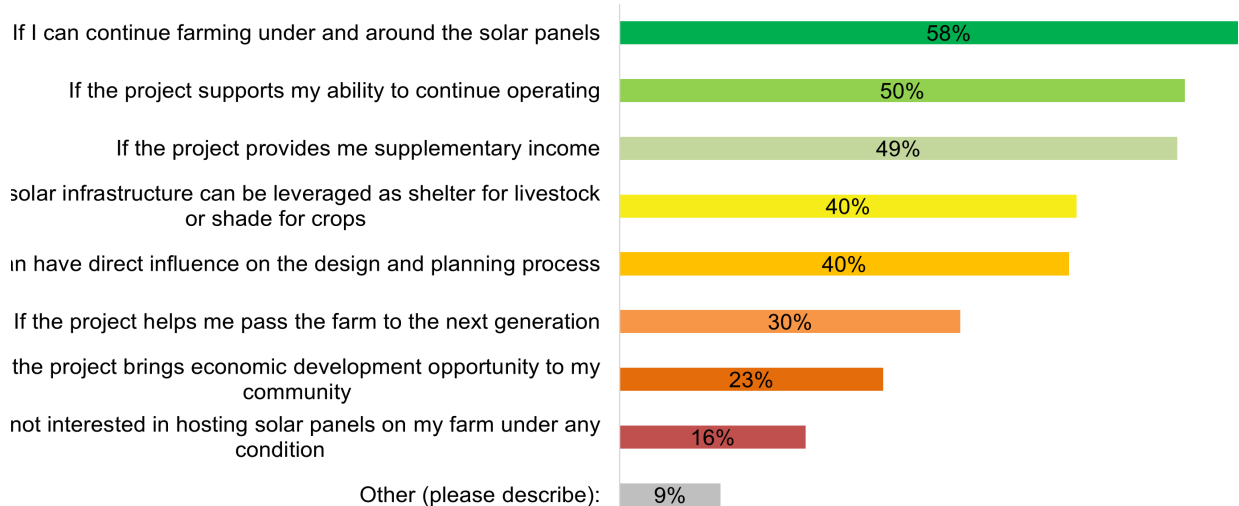


FIGURE 6. CONDITIONS OF INTEREST TO HOST SOLAR ON FARM (N=146)



To support farmers and farmland owners interested in adopting solar, we explored what key services and information is most significant. Most frequently (60%), respondents noted that information on agricultural dual-use/agrivoltaic options would support their decision making about farmland-solar. Information on financial costs and benefits ranked second in importance (51%), followed by information on impacts to farmland soils over time (50%). **The magnitude of interest in solar that supports a dual-use and enhances farm viability emphasizes that Smart Solarsm practices are needed to maximize land efficiency and harness valuable economic opportunities for farmers in CT.**

INSIGHTS FROM THE SOLAR INDUSTRY

Early-stage efforts to advance dual-use in CT indicate that regulatory gaps and complexity, a lack of clear permitting standards and guidelines, and higher capital costs are precluding broader deployment across the state. These regulatory and economic barriers render dual-use projects inaccessible to CT developers. Study participants explained how a lack of CT state agency alignment and coordination on farmland-solar issues increases complexity and costs, and therefore reduces their ability to implement projects in the state. Lacking clear guidelines and expectations from both CT DoAg and CT DEEP, dual-use solar remains onerous for developers:

“The most distinct issue is the lack of a cohesive view in the state from different regulatory bodies. DEEP and the Department of Agriculture have different takes on things. And the way that DEEP has rewritten these SCEF guidelines in some regards has almost forced any type of SCEF project to be on farmland.” – CT based company with experience in dual-use development

“There’s a lot of trying to make [solar on farmland] work and we sit back and look at it from our side and say, “Well, if you just got everybody together on this, we could streamline this whole thing and make it work better for everybody.” – CT based solar developer

Further, industry participants stressed the importance of cross-sector partnerships for informing best practices for farmland-solar. To design successful projects that meet the needs, priorities, and concerns of farmers, developers are keen on working across sectors – participants explained how their ability to deliver legitimate dual-use projects is contingent on input from the CT farming community.

Solar developers explained how regulatory hurdles and a lack of farmer-informed best practices increase project development soft costs. They also stressed how dual-use installations have higher hard costs relative to conventional projects. Together, these increased costs preclude solar industry adoption of dual-use and consequently thwart the potential for dual-use to enhance farm viability in CT. Study participants emphasized how the high cost of dual-use needs to be addressed through market mechanisms to stimulation adoption. **These findings indicate that a comprehensive policy framework that supports cost-effective, cross-sector innovation is critical for the success of Smart SolarSM on CT farmland.**

Summary of Findings

- Solar impacts on farmland preservation, land prices, land access, and farm productivity are most concerning to farmers and farmland owners.
- Farmers are interested in solar projects that maintain the dual-use of land and enhance farm viability.
- Regulatory complexity, a lack of clear permitting standards, and higher capital costs challenge solar industry adoption of farmland-solar.
- The magnitude of interest in dual-use solar underscores strong potential for Smart Solar to address concerns and create opportunities for CT farmers.



Dual-use crop and cattle project in Grafton, Massachusetts

RECOMMENDATIONS TO ACHIEVE SMART SOLAR IN CONNECTICUT

AFT's recommendations are a synthesis of findings from the statewide farmer survey, solar developer interviews and roundtable, and discussions with other key stakeholders in CT. We also consulted the project advisory committee and convened agency briefings with DoAG, DEEP, and PURA staff to further refine a framework for Smart Solarsm in CT. The resulting recommendations are intended to stimulate the cross-sector coordination and policy innovation that is needed to mitigate impacts to CT farmland while also creating opportunities for solar to enhance farm viability and agricultural diversification. Based on these intentions and the insights from key stakeholders in the state, to achieve Smart Solarsm in CT AFT recommends:

AFT'S **SMART SOLARSM** RECOMMENDATIONS FOR CONNECTICUT

1. Maintain and expand state funding and programs designed to support farmland protection, climate-smart agriculture, and incorporate Smart Solarsm principles.
2. Direct development away from high quality farmland and implement a Farmland Mitigation Fee.
3. Institute a cross-sector working group and boost agency capacity to tackle farmland-solar issues.
4. Explore market-facing mechanisms, such as bid preferences, in the annual state renewable portfolio standard procurement process that reward projects implementing bona fide dual-use, ecosystem services, and farm viability practices and applications.
5. Develop financial incentives and market mechanisms for dual-use/agrivoltaics.
6. Establish clear standards and strengthen enforcement authority to support Smart Solarsm methods.
7. Invest in and support UCONN Extension as a key hub for farmland-solar research, farmer and stakeholder engagement, dual-use demonstration projects, and ongoing technical assistance for climate-smart agricultural practices.

Maintain and Expand Farmland Protection

With Smart Solarsm policies and continued investment in farmland protection, Connecticut can guide expansion of renewable energy installations in ways that minimize negative impact on the state's best farmland, which plays a critical role in addressing climate change. Pressure from utility-scale solar development compounds the already severe "competition for land" in CT and New England, underpinning the need to advance strategies for solar development and grid infrastructure. Done right, Connecticut can be a regional leader in advancing clean energy while reinforcing conservation of the state's most productive farmland and other natural resources.

To that end, the Department of Agriculture administers a farmland protection program that is currently funded through bond funds allocated by the CT General Assembly and Community Investment Act funds. To date, this program has protected over 400 farms covering approximately 48,000 acres (personal correspondence with CT DoAg). With the rising cost of farmland, increased funding for state farmland protection program is critical. Governor Lamont's Executive Order 21-3^{ix} (December 2021), directs DoAg to accelerate and streamline the process to protect working lands with the goal of increasing transactions and doubling the number of easements closed in four years. Governor Lamont also encourages the Department to evaluate program challenges that are hindering achievement of these goals, while including equity, adaptation, mitigation, and resiliency elements in the process. In alignment with this Executive Order, AFT supports more robust funding for farmland protection as well as opportunities for on-farm renewable energy generation on conserved farms.

Implement a Farmland Mitigation Fee

To protect CT's most productive farmland AFT recommends design and implementation of a statewide Farmland Mitigation Fee for projects with significant impacts on agricultural resources. A Farmland Mitigation Fee, such as the agricultural payments required for certain projects exceeding 30 acres of impact to high quality soils in New York state^x, encourage development on disturbed sites and less productive agricultural areas. The resulting funds should be dedicated to municipal or state programs that protect farmland and be invested in actions that support farm viability^{xi}. This "disincentive" approach can avoid displacement of CT's most productive farmland, reduce the value of solar on farmland that isn't dual-use, and ultimately encourage solar industry innovation. AFT recommends the cost structure of the Farmland Mitigation Fee to be based on the amount and quality of land, land use (e.g., dual-use), and project type (on-farm versus commercial). The farmer preferences for solar siting based on land type identified in this report can inform the Farmland Mitigation Fee structure for CT.

To minimize solar impacts on land access and price in CT, AFT recommends that the feasibility of municipal-wide or statewide caps on farmland conversion due to utility-scale solar is explored, as recently enacted in New Jersey^{xii}. Development caps could enforce a threshold limitation on farmland conversion and therefore protect agricultural economies in CT. Further, the fulfillment of Agriculture Impact Mitigation Agreements by solar developers could be pursued to help preserve the integrity of farmland for future farmers. These mitigative policy mechanisms can ensure that safeguarding as much of the state's farmland base as possible, now and in the future, remains a priority during CT's energy transition.

Institute a Cross-sector Working Group and Boost Agency Capacity

To inform dual-use standards in CT, a cross-sector Smart Solarsm working group is recommended to represent farmers, developers, land trusts, and regulator perspectives. This public working group could aim to build constituency, elevate farmer voices, and educate developers and regulators on Smart Solarsm practices. This could also include representatives with experience in dual-use from neighboring states to encourage more regional thinking and expedite the learning process in CT. The results from this survey can help the working group formulate dual-use guidelines, best practices, and specific targets to be approved and implemented by PURA, and ultimately enforced by the Connecticut

Siting Council. To enable action and accountability for dual-use solar development, PURA should defer to the expertise of the Smart Solarsm working group, which can inform the formal process for enactment of farmland-solar standards.

Expanding the expertise of CT DEEP and CT DoAg to ensure adequate coordination and innovation across agencies is also critical to support both farmers and developers interested in low impact solar development and incentives for dual-use. To this end, AFT recommends legislative support and funding to enable greater state agency capacity to focus on farmland-solar issues. An agriculture and forestry representative may also be added to the Connecticut Siting Council and/or PURA to reduce friction and provide clarity for solar siting on farmland. It is recommended that a joint process and timeline is established and streamlined for collaborative review of farmland-solar proposals.

Explore Bid Preferences for Multi-use Projects

The shared learning resulting from the working group and agency expansion will help to inform and shape mechanisms to support dual-use/agrivoltaics, such as competitive bid-preference criteria and pricing incentives. AFT recommends a study to evaluate the feasibility of bid preferences instituted by PURA to reward solar developers that incorporate dual-use and/or climate-smart agricultural practices in projects, such as regenerative farming, enhanced grazing land management, and pollinator habitat establishment that improve soil health and enhances soil carbon sequestration. A bid-preference program would place value on critical ecosystem services and encourage industry innovation through a 20% preference for multi-use projects or through a point-based system, like one enacted in Illinois^{xiii}. The bid-preference criteria could also direct development patterns to benefit CT farmers by awarding preference for projects that provide farm-energy offset and are farmer-owned. Similarly, points can be offered to incentivize on-farm solar and deter utility-scale projects on farmland.

Develop Market Mechanisms for Dual-use Solar

While a bid preference is an effective strategy to encourage farm-compatible solar development, it does not fully address higher capital costs associated with dual-use projects. Improving the price-performance of dual-use will be key to increase industry adoption in CT, therefore AFT recommends that market mechanisms, such as a tariff-based dual-use/agrivoltaic adder or preferential financing, are developed. Insights from the working group and the findings from this survey study could inform the incentive framework for different types of farmland and farmer priorities. The incentive program could feature a tiered adder framework to drive development towards certain types of farmland and types of solar projects (e.g., on-farm, commercial). AFT recommends an incentive program for dual-use in CT is focused on long-term farm viability – flexible provisions that minimize solar array specifications but focus on agricultural production outcomes can provide developers and farmers the latitude to design projects that support changing farming practices over time and accommodate specific farming needs.

Attractive financing from Connecticut Green Bank for projects that meet dual-use objectives could also be considered. Preferential financing or better loan rates could increase the cost-competitiveness of dual-use and therefore stimulate smarter solar practices on CT farmland. Market mechanisms for dual-use will make development more cost-effective, which increases the flow of financial benefit to farmers who engage in solar lease agreements. The increased capital provided to the developer who delivers a bona fide dual-use project should translate into a higher lease payment for the farmer and farmland owner. These approaches can ensure consistent income for farmers and contribute to a legacy of solar projects that maintain agricultural production.

Strengthen Enforcement Authority and Smart Solarsm Siting Methods

To ensure farm viability is supported in the long term, inter-agency enforcement authority and methods should be established to measure and maintain performance over the lifetime of farmland-solar projects. AFT recommends accountability and compliance with dual-use criteria and Smart Solarsm Siting Guidelines^{xiv} that are promulgated by PURA and enforced by the Connecticut Siting Council. As administrator of energy programs in CT, it is recommended that PURA solicit input for rigorous eligibility requirements, maintenance standards, and decommissioning considerations from the Smart Solarsm working group and incorporate these when formulating specific energy procurement targets and project review by the Connecticut Siting Council. Keeping developers accountable and guaranteeing long-term agricultural productivity will require the Connecticut Siting Council to ensure adherence to project standards, performance targets, and ongoing dual-use operation over the lifetime of the system.

Support UConn Extension as a Key Leader

AFT advocates for increased funding to support the University of Connecticut Extension as a key hub for dual-use in CT. It is encouraged that UCONN Extension explores their ability to contribute to regionally relevant crop trials, soil impact assessments, and demonstration. Funds from DoAg's Climate Smart Agriculture Grant^{xv} (FY 2023) could be used to institute a technical assistance or training program and drive farmland-solar workforce development at UCONN Extension in collaboration with the UCONN Center for Land Use Education and Research (CLEAR). Additionally, new staff members could be incorporated and trained to focus on land use and energy issues within UCONN Extension. AFT also recommends that UCONN Extension engage in a regional network partnership with other Extension offices to increase their capacity to address farmland-solar issues and contribute to the future of Smart Solarsm in CT. Other land-grant institutions such as University of Massachusetts Clean Energy Center, Rutgers University Agrivoltaics Program, and Cornell's Sustainable Solar research program can serve as models for UCONN.

CONCLUSIONS: SMART SOLAR LOOKING FORWARD

The challenges and opportunities at the nexus of energy and agriculture in Connecticut are a microcosm of broader regional circumstances. CT is representative of densely populated, land-constrained states with aggressive renewable energy goals and rich agricultural heritage – which is why it serves as a good case study to inform a better pathway forward that mitigates tradeoffs between clean energy and agricultural viability in other New England states. While the insights provided in this report are especially valuable for CT, more work is needed to further refine Smart Solar strategies based on robust interdisciplinary research and cross-sector policy innovation.

Recommendations for Future Research

This project has identified key research priorities in pursuit of smarter solar practices. First, increased attention to distinctions in interest and concern with solar across farmer demographics is warranted. A more segmented analysis is needed to understand variance in issues across farm-renters versus farmland owners, young versus older farmers, and small versus large-scale producers. Greater focus on impacts of solar development on farmland price and access is also critical – future research should aim to understand implications at the community and state level, and to develop mitigation measures that minimize negative impacts.

Second, the findings of this farmer survey indicate variation in support for solar across project types (on-farm versus commercial). Future efforts should focus on defining the implications of Farmland Purchase of Development Rights programs on solar siting and ownership across project types, including the potential to implement allowances around bona fide dual-use projects. Similarly, economic and policy research efforts could focus on the potential for restructuring property taxes associated with dual-use solar, which could keep land involved in dual-use assigned an agricultural tax to incentivize industry innovation and make farmland-solar more financially viable for farmers. Research is also needed to assess options for agricultural landowners to directly finance farm-owned dual-use systems and the availability of third-party financing of such projects to enhance farm viability.

Third, AFT emphasizes opportunities for future research led by UCONN Extension, UCONN CLEAR, and/or other institutions such as Yale School for the Environment to advance Smart Solarsm in CT. This includes but is not limited to a technical feasibility study to evaluate pathways to achieve state energy goals relative to transmission and land constraints. A geospatial database that identifies viable locations for solar development, including disturbed lands and potential dual-use sites, could accelerate Smart Solarsm siting.

Lastly, more research is needed to assess solar impacts on crop productivity and soil health in New England, and specifically in CT. Horticultural and soil science research should collect and aggregate microclimate and yield data produced by dual-use demonstration plots relevant to CT's top agricultural commodities. The findings could inform UCONN Extension training programs and technical assistance, and advise solar construction and decommissioning standards that mitigate impacts to land.

Ensuring an Abundant Future

In conclusion, Connecticut's clean energy goals are a key state priority that must also be well aligned with state farmland preservation goals and thriving agricultural communities. Reconciling trade-offs between critical land uses and achieving Smart Solarsm goals will demand creative and proactive effort, with cross-sector engagement and inter-agency coordination. AFT is enthusiastic about the potential for a Smart Solarsm approach supported by research and policies designed to avoid, minimize, and mitigate impacts of solar development on farmland while enhancing farm viability. Applying the Smart Solarsm strategies proposed in this report will help maximize the economic and environmental opportunities associated with solar development, while safeguarding Connecticut's agricultural heritage and rural communities.



Million Little Sunbeams – Dual-use hay site in Monson, Massachusetts Photo credit: AgriSolar Clearinghouse



CITATIONS & ADDITIONAL RESOURCES

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^{vii}American Farmland Trust. (2021). Farmland Needed: How Connecticut Can Help Farmers Access the Land They Need to Succeed. Retrieved from <https://portal.ct.gov/-/media/DOAG/publications/Farmland-Needed--How-Connecticut-Can-Help-Farmers-Access-the-Land-They-Need-to-Succeed.pdf>

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Additional Resources

AFT New England Smart Solar – Collection on Farmland Information Center: https://farmlandinfo.org/collections/?special_collections=new-england-smart-solar-siting

Solar Leasing: A Guide for Agricultural Landowners in the Pacific Northwest. Published November 2022 by American Farmland Trust, Farm Commons, USDA, Western Extension Risk Management Education: <https://farmlandinfo.org/publications/solar-leasing-a-guide-for-agricultural-landowners-in-the-pacific-northwest/>



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