Agricultural Solar Stakeholder Group
June 3, 2021 Meeting Materials

Agricultural Solar Stakeholder Group Meeting
Thursday, June 3, 2021; 9:00 am - 12:00 pm

Meeting Registration Link:
https://mainestate.zoom.us/webinar/register/WN_8hs0stsjS62VoE3nQNSRMA

Desired Outcomes

By the end of this meeting we will have:

- Agreed on a shared set of ground rules for working together
- Learned about the scope of solar development and associated drivers in Maine
- Learned about the importance of agricultural soils (prime and statewide importance) and some technical resources for identifying them
- Agreed on the charge of the Stakeholder Process by developing a problem statement and list of shared principles
- Provided an opportunity for public input

Agenda

What	When
Initial Welcome and Agenda Review – Jo D. Saffeir (Facilitator) Welcome and Purpose – DACF Commissioner Amanda Beal Nancy McBrady & Celina Cunningham (co-Chairs) Meeting Process and Ground Rules Review – Jo D. Saffeir	9:00 - 9:15
Stakeholder Group Member Introductions	9:15 - 9:30
Current Scope of Solar Development and Drivers in Maine - Celina Cunningham & Ethan Tremblay, Governor's Energy Office	9:30 - 10:00
Solar Siting Mapping Tool - Sarah Haggerty, Maine Audubon	10:00 - 10:30
Break	10:30 - 10:40

Articulation of Problem Statement and Shared Principles	10:40 - 11:20
Identification of Solar Siting Levers for Group's Future Consideration	11:20 - 11:40
Public Comment	11:40 - 11:50
Next Steps and Next Meeting: Thursday, June 24, 9:00 am – 12:00 pm	11:50 - 12:00

Agricultural Solar Stakeholder Group Process

DRAFT Ground Rules

1. Meetings start and end on time.
2. Come prepared, having read all meeting materials in advance.
3. Be present and engaged.
4. Strive for equal air time, enabling everyone to participate fully.
5. Listen with curiosity and an openness to learning and understanding.
6. Adopt a creative problem solving orientation.
7. Commit to working toward consensus.
8. Meetings and materials are public, and comments are on the record.
9. Humor is welcome; it's OK to laugh while addressing a serious topic.

Decision-making: Decisions by the Stakeholder Group are advisory and represent recommendations to the Department of Agriculture, Conservation & Forestry and the Governor's Energy Office. The Stakeholder Group will strive to make decisions by consensus. Where not possible, recommendations supported by the majority will be advanced and other perspectives will be noted.

Agricultural Solar Stakeholder Group Membership

Co-Chairs	
Celina Cunningham	Governor's Energy Office
Nancy McBrady	Dept. of Agriculture, Conservation and Forestry
Stakeholders	
Nick Armentrout	Spring Creek Farm
Emily Cole	American Farmland Trust
Heather Donahue	Balfour Farm
Ellen Griswold	Maine Farmland Trust
Sarah Haggerty	Maine Audubon
Kaitlin Hollinger	BlueWave
Matt Kearns	Longroad Energy
Fortunat Mueller	ReVision Energy
George O'Keefe	Town of Rumford
Jeremy Payne	Maine Renewable Energy Association
Andy Smith	The Milkhouse
Julie Ann Smith	Maine Farm Bureau
Patrick Wynne	City of Hallowell
Staff	
Yvette Meunier	Dept. of Agriculture, Conservation and Forestry
Ethan Tremblay	Governor's Energy Office
Facilitator	
Jo D. Saffeir	jsaffeir@gmail.com

Agricultural Solar Stakeholder Group Summary

What

The Maine Department of Agriculture, Conservation and Forestry (DACF) and the Governor's Energy Office (GEO) are convening a stakeholder group to examine the status of solar energy development on prime farmland and soils of statewide importance. Prime farmland and soils of statewide importance are critical natural resources and are key to Maine's current and future agricultural productivity, biodiversity, and food security. Solar energy development is key to reducing greenhouse gas emissions and creates economic benefits in communities throughout the state.

Why

- In 2019, Maine enacted emissions reduction and renewable energy targets and other policies that encourage solar development. Solar developers are actively working to secure potential sites for solar installations, including agricultural land.
- Recent reports from other New England states suggest that much of the land used will be previously undeveloped farmland and forestland.
- Ground-mounted solar arrays are likely to have useful lives of at least 25-30 years.
- Farmland is already under immense pressures and threats of development in the US. Between 1992-2012, 31 million acres of agricultural land was lost to development.
- Maine is in a unique position to grow its food economy locally, regionally and nationally; however, that will require preserving working lands for future generations.
- Given the importance of farmland, the State is considering whether additional mechanisms are needed to adequately preserve farmland, including agricultural soils. The group will also discuss whether there are important agricultural resources beyond soils that should be considered.
- Dual-use farmland can be an important tool for diversifying income to farms. Opportunities for aligning solar and agricultural uses may exist with increased education and engagement.

How

- Identify potential solar siting policy levers
- Create guidance for solar development based on the proposed the array's size, location, or design
- Additional priorities can be identified by group

When

The stakeholder group will meet monthly during the summer and autumn of 2021, targeting a report with consensus where possible and recommendations by January 2022.

Who

Stakeholders including representatives of Maine's agricultural community, renewable energy developers, municipal representatives, advocates, and relevant state agencies. The stakeholder group will solicit information from additional subject matter experts. DACF and GEO will co-chair and provide staff support.

Agricultural Solar Stakeholder Group Outline

Statement of the Issues:

- In 2019, Maine law changed to encourage solar development. Solar developers are actively working to secure potential sites for solar installations, including agricultural land.
- Recent reports from other New England states suggest that much of the land used will be previously undeveloped farmland and forestland.[1]
- Ground-mounted solar arrays are likely to have useful lives of at least 25-30 years.
- Farmland is already under immense pressures and threats of development in the US. Between 1992-2012, 31 million acres of agricultural land was lost to development.[2]
- Maine is in a unique position to grow its food economy locally, regionally and nationally; however, that will require preserving working lands for future generations.
- Given the importance of farmland, the State is considering whether additional mechanisms are needed to adequately preserve farmland, including agricultural soils. The group will also discuss whether there are important agricultural resources beyond soils that should be considered.
- Dual-use farmland can be an important tool for diversifying income to farms. Opportunities for aligning solar use with pollinator habitat, meadow/grassland ecosystems and/or mixed agricultural use may exist with increased education and engagement.

Major Focus Areas:

I. Define Priorities/Principles

- Prime farmland and soils of statewide importance are critical natural resources and are key to Maine's current and future agricultural productivity, biodiversity, and food security.
- Solar development is key to reducing greenhouse gas emissions and creates economic benefits in communities throughout the state.
- Create guidance for solar development based on the proposed the array's size, location, or design
- *Additional priorities can be identified by group*

[1] Wildlands and Woodlands, Farmlands and Communities Report. Harvard Forest, Harvard University (2017).
[2] Farms Under Threat: The State of America's Farmland, American Farmland Trust (2018).

II. Identify Potential Solar Siting Levers

- What mechanisms should be considered to ensure that prime farmland and agricultural soils of statewide importance are not permanently and irreversibly impaired by solar development?
    - Design best practices (e.g. mounting hardware)?
    - Statutory protection in Maine law?
    - Limited to certain % of proposed project footprint? Total acreage?
    - Limited to less productive acreage?
    - Mitigation Fund (In Lieu Fee) model?
    - Additional siting considerations?[3]
    - Farm and Open Space Tax Law implications
- Other state models?
    - https://farmandenergyinitiative.org/wp-content/uploads/2020/08/Final-FSPP-Toolkit-Report.pdf
    - NY: Guidelines for Solar Energy Projects – Construction Mitigation for Agricultural Lands
- Determine appropriate state entity, capacity, and role
    - DACF/DEP/PUC?
    - Staff capacity and timeframe?
- Appropriate implementation mechanism?
    - State-issued guidance
    - Third-party guidance
    - Additional regulatory requirements
        - Alternatives analysis?
        - Cumulative impacts?
        - Criteria (similar to NRPA?)
        - Decommissioning

III. Identify Practical Interventions to Drive Appropriate Development

- Many dual-use projects are not currently financially competitive. Such projects may currently require additional costs (maintenance, types/spacing of arrays, insurance) and the loss of production to allow for crops/animal access, etc.
    i. The Massachusetts SMART tariff establishes an "Agricultural Solar Tariff Generation Unit," or ASTGU, which receives a six-cent rate adder for solar arrays designed to coexist with agricultural production. https://www.mass.gov/files/documents/2017/10/16/225cmr20.pdf
- Incentives for previously disturbed sites/marginal lands/impervious areas?

[3] E.g. pollinator habitat: https://www.canr.msu.edu/news/michigan-pollinator-habitat-planning-scorecard-for-solar-sites

IV. Process and timeline

- Launch six+ month process (with option to continue group meetings into 2022).
- DACF and GEO to co-chair and staff.
- Meeting purposes
    - Assemble group, formalize processes and plan
    - Fact-finding/presentations to stakeholder group
    - Process to synthesize findings with objective of consensus where possible
    - Finalize deliverable – report with findings and recommendations

V. Draft Calendar

- June 2021 – First Stakeholder Meeting
    i. Focus: Formalize processes and plan; define priorities.
- June 2021 – Second Stakeholder Meeting
    i. Begin discussing "solar siting levers" – one or two topics per session? Factfinding/presentation/discussions
- July 2021 – Third Stakeholder Meeting
    i. Continue discussing "solar siting levers" – new one or two topics with Factfinding/presentation/discussions
- August 2021 – Fourth Stakeholder Meeting
    i. Finish discussing "solar siting levers" – final topics with factfinding/presentation/discussions
    ii. Discuss practical interventions with factfinding/presentation/discussion
- September 2021 – Fifth Stakeholder Meeting
    i. Synthesize findings with objective of consensus
    ii. Identify deliverable and assign staff/others for drafting
- October/November 2021
    i. Circulate draft deliverable; convene to receive feedback and finalize.
- December 2021/January 2022
    i. Deliver report/status update/memo to Legislature

Executive Summary

In 2019, Governor Mills signed LD 1494, "An Act to Reform Maine's Renewable Portfolio Standard (RPS)," which sets ambitious renewable energy targets for the state. The act requires 80% of Maine's electricity to come from renewable resources by 2030 and sets a goal of having 100% of Maine's electricity served by renewables by 2050. In addition, the electric sector is expected to support rapid load growth due to electrification of end uses, especially in the transportation and building sectors, to help meet the state's greenhouse gas (GHG) reduction goals.

Maine, like much of New England, has these dual goals to achieve – 1) serving growing and likely more dynamic load due to electrification, and 2) increasing the share of renewables serving the state's electricity needs. Maine has an abundance of high-quality renewable resources available for development that positions the state well to achieve both these goals. At the same time, Maine's current resource mix, geography, and population distribution pose unique considerations that need to be addressed through intentional action and thoughtful policy support to the market to ensure that the renewable transition is effective, affordable, and equitable.

This study, sponsored by the Maine Governor's Energy Office (GEO) and conducted by Energy & Environmental Economics (E3) and Applied Economics Clinic (AEC), fulfills the requirements of LD 1494, which called for a Renewable Energy Goals Market Assessment (REGMA) to assess options for how to meet the renewable transition in Maine over the next decade. It is meant to support policy discussions and decision-making to achieve the state's RPS. The analysis in this study is meant to complement the work of the Maine Climate Council (MCC) in studying and supporting pathways to meeting Maine's clean energy and GHG reduction requirements.

The REGMA analyzes six future scenarios to explore plausible renewable portfolios that would enable Maine to meet its 2030 RPS target. The scenarios were informed by stakeholder feedback and are meant to reflect the characteristics that are unique to Maine – onshore resource potential, land use considerations, transmission availability, offshore wind potential, and coordination with the rest of New England. Comparing the resource portfolios, costs, and equity impacts across the scenarios provides insight into the possible effects of each of these unique characteristics on Maine's electric sector and population. Taken together, these individual effects paint a larger picture of the opportunities and challenges that Maine may face as it works towards achieving the RPS. As such, ***the scenarios and their results are not meant to be prescriptive*** and are instead intended to highlight the considerations to support policy discussions and decisions related to the RPS.

Key findings from the study that provide insight into how Maine may achieve its RPS target in the next decade are found below.

- ***Maine is on track to meeting its RPS until 2026, but new resources will be needed to meet increasing goals thereafter***. A combination of existing generation and resources procured previously and through LD 1494 and LD 1711, "An Act To Promote Solar Energy Projects and Distributed Generation Resources in Maine," will be sufficient to meet the need for renewable

energy credits (RECs) until 2026. Beyond this point, new resources will be needed to meet increasing goals. Scenario analysis indicates a range of new builds between 800 and 900 MW by 2030 will be needed. This need can be satisfied by a number of resources, though each requires the consideration of tradeoffs: Maine's high-quality onshore wind potential is largely inaccessible absent investments in transmission; small-scale solar may be developed in proximity to loads and provides resiliency, but significant transmission and distribution upgrades are likely needed to interconnect large amounts of these systems; and offshore wind is still in the nascent stages of technological development but could emerge as a competitive source of renewable supply. Given the challenges facing renewable development in the state – particularly with respect to transmission – there is need for action well before 2026 so that the intervening years are used to develop and implement plans to ensure enough new renewable generation is online and operational by 2026. Further, given federal tax incentive expiration, there are cost savings to advancing development to before 2026.

+ ***Transmission will be a key driver of renewable development***. Building new transmission is difficult in New England and can be challenging in Maine. At the same time, the report required by LD 1401[1] and subsequent findings show that key transmission pathways in Maine are severely congested and constrained. This study highlights that many lower-cost pathways to meet Maine's RPS requirements in the next decade are achievable through the development of high-quality wind resources in western and northern Maine, which in turn require new transmission investments. The scale of these transmission investments, along with the longer development timelines as compared to renewable projects, will make it difficult for any single wind project to shoulder the development burden of these transmission projects. Limited transmission availability will present similar challenges for the development of other generation sources, such as solar. A state-sponsored anticipatory transmission planning process could help address this issue by identifying the transmission needed to meet the RPS in advance of renewable development. Maine could look to states like Texas (Competitive Renewable Energy Zone, or CREZ, process) or California (Renewable Energy Transmission Initiative, or RETI) to see how other states in similar situations have successfully approached this challenge.

+ ***A technologically diverse portfolio helps lower risk***. Each resource type has its own set of challenges that introduce risk into the resource portfolio. Onshore resources in western and northern Maine require transmission upgrades and could face siting challenges. Floating offshore wind is not yet deployed at scale and thus has a higher initial cost, which may decrease with increasing penetration. Large penetrations of distributed generation, which are expected by 2025 (500 MW), will likely require distribution and transmission upgrades. There is also uncertainty associated with the resource costs, as technologies are continuing to evolve. Pursuing a diverse portfolio serves as a hedge against several uncertainties, including slower-than-expected cost declines and the development of new transmission. This study explores one such diverse portfolio, but the appropriate mix will be ultimately decided to meet multiple policy objectives.

[1] *"Resolve, To Study Transmission Solutions to Enable Renewable Energy Investment in the State Final Report," 2020.*

- ***Regional coordination can help lower the costs of meeting Maine's RPS***. In addition to having a large amount of land for renewable development, Maine has some of the highest-quality wind resources available in New England. If developed, these resources can help to meet both Maine and the broader region's clean energy goals. New transmission is required to access these resources, however, due to their remote location. The study results show that coordination of Maine with neighboring states can mitigate the "lumpiness" challenge of new transmission investment—that transmission projects are generally large in size, are expensive, and the full project has to be developed before any benefits can be realized—so that Maine's customers do not bear the full cost of transmission to access high-quality wind resources in the northern and western parts of the state.
- ***Storage paired with solar resources can provide value***. Storage paired with solar was found to be chosen economically alongside onshore wind. Maine's winter peak is projected to increase with heating electrification. Pairing solar with storage improves the combined generation profile of these hybrid resources, enabling them to generate during evening peak demand, increasing their value to the system. Storage has additional benefits, such as transmission and distribution deferral value, resiliency, and ancillary services provision, which are not captured in this RPS-focused study. Including these value streams is likely to further improve the economics of storage.
- ***Energy equity challenges cut across four dimensions: resource diversity, customer-sited resources, geographic resource distribution, and cost.*** Successfully achieving Maine's renewable energy goals may result in at least three benefits for its vulnerable communities: 1) reductions in emissions resulting in corresponding improvements in air quality and human health, 2) renewable resources increasing the energy supply's resiliency, and 3) clean energy development creating employment and community investment. Ensuring equity considerations are prioritized during Maine's clean energy transition requires careful attention to resource diversity, customer-sited resources, geographic resource distribution, and the cost impacts experienced by vulnerable communities. Thoughtful selection of a resource mix should be complemented with periodic review and modifications to rate structure to ensure Maine's vulnerable communities are not adversely impacted. Investment in programs that provide resources to vulnerable communities should also continue to be supported. Furthermore, siting of new resources should consider and seek to minimize impacts to existing industries, stakeholders, communities, and natural resources.

This study finds that Maine has several economical pathways to meet its renewable goals. Each resource option has its own set of challenges to overcome, with the primary challenge being building transmission to access high-quality renewables in the state and the associated siting, permitting, and environmental concerns. This study outlines potential policy implications of the renewable transition and is meant to support policy considerations as the state charts its way to a high renewable future.

STRATEGY C

REDUCE CARBON EMISSIONS

in Maine's Energy and Industrial Sectors Through Clean-Energy Innovation

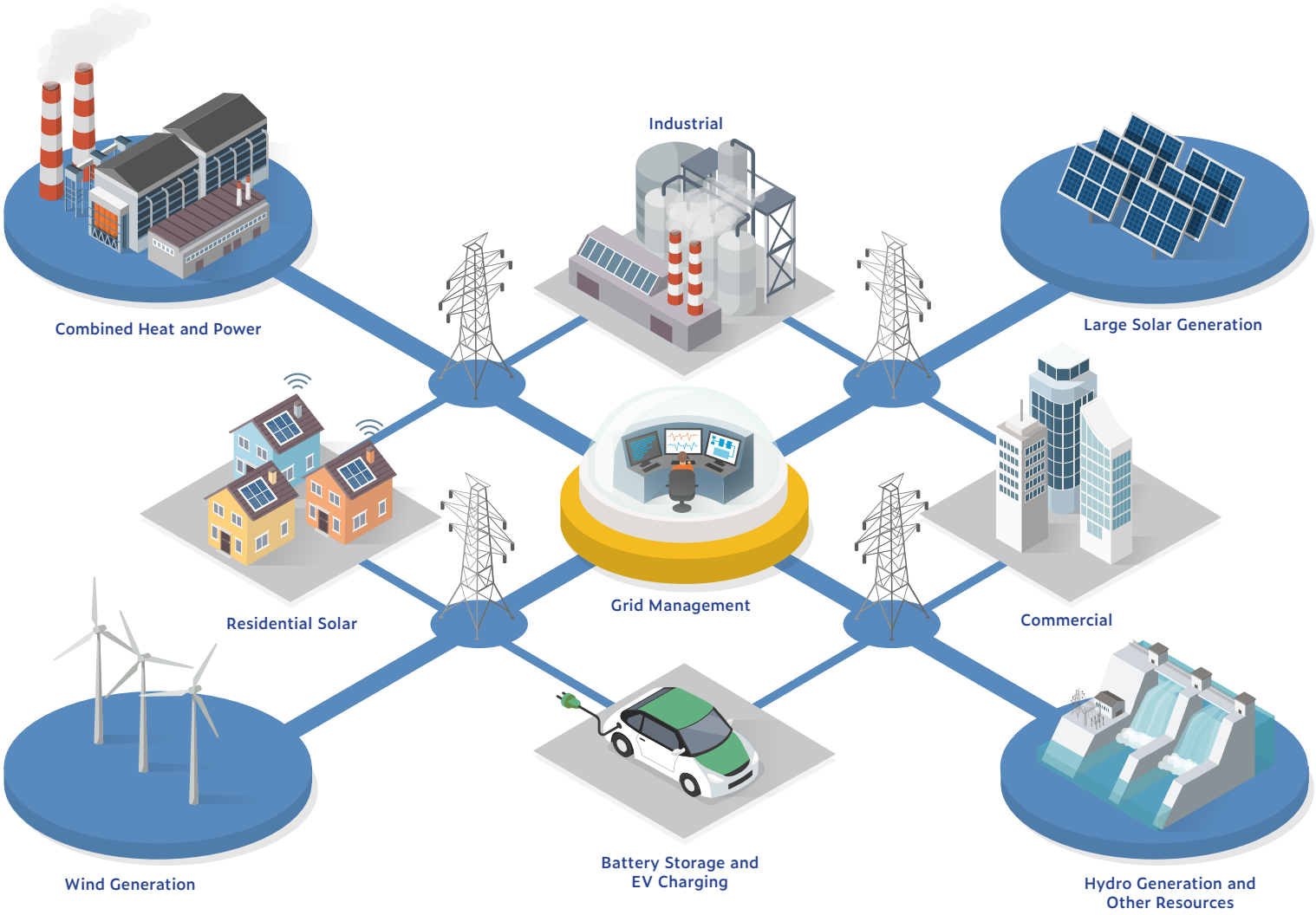
Sectors with high greenhouse gas emissions, such as transportation and heating, must shift their energy sources from fossil fuels to electricity and low-carbon fuels to achieve Maine's climate goals. This makes it even more essential to produce and consume electricity that is increasingly clean and from lower-emissions resources. This transition must be managed effectively to ensure affordability and reliability.

Maine is a member of a cooperative effort by 10 Northeast and Mid-Atlantic states to limit emissions called the Regional Greenhouse Gas Initiative (RGGI). RGGI is the first mandatory, market-based carbon dioxide (CO_2) emissions reduction program in the United States, and it is focused on the power-generating sector. RGGI proceeds in Maine have been used to provide technical assistance and financial incentives to help Maine's residents, institutions, businesses, and industries make investments in energy efficiency.

A Renewable Portfolio Standard (RPS) establishes the percentage of electricity that an electricity supplier is required to provide from renewable resources. To encourage more generation of lower-emissions electricity, Maine has increased the state RPS to 80% by 2030, with a goal of 100% renewable electricity by 2050. Additionally, pairing energy storage with small distributed and large utility-scale renewable resources provides opportunities to maximize the value of renewable energy to our electric grid.

DISTRIBUTED ENERGY RESOURCES

Distributed energy resource (DER) generally refers to small-scale electricity generation and controllable loads that are spread out and are connected to the distribution grid system, as opposed to the larger transmission system, or directly to a building or other host facility. The most common examples of DERs are residential solar installations, but DERs can also include larger solar installations, wind, small-scale hydro, tidal, and even energy storage. Distributed energy systems can also support investments in infrastructure that can lead to overall reduced costs (providing savings for ratepayers and supporting equity goals) and can avoid barriers that often accompany small-scale renewable energy projects.



In Maine, a distributed generation resource is defined by statute as being fueled by renewable technologies, and programs have recently limited the size to being less than 5 MW in capacity. Additionally, DERs can include demand-response technologies and interactive resources, such as electric vehicle smart chargers, smart thermostats, and heat-pump water and space heaters. These resources either provide energy to the electrical grid or allow for greater control of demand for electricity and are located at various geographic locations across the grid system, sometimes "behind the meter."

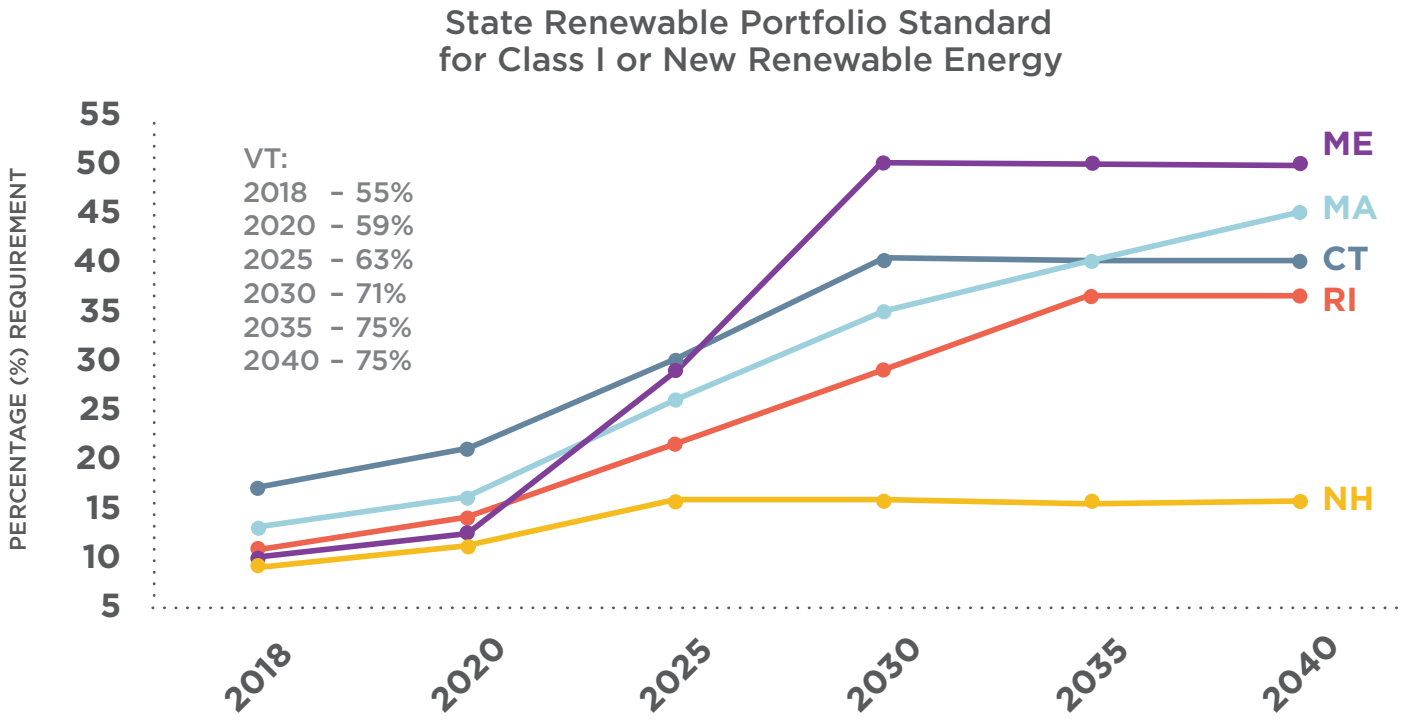
Figure 10 below from ISO New England shows the percentage requirement from Class I (new renewable-energy resources). It does not include Maine's current Class II requirement of 30% which includes the existing forms of renewable energy generation. With these two classes combined, Maine will lead the region in clean power usage after 2025.

Maine's clean-energy resources provide a significant opportunity to embrace energy innovations that can drive economic growth. As overall demand for electricity increases, we must continue to encourage energy efficiency and support shifting use away from high-use time periods (peaks) through demand management and "load flexibility" strategies. This will not only make Maine's grid cleaner, but more reliable and affordable — critical to ensuring a cost-effective transition to electrified heating and transportation sectors.

Reducing emissions and increasing energy generation in Maine carries important equity considerations. The Equity Assessment suggested that associated processes, procurements, and policies for clean-energy development and deployment should seek price stability and affordability for all ratepayers.

Incentives that support targeted programs for low- to moderate-income access to cleaner, money-saving electrification technologies in heating and transportation will be key. In addition, a focus on electric-rate structure, charging availability, and diverse communications with trusted partners about programs and savings will be essential to ensure equity. Clean-energy technology offers benefits like reduced pollution and job opportunities for frontline communities. Therefore to achieve equity outcomes, clean-energy benefits should be targeted to communities who would most benefit.

Figure 10: New England States' Class I Renewable Portfolio Standards.



Source: ISO New England.
This chart is showing just Class I (and Class IA in Maine) resource requirements; the 80% RPS by 2030 includes Class II resources which can make up the remaining 30% in Maine.

1

Ensure Adequate Affordable Clean-Energy Supply

- **Achieve by 2030 an electricity grid where 80% of Maine's usage comes from renewable generation.**
- **Set achievable targets for cost-effective deployment of technologies such as offshore wind, distributed generation, and energy storage, and outline the policies, including opportunities for pilot initiatives, necessary to achieve these results.**

Maine will need to ensure adequate affordable clean-energy supply to meet our 100% RPS goal and any increased load through the development of centralized generating resources, distributed energy resources, and other measures.

To ensure available resources, it will be necessary to create new or expand existing clean-energy procurements in 2021 and 2022 based on the results from the Governor's Energy Office study due in January 2021. The state should analyze how to achieve 100% clean energy earlier than the 2050 goal now in statute.

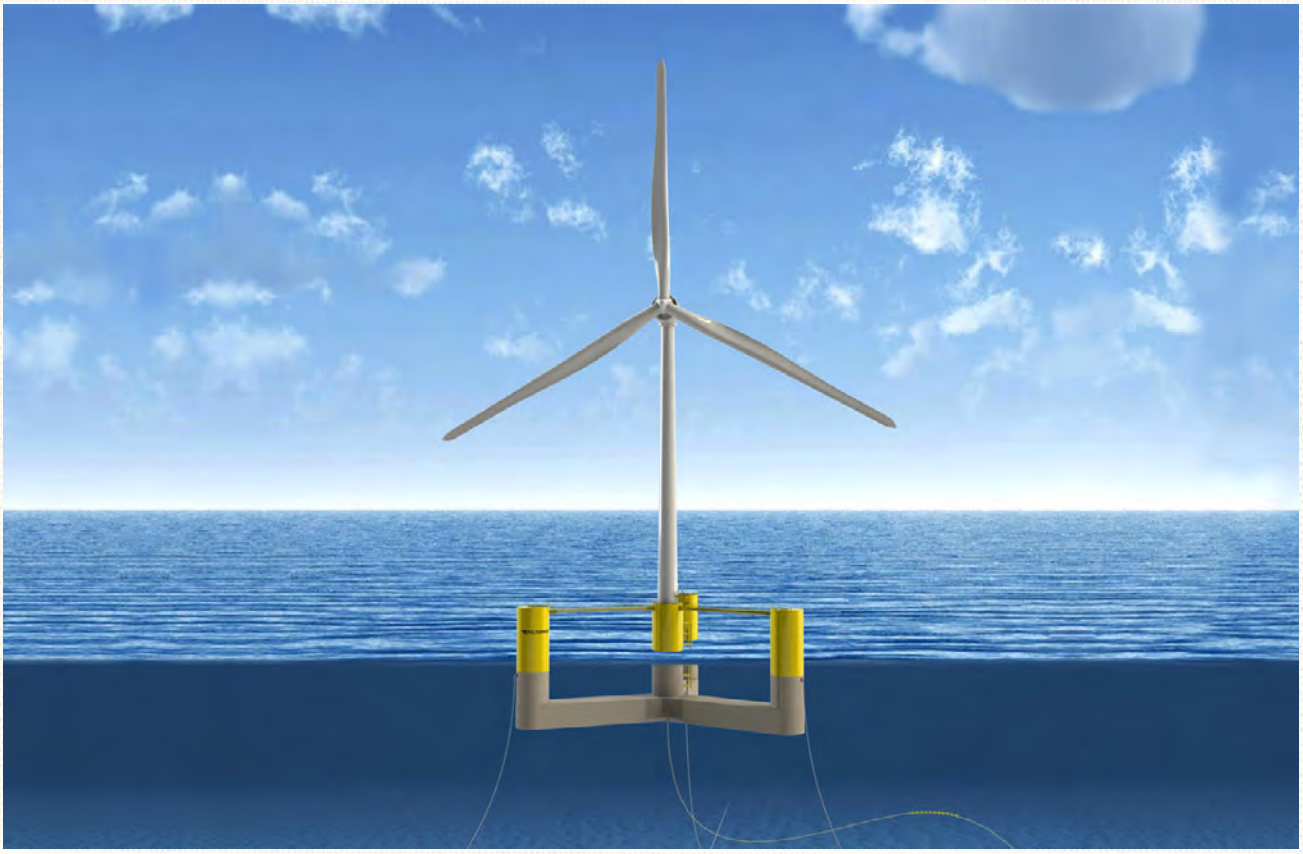
Maine should leverage this development of renewable-energy resources to ensure the highest benefits for our residents and economy. This will require additional procurements of clean-energy supply and could be supported through specific development targets for offshore wind, smaller distributed energy resources, and energy storage. The state should work with landowners, developers, fishermen, and other important stakeholders to develop siting guidelines that seek to minimize impacts to communities, fishing, and the environment, and avoid significant losses of key farmlands.

Research has demonstrated that renewable energy sources can provide energy at a cost lower than or comparable to non-renewable sources. And as renewable-energy technology continues to advance, the cost of renewable energy is expected to further decrease, ensuring lower and more stable energy costs for Maine's families and businesses.

Continued development of clean-energy resources to meet the state's RPS and climate goals will create the opportunity for growth of a clean-energy economy, including the creation of thousands of high-quality jobs. As Maine shifts to a cleaner electricity and heating sectors, efforts should be made to reduce negative impacts on workers in existing Maine-based fossil-fuel businesses, like heating-fuel delivery, giving careful consideration to support the transition for these workers.

ADVANCES IN RENEWABLE ENERGY IN MAINE

Renewable energy technologies have advanced immensely over the last few decades. These advancements, along with supportive state and federal policies, have resulted in deployment of competitively-priced renewable electricity generation. The clean-energy sector in Maine has been experiencing growth, especially following the passage of numerous supportive clean-energy policies in 2019. For example, solar energy generation — from residential projects to large utility-scale projects — has attracted significant investment and development interest. In the most recent RPS procurement in 2020 run by the Public Utilities Commission, solar was the majority of the large-scale generation selected. These projects were highly cost competitive, with first-year energy prices averaging 3.5 cents per kWh.



MAINE'S OFFSHORE WIND
Clean-Energy Opportunity

Offshore wind-energy generation holds great potential in Maine; some of the strongest offshore wind speeds in the country are in the Gulf of Maine. Responsibly sited offshore wind can supply Maine's anticipated growing energy needs, while supporting significant economic opportunity.

As part of the state-initiated Maine Offshore Wind Initiative, Maine is working to position itself to benefit from future offshore wind projects, including opportunities for job creation, supply chain and port development, and offshore wind's impact on the state's energy future. To help fund this effort, the U.S. Economic Development Administration has provided the state with a $2.2 million grant to develop a comprehensive roadmap that will build on Maine's national leadership on floating offshore wind reflecting the substantial work and research done in the state and Gulf of Maine.

This roadmap will assess Maine's competitive advantage on floating offshore wind and the state of associated supply chain, infrastructure, technology, and workforce opportunities. It will also identify gaps in infrastructure and investments needed to best position the state for these opportunities. Combined with the development of innovative floating wind-turbine technologies — namely Aqua Ventus at the University of Maine — there is significant potential for homegrown offshore-wind technology and related opportunity.

This roadmap will assess Maine's competitive advantage on floating offshore wind and the state of associated supply chain, infrastructure, technology, and workforce opportunities. It will also identify gaps in infrastructure and investments needed to best position the state for these opportunities. Combined with the development of innovative floating wind turbine technologies led by the University of Maine and a first-in-the-nation floating research array in the Gulf of Maine, there is significant potential for homegrown offshore wind technology and related opportunity.

Prior to any application for offshore-wind activities in the Gulf of Maine, in federal or state waters, it is essential that the state require meaningful consultation with stakeholders including Maine's fishing industry, on the identification of a site.

Turbines from Fox Island Wind generate power for the neighboring island communities of Vinalhaven and North Haven.

2

Initiate a Stakeholder Process to Transform Maine's Electric Power Sector

- **Establish a comprehensive stakeholder process in 2021 to examine the transformation of Maine's electric sector and facilitate other recommendations of the Maine Climate Council.**

To meet Maine's greenhouse gas emissions reduction targets, large portions of the energy used in our economy will need to be converted from higher emitting sources, like fossil fuels, to electricity — a transition referred to as "beneficial electrification" — and this electricity must increasingly come from cleaner generation sources. In addition, the way we manage energy should change; instead of continually adding expensive infrastructure to meet peak loads, we can manage demand more wisely and improve markets to keep electricity affordable.

Beneficial electrification in heating and transportation may still require significant expansion and investment in Maine's electricity transmission and distribution system, or electric grid. Effective preparation for increased electricity usage requires increased energy-efficiency efforts, thoughtful management of energy uses, modernization of the electricity grid, enhanced grid management systems, greater use of markets and aggregation, and accompanying statutory and regulatory policies to ensure that Maine's power sector evolves efficiently and affordably. These elements reflect a fundamental transformation of the electricity sector that is now underway nationally.

Maine's stakeholder process will examine and provide recommendations regarding the transformation and planning of our electric sector to accomplish the recommendations of the Maine Climate Council, achieve Maine's greenhouse gas reduction requirements and clean-energy goals, and help ensure the state's competitiveness well into the future.

The process will be managed by the Governor's Energy Office in coordination with the Maine Public Utilities Commission. Areas for consideration should include: utility structure, load management, data and information access, grid modernization and expansion, non-wires alternatives, interconnection, distributed energy resources, aggregation, equitable cost allocation, and rate design, integrated grid planning, regional and local electricity markets, regional collaboration, reliability and resiliency, and changes in law and regulation.

3

Accelerate Emissions Reductions of Industrial Uses and Processes

- **Launch an Industrial Task Force to collaboratively partner with industry and stakeholders to consider innovations and incentives to manage industrial emissions through 2030 and reduce total emissions by 2050.**

Industrial facilities in Maine have historically participated actively in energy-conservation programs; however, additional cost-effective opportunities remain to be pursued. Expanding programs like the industrial energy-efficiency program offerings through Efficiency Maine Trust will encourage additional investments that will result in more competitive manufacturing businesses and reduced emissions.

Achieving deep emissions reductions in this sector by 2050 will likely require significant shifts away from petroleum-based fuels to cleaner alternatives. Some fuel-switching opportunities can be both cost effective and reduce greenhouse gas emissions, such as converting from oil to natural gas and increasing efficiencies through combined heat and power (CHP) technologies.

Emissions modeling also shows other greenhouse gas, non-CO_2 emissions sources, as reported in the "other" sector of emissions, which come from industrial processes, agricultural, and landfill emissions along with other types of waste. Best practices and incentives

Beneficial Electrification: Converting from higher-carbon-emitting sources, like fossil fuels, to electricity that is increasingly procured from clean, renewable resources that will advance Maine's climate goals.

can encourage mitigation of these emissions through innovation. Some of these same emissions sources may provide unique opportunities for energy production — including biodigesters or landfill-emissions-capture technologies.

Many industrial facilities in Maine have already made these transitions in recent decades. Other opportunities, such as shifting to renewable fuels (e.g., hydrogen-rich fuels produced using renewable energy electrolysis or utilizing carbon capture and sequestration) are not yet widely commercially available or cost competitive, but they may be in the future. In the longer term, investment in new technologies will support emissions reductions, create new jobs, and secure current industries and employment by making Maine's industrial sector more competitive.

In an effort to stem future industrial emissions increases and find innovative pathways for the long-term reductions required for Maine's 2050 goals, the Maine Climate Council should create an Industrial Task Force of Climate Council members with interest and expertise, as well as outside stakeholders, to focus on solutions to address industrial emissions over time, while supporting continued economic growth in this important sector.

4

Encourage Highly Efficient Combined Heat and Power Facilities

- **Analyze policies, including the potential for long-term contracts, needed to advance new highly efficient combined heat and power production facilities that achieve significant net greenhouse gas reductions.**

CHP, sometimes referred to as cogeneration, is the production of both electricity and thermal energy, at the same location of the energy consumption. Where typically the heat produced by electricity generation is lost to the air, CHP facilities utilize the heat byproduct for on-site activities, resulting in increased overall efficiency.

Highly efficient CHP facilities capture heat from electricity generation to provide steam or hot water for use in space heating and cooling, water heating, and industrial processes, thereby increasing overall facility efficiency and reducing emissions. CHP avoids energy waste, reducing the need for additional energy consumption to accomplish heating and industrial processes. CHP can both reduce Maine's emissions and support existing industrial businesses and large institutions with lower operating costs.

Maine sawmills and wood manufacturers, for example, that have installed boilers to provide steam for drying lumber are increasingly investing in CHP facilities that also generate power from the same wood fuel source. Technological advances are allowing smaller facilities the ability to install efficient burner technologies. These opportunities establish greater efficiencies in wood-derived energy and provide markets for mill waste that might otherwise be landfilled.

Maine should continue to support the growth of highly efficient CHP facilities, including through the long-term contracting authority of the Maine Public Utilities Commission.

For sawmills and paper mills that produce wood chips, sawdust, and residuals during their manufacturing process, the best option for this material may be a highly efficient combined heat and power facility. At Robbins Lumber (at right), a fifth-generation family-owned white pine sawmill in Searsmont, a newly-installed combined heat and power facility handles the sawmill's residuals, while generating heat to dry lumber, heat buildings, and renewable electricity. This supports the mill's economic viability, adds value to lumber grown through sustainable forestry practices, and provides locally-sourced construction materials that sequester carbon for the long-term.

FISHERIES AND AQUACULTURE

Maine should closely monitor species and habitat changes and provide information about ocean temperature, salinity, and acidity changes at the local level to support fishing and aquaculture businesses.

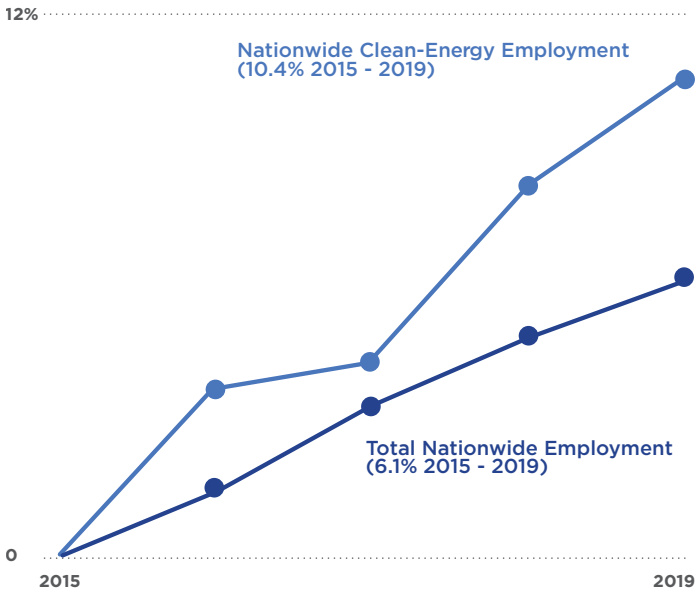
Maine's wild fisheries and aquaculture industries will need to be managed in the context of changing ecosystems and a changing climate. This will require market support to promote stable businesses. It will also require industry groups and the state to work together to develop regulatory and policy changes at the local, state, and federal levels that promote the long-term productivity of valuable marine resources.

A proposed Maine Seafood Business Council will work with Maine's seafood harvesters, shoreside businesses, and working waterfronts to provide them with access to information and tools to support operational decisions, capital investments, and long-range planning to implement climate adaptation and mitigation strategies.

To support diverse markets for Maine fishermen and aquaculture businesses, Maine should expand local and direct marketing opportunities for sustainably produced Maine seafood. Increased local consumption of Maine seafood is an important piece of strengthening our local food systems.

State support for the growing aquaculture sector can serve to increase Maine seafood production, provide important economic opportunities for coastal communities, while also harnessing potential ocean acidification mitigation and other environmental services — especially with crops like seaweed and kelp (that can lower the acidity of surrounding waters), and shellfish, which are known to improve water quality. Technical assistance, financing tools, and policy strategies will be needed to help fishing and aquaculture businesses plan for and transition activities in a changing ocean ecosystem.

Figure 11: Clean-Energy Employment.



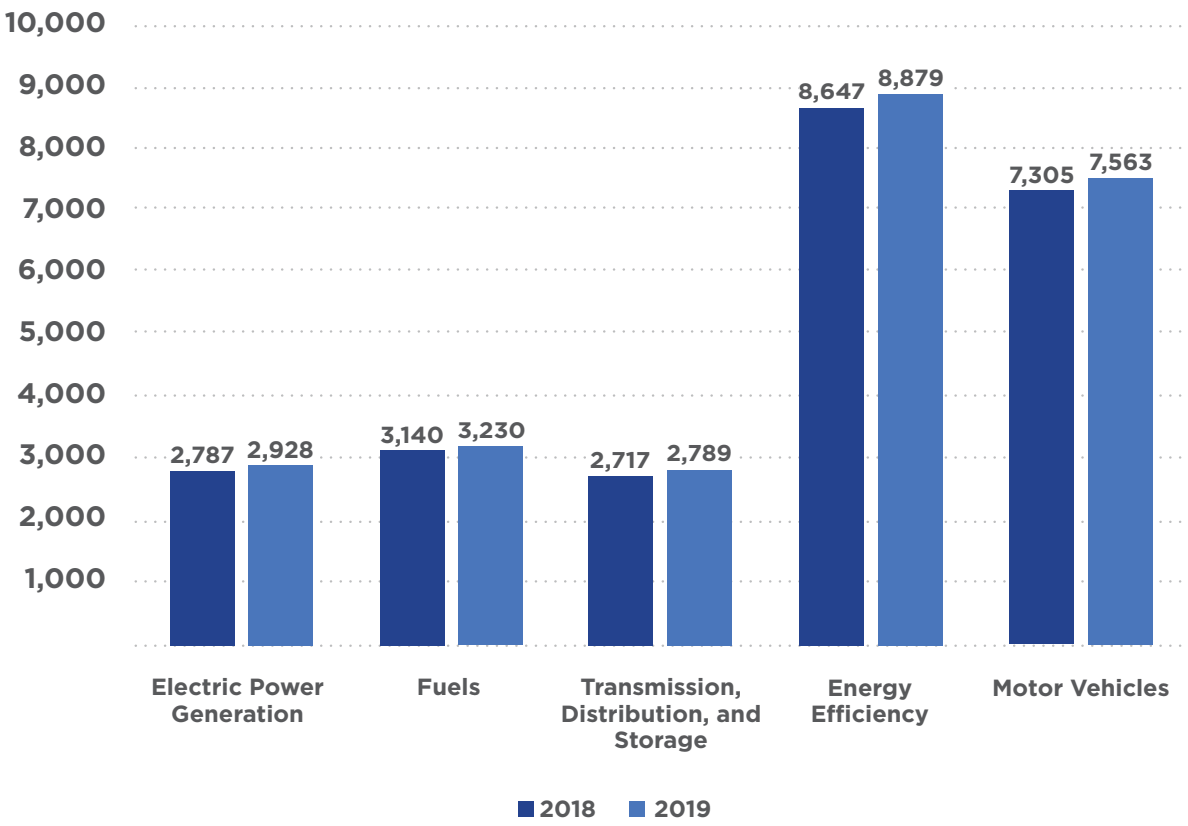
Maine should continue to evaluate and implement changes to Maine's fishery and aquaculture laws and regulations that provide the opportunity to address environmental change and emerging fisheries. And with both federal regulation and co-management roles, partnership and advocacy in regional and federal contexts will also be required.

2

Clean-Energy Jobs and Businesses in Maine

- **Launch a workforce initiative by 2022 that establishes ongoing stakeholder coordination between industry, educational, and training organizations to support current and future workforce needs.**
- **Establish programs and partnerships by 2022 for clean-tech innovation support to encourage the creation of clean-energy and climate solutions.**

Figure 12: Employment by Major Energy Technology Application.



The plan recommends that Maine commit to increasing its current clean-energy workforce, while establishing new supply chains for Maine-based manufacturers to create sustained, good-paying skilled-labor jobs across the state.

Maine's climate goals and renewable energy policies mean that our clean-energy sector is poised for robust growth. A supporting report to this Plan, Strengthening Maine's Clean Energy Economy, describes the opportunity to create economic recovery and good jobs in this fast-growing sector, and outlines the specific targeted investments, policies, and workforce-training strategies that will be needed.

Nationally, the clean-energy economy is growing faster than the economy as a whole. Between 2015-2019, the U.S. clean-energy sector added jobs faster than the rest of the U.S. economy. The plan finds that median U.S. hourly wages for clean-energy jobs are about 25% higher than the median wage. Clean-energy careers also offer a higher prevalence of health insurance and retirement benefits.

In Maine, there were approximately 14,000 clean-energy workers employed in 2019. Of those, nearly 8,900 people are employed in energy-efficiency jobs, roughly the same as the total number of people employed in traditional-energy jobs including electric power generation, fuels, and transmission, distribution and storage combined. From 2018 to 2019 in Maine, all sub-sectors within the energy industry experienced job growth.

At the same time, Maine is projected to lose overall employment in the next 10 years due to demographic trends as older workers retire. The clean-energy industry can help attract younger workers — both from within the state and outside of Maine.

A skilled workforce is a key component of Maine's transition to a clean-energy economy. By supporting educational and training pathways for Maine people to find careers, and attracting a talented, diverse workforce to Maine, the clean-energy industry has the potential to create new, sustained opportunities.

The Strengthen Maine's Clean Energy Economy Plan highlights the importance of encouraging efforts to target the creation of these high-quality jobs through strategies that pair job quality standards with clean-energy investments. Some of these may include prevailing wages, project labor agreements, safety and health protections, community benefit agreements, registered apprenticeship utilization, and local-hire provisions. Domestic content requirements (guarantees of components and contracting with Maine workers and businesses) can also assist in building local supply chain opportunities. These and other related requirements should be considered when developing clean-energy projects and relevant policies.

REBUILDING OUR ECONOMY
Tackling Climate with Shovel-Ready Infrastructure Projects

Investments to prepare our communities and infrastructure for climate-change impacts will create thousands of good-paying jobs in the engineering, design, and construction sectors. Investing in shovel-ready projects during a time of significant economic hardship can help revitalize Maine's economy in the short and long term, while also making our communities and state infrastructure systems more resilient.

Maine should develop a list of climate-related infrastructure projects in early 2021 to utilize for near-term economic recovery, and track over the long term to identify backlogs. Maine communities and the state have already identified critical infrastructure projects aimed at adapting to and reducing climate-change impacts. Many of these projects do not have the necessary funding. This includes a backlog of $325 million in infrastructure projects that local communities have identified to reduce disaster risk.

Much-needed pre-development assistance would help ensure that infrastructure projects are made shovel-ready for state or federal support including design, engineering, and permitting; grant writing; and matchmaking with investors for public-private partnerships.

MOISE MULAMBA KALONJI

Moise Mulamba Kalonji of Portland, a native of the Democratic Republic of the Congo, is an electrical engineering student at Southern Maine Community College.

Why did you choose Maine to live and study?

Prior to the U.S., I earned an engineering degree from the American Christian Liberal Arts University in Kinshasa, studied engineering and energy project management at Technische Universität Berlin, and worked for Greening Africa Together to promote solar energy and access to clean water. When I came to the U.S., I heard that Maine was safe and welcoming to immigrants, and the future here is bright in the clean-energy fields in which I want to work.

What do you want to achieve in clean energy?

My passion is solar, and I want to own my own solar energy company someday. My experiences in Africa and Europe showed me the great potential for clean energy to improve our environment and our economy, which is a sentiment I share with many of my classmates at SMCC. We are all excited about the opportunities the renewable-energy industry could have for us and for Maine.

What should be considered for this Plan as it moves forward?

There is more to be done to ensure new Mainers like me have access to the clean-energy economy, as energy consumers and also to support its growing workforce needs. We must think boldly about our actions and realize what we do in Maine has an effect across the world. And we should rise to the challenge before us — I'm proud to be here for the greening of Maine, and ask others to join in and help our state thrive against climate change.

STRATEGY E

PROTECT MAINE'S ENVIRONMENT AND WORKING LANDS AND WATERS

Promote Natural Climate Solutions and Increase Carbon Sequestration

Climate change and development are harming Maine's natural and working lands and waters, which are key to the state achieving its carbon neutrality commitment by 2045.

By current estimates, Maine loses approximately 10,000 acres of natural and working lands to development each year — a figure which is projected to grow in coming years. This development is a direct source of carbon emissions and hinders the growth of natural climate-change solutions, such as the powerful carbon-storage potential of forested lands. Maine's forests alone can draw back, or sequester, an amount equal to at least 60% of the state's annual carbon emissions, a figure that rises to perhaps 75% if forest growth and durable products are included.

Maine's coastal and marine areas also store carbon, while supporting our fishing, aquaculture, and tourism industries. Coastal and marine areas face rising sea levels and other climate-change impacts, which could turn these areas from sinks of carbon into sources of carbon. Maine's coastal sand dunes, wetlands, and marshes are also a powerful natural climate solution for protecting our coastal communities from flooding and erosion. Conserving and restoring coastal and marine areas will preserve their carbon-storage value as well as their other benefits.

Financial incentives and technical assistance are required to support foresters, landowners, loggers, farmers, fishermen, and communities to reduce emissions, increase their resilience to climate change, and implement enhanced opportunities for carbon-storage initiatives.

Improved monitoring of these lands and waters, and better sharing of that information, will serve to support practitioners in making proactive, informed decisions to combat climate change.

Protecting natural and working lands from development maintains their potential to draw back carbon from the atmosphere, as well as to provide important co-benefits. In addition to storing carbon, Maine's natural and working land supports our farming, forestry, and outdoor-recreation industries. They provide clean drinking water and important wildlife habitat, and help moderate flooding events.

1

Protect Natural and Working Lands and Waters

- **Increase by 2030 the total acreage of conserved lands in the state to 30% through voluntary, focused purchases of land and working forest or farm conservation easements.**
  - » **Additional targets should be identified in 2021, in partnership with stakeholders, to develop specific sub-goals for these conserved lands for Maine's forest cover, agriculture lands, and coastal areas.**
- **Focus conservation on high biodiversity areas to support land and water connectivity and ecosystem health.**
- **Revise scoring criteria for state conservation funding to incorporate climate mitigation and resiliency goals.**
- **Develop policies by 2022 to ensure renewable energy project siting is streamlined and transparent while seeking to minimize impacts on natural and working lands and engaging key stakeholders.**

FORESTS AND FARMS

Protecting natural and working lands is critical to maximize carbon storage, support working farms and forests, ensure valuable ecosystems remain in place for future generations, and contribute to Maine's fight against the effects of climate change.

Conserving forests and farmland through conservation easements is one of the more cost-effective strategies to help reach carbon neutrality by maintaining forest cover and ensuring the lands will be available for future forest and farmland ecosystem services. A 2019 report on land conservation suggested that Maine currently has approximately 20% conserved lands or about 4 million acres.

A combination of voluntary, focused purchases of working forest or farm conservation easements and lands will support robust forest products and agricultural economies, increase carbon storage opportunities, help food security, conserve biodiversity, and enhance climate adaptation and resilience for wildlife, people, and communities.

To that end, Maine should support dedicated and sustained sources of funding to support the conservation target and to protect natural and working lands. This should prioritize providing state-matching funds for the newly-renewed federal Land and Water Conservation Fund for state projects, the Agricultural Conservation Easement Program, and other applicable grant programs that leverage additional dollars.

Additional attention needs to be focused on policies to ensure renewable-energy project siting is streamlined, transparent, and thoughtfully balances potential impacts on working land, engaging key stakeholders.

COASTAL AND MARINE

Along the coast, protecting and restoring coastal and marine ecosystems benefits biodiversity, protects our communities from the impacts of climate change, and stores carbon. Sand dunes and beaches, seagrasses, and tidal salt marshes act as natural barriers to waves. Protecting floodplains, wetlands, and streams helps to reduce flooding damages.

Maine should ensure a network of biologically and geographically diverse lands, which are well connected, to allow plants and animals to move across the landscape to find the places they need to thrive as these habitats change over time.

MELISSA LAW

Melissa Law is the co-owner of Bumbleroot Organic Farm, an organic vegetable and flower farm in Windham, an award-winning entrepreneur, and a member of the Maine Climate Council.

Why is it important for farmers to engage in climate issues?

Farmers are on the frontlines of climate change — our livelihoods literally depend on the weather. As weather becomes less predictable and more severe, it will be increasingly difficult for farmers to grow the food that sustains us all. As a young farmer, I view climate change as the biggest challenge my business will face in the decades to come. I want to make sure young voices are heard, as future generations will bear the burden of this crisis. I view climate action as nonnegotiable.

What is your concern for farming's future with climate change?

The climate crisis threatens farms of all sizes and sectors — from vegetables and specialty crops to dairy, livestock, and commodities. It will undermine crop yields, supply chains, and food security. Supporting farm businesses and strengthening local and regional food systems are key to building resilience to the instability and economic impacts of climate change in our state.

What should farmers know about this plan?

This plan protects farmland from development, promotes climate-friendly practices in agriculture, and strengthens our local food system — all of which are critical for farmers and for Maine communities. Not only will this result in increased carbon sequestration and reduced emissions, this will ensure that our communities have local food producers, enhance food security for Maine people, and reduce our dependence on food transported thousands of miles to our state.

2

Develop New Incentives to Increase Carbon Storage

- **DEP will conduct a comprehensive, statewide inventory of carbon stocks on land and in coastal areas (including blue carbon) by 2023 to provide baseline estimates for state carbon sequestration, allowing monitoring of sequestration over time to meet the state's carbon-neutrality goal.**
- **Establish by 2021 a stakeholder process to develop a voluntary, incentive-based forest carbon program (practice and/or inventory based) for woodland owners of 10 to 10,000 acres and forest practitioners.**
- **Engage in regional discussions to consider multistate carbon programs that could support Maine's working lands and natural-resource industries, and state carbon-neutrality goals.**

With most of Maine's working lands privately owned, policies and incentives for landowners to improve land management are needed to maximize natural carbon sequestration and meet Maine's climate-change goals and objectives. Opportunities to incentivize carbon storage in Maine's coastal and marine areas should be analyzed.

In coming years, Maine will engage in regional discussions to consider multistate carbon programs that could support Maine's working lands and natural-resource industries, and advance the state carbon-neutrality goals. Careful study of the impact of out-of-state carbon markets and the impact they could have on Maine's sequestration targets and potential regional concepts that could support state and landowner goals should be evaluated.

FORESTS Financial incentives should be developed to encourage the adoption of climate-friendly practices and investment in new technologies. Updating Maine's land taxation policies, including updating the Open Space Current Use Taxation Program and maintaining the Tree Growth Tax Law, could provide incentive for landowners to adopt land-management practices with climate mitigation and adaptation benefits to increase carbon storage.

In addition, Maine should establish a stakeholder process to develop a voluntary, incentive-based forest carbon program (practice and/or inventory based) for woodland owners of 10 to 10,000 acres and forest practitioners to increase carbon storage in Maine's forests and encourage good forest management practices while maintaining current timber harvest levels.

Incentivizing high-quality on-the-ground performance by loggers and facilitating the use of low-impact timber-harvesting equipment would also support progress toward achieving climate goals.

FARMS Incentives to adopt climate-friendly agricultural practices that focus on soil health — cover cropping, reduced tillage, and rotational grazing — will help sequester carbon on Maine farms, while improving water-holding capacity and preventing soil erosion, which will help farms to be more resilient in the face of droughts or extreme weather events. Funding for farming infrastructure and technology upgrades, such as renewable-energy generation and reduced fossil-fuel usage, can also reduce greenhouse gas emissions attributed to agriculture.

Existing state programs, policies, and financial incentives should be updated and refocused to address climate-change mitigation and resilience. This includes continuing and updating climate-friendly public land management practices and incentive programs to incorporate current climate science and support landscape and species resiliency.

COASTAL AND MARINE Coastal and marine environments store carbon, and some such as salt marshes may store more carbon per area than land. Maine's approximately 5,000 miles of total coastline is a prime opportunity to create long-term "blue carbon" storage that requires protection from development and sea-level rise.

As part of the comprehensive, statewide carbon inventory conducted by DEP, in partnership with the Scientific and Technical Subcommittee, Maine should determine where and how much blue carbon can be stored by conducting a coastwide survey of coastal environments like salt marshes, seaweeds, and seagrass beds. We should explore innovative solutions like opportunities for seaweed aquaculture to enhance long-term carbon burial and to support targeted reductions of coastal acidification. The state should also explore the opportunity for formal blue-carbon storage incentives or carbon-permit program to encourage blue-carbon habitat conservation and restoration.

3

Expand Outreach to Offer Information and Technical Assistance

- **Increase technical service provider capacity by 2024 to deliver data, expert guidance, and support for climate solutions to communities, farmers, loggers, and foresters at the Department of Agriculture, Conservation and Forestry, Maine Forest Service, Department of Inland Fisheries and Wildlife, the Department of Marine Resources, and the University of Maine.**
- **Launch the Coastal and Marine Information Exchange by 2024.**

By reaching out to communities and stakeholders to offer information and technical assistance on adopting natural climate solutions, Maine can help increase carbon storage and protect Maine's natural and working lands and waters from the effects of climate change.

Increasing the number of field foresters at Maine Forest Service should support landowner and land-manager adoption of climate-friendly practices, as well as efforts to support good forest-management practices.

Natural climate solutions, such as soil-health practices, should be a priority for state agricultural programs. Technical assistance to farmers via Soil and Water Conservation Districts, the University of Maine Cooperative Extension, Natural Resources Conservation Service, and other non-governmental organizations about agricultural practices with mitigation and adaptation benefits should be made more widely available.

The state's "Beginning with Habitat" program at the Department of Inland Fisheries and Wildlife and "Maine Natural Areas Program" at the Department of Agriculture, Conservation and Forestry should be enhanced to support technical assistance to towns, land trusts, land managers, and landowners to protect native species, conserve land and waters vulnerable to climate change, and address climate-related threats such as invasive species.

A new Coastal and Marine Information Exchange should be created by the state or supporting entities to provide accessible and relevant information and support to facilitate climate mitigation and adaptation in Maine's coastal communities and industries.

4

Enhance Monitoring and Data Collection to Guide Decisions

- **Establish a "coordinating hub" with state and non-state partners for key climate-change research and monitoring work to facilitate statewide collaboration by 2024.**
- **Create the framework and begin pilot for a coordinated, comprehensive monitoring system by 2024.**
- **Incorporate climate research and climate-change-related technologies into Maine's research and development priorities such as those developed by the Maine Innovation Economy Advisory Board and the Maine Technology Institute.**

While Maine needs a comprehensive strategy for monitoring and gathering data on a variety of climate-change-related effects, special attention must be paid to both inland and marine ecosystems in order to understand impacts, identify future trends, and monitor economic and social conditions — all to encourage improved and adaptive local decision making.

Research and development of greenhouse gas mitigation and adaption land practices will support Maine's agriculture and forestry sectors, including how to maximize stand carbon dynamics, forest soils, agricultural soils, and coastal environments to sequester carbon.

The state should promote and encourage economic and ecological research that seeks to find a role for carbon storage, especially in the agriculture and forestry industries. There are significant research needs associated with the development of new wood-based products as well as continued development and planning efforts supporting the growth and stability of Maine food systems.

In the marine realm, tracking marine and coastal habitats and species — including economically important, at-risk, and invasive species — will inform improved management practices, planning, and restoration priorities. Monitoring should include temperature, oxygen, and ocean acidification.

Lastly, a comprehensive Maine carbon-cycle analysis is needed for the state to understand and track its progress towards carbon neutrality and allow for accurate potential future participation in carbon-offset markets.

Photos at left: Kelp can provide a natural climate solution to draw down greenhouse gases and reduce acidification and nutrient pollution in coastal waters. As it grows, kelp draws carbon out of ocean water, creating a "halo effect" that can help improve nearby water quality. Scientific researchers, like those shown here from the Bigelow Laboratory for Ocean Sciences, and aquaculture businesses in Maine are now partnering to experiment with growing kelp alongside shellfish growing operations to naturally improve water quality and reduce local acidification.

Excerpts from DACF's Technical Guidance for Utility-Scale Solar Installation and Development on Agricultural, Forested, and Natural Lands (Jan. 8, 2021)

PURPOSE AND SCOPE

In 2019 the Maine Legislature enacted solar energy legislation that resulted in significant growth in the development of utility-scale solar projects. Replacing fossil fuels with clean, alternative renewable energy sources that do not contribute to greenhouse gas emissions is a desirable objective for the state. As we work to achieve greater renewable energy generation, it is equally important to ensure that solar development does not negatively impact our state's agricultural and natural resources, including active farmland, productive timberland, rare plant populations, or rare and exemplary natural communities. The Department of Agriculture, Conservation and Forestry (DACF) has developed this technical guidance document regarding the siting of utility-scale solar projects with consideration for valuable agricultural land, forest resources, and rare or unique natural areas.

DACF also recognizes that solar energy production can provide economic benefit to landowners, and that there are ways to maximize compatibility of multiple uses on certain sites. This technical guidance document is intended to provide farmers and forest landowners with practical information to utilize when first considering solar development on their property, as well as planning important preconstruction, construction, and post-construction/ decommissioning activities. It further provides technical information for solar developers to consider when designing, installing, and removing solar projects.

As a general statement of policy, DACF strongly recommends siting of commercial scale solar projects on non-agricultural lands and within areas that do not: contain rare plant populations; provide habitat for rare or exemplary natural communities; contribute to fragmentation of large undeveloped blocks of forestland; or diminish the ability for these natural and working lands to effectively sequester carbon. If impacted by development, these natural areas, productive soils, and prime agricultural lands are finite resources that can take decades to restore, and in some cases, restoration may not even be possible.

Non-agricultural siting locations would include: on top of buildings; in parking lots; on closed landfills; on significantly disturbed sites such as brownfields, where previous development was located or significant grading has taken place; and in regenerating wooded areas that are not comprised primarily of important farmland soils (or similar areas that have little or no commercial farming potential). To determine if a project is located on important farmland soils please, refer to DACF's guide to Determining Prime Farmland Soils and Soils of Statewide Importance here: https://www.maine.gov/dacf/ag/docs/prime-farmland-determination-guidelines.pdf.

If agricultural lands are to be used for solar siting, DACF encourages consideration of dual-use projects. Dual-use, or agrivoltaics, is a mixed land use production system combining the agricultural use of the land with solar energy production. The integrated spacing of solar panels and elevated construction of arrays allows light to penetrate the ground at levels which support the growth of crops, forage grasses, or pollinator habitat while retaining soil moisture. The meadow and grassland habitats provide meaningful benefits to improving soil health. Solar arrays can also be co-located with grazing for cows, sheep, and goats, apiaries for honey production, and crops. In addition to agricultural production, land leases can provide farmers additional revenue for leasing their land to Solar Developers for 20 to 35-years of the facility's lifespan. With proper planning and installation, the land could be reverted to agricultural or forest production upon decommissioning. For more information on dual-use please see our factsheet here: http://www.maine.gov/dacf/ard/resources/docs/dual-use-factsheet.pdf

I. Solar Basics

Solar energy or photovoltaic (PV) power is produced by capturing the sun's energy and turning it into electricity. The sun releases packets of energy known as photons. When these photons hit a solar panel (also known as a module), which is made up of multiple solar cells, they knock electrons loose from their atoms. Solar cells are made of silicon, like semiconductors, with a positive and negative layer. These layers create an electric field, like a battery that allows the electrons to travel along the panel in one direction around a circuit. As such, solar modules generate direct current (DC) electricity. DC power is compatible with battery storage but needs conversion to alternating current (AC) before being sent to the electrical grid.

A PV system consists of modules mounted on a racking system, wired together in series along a run. The length of the run will depend on the capacity of the inverter the modules will be connected to. For a residential scale project, an inverter would be connected to an electrical panel and potentially to a battery bank with a charge controller to regulate the battery's charge as well for off-grid or emergency back-up applications. Batteries are not required for grid-tied projects.

In utility-scale applications, electrical wire from inverters is combined and buried in underground conduits or run above ground along the racking and routed to a central equipment pad. Electricity is then fed into batteries and/or a transformer that sends electricity into the grid with above-ground cable. To minimize trenching for electrical conduit, runs can be orientated to terminate at inverters positioned on either side of a centrally located electrical conduit trench.

Solar arrays are a collection of modules mounted on metal racking systems, similar to roof racks on a car. Arrays may be fixed in their tilt and orientation (fixed mount) or may have mechanical parts that allow the array to adjust, tilt, and orient to track the sun to maximize their production (trackers). While trackers may generate more energy than fixed systems, the costs

and maintenance associated with them have limited their widespread adoption. Climatic conditions such as temperature, wind and snow load have an impact on the output of the equipment. For this reason it is important to determine if the proposed equipment has a proven track record in the northeast.

Most applications are fixed roof-mounted or ground-mounted arrays. Rooftop racking systems may be clamped to standing seam metal roofs or screwed into roof rafters. The preferred orientation is due south with an angle matching actual latitude. In Maine, that is 45 degrees; however, the sun's angle changes seasonally, from being more overhead in the summer to lower in the sky during the winter, so a range of 30 to 45 works well in most cases. Steeper pitched roofs will help shed snow from the array.

Ground-mounted arrays include a metal racking structure anchored to the ground supporting modules at a determined height above the ground. Applications may include flat roofs on large commercial buildings, parking lots, landfills, agricultural fields and greenfield projects. Wind, snow load, soil composition, array size, and row spacing are considerations for the height, anchoring, and construction of ground-mounted arrays. The racking structure may be mounted on driven piles, anchor systems, or utilize weighted ballasts. Arrays on commercial roofs have a low profile, and rows consist of single panels positioned in a landscape orientation with a minimal tilt to minimize row shading. These are typically anchored with cement blocks to avoid any roof penetrations.

In open areas, driven beams can be used to support an array. Beams made of steel are driven into the ground to a depth dependent on an impervious layer, and the racking system is affixed to the beams. This is a less costly installation method compared to other foundation methods but is dependent on favorable subterranean conditions.

Other anchoring systems, such as helical piles and ground screws, may be used. These applications can handle vertical loads at relatively shallow depths, do not require concrete, and can be removed and reused after the project has been decommissioned. These installations do not produce significant tailings, which could require grading. Ground screws can be installed with a skid steer avoiding the use of heavier equipment.

At sensitive locations such as landfills and brownfield sites, alternative ballast anchoring systems should be proposed to avoid driven piles with concrete footings and ground penetration. On landfills, precast pavers, or steel baskets filled with rock are used to weigh down the ballasts on top of the landfill cover. These can easily be moved into place with a skid steer.

A geotechnical or soil survey of the ground conditions will help determine which application may be best suited to a particular site. Typically, the most cost-effective installations will not require grading or bringing in additional materials like concrete; as a result, ground screws are becoming more widely used.

Most ground-mounted arrays are installed at the height of three feet (3’) above the ground on the southern end and a height of five feet (5’) or more on the northern end. For dual use systems in particular, these minimal clearances allow for ease of maintenance and livestock foraging. Where crop system integration is applied, arrays may have higher minimum clearances for hand harvesting or to accommodate mechanized harvesting equipment. They might also have gaps between panels along the racking system or utilize smaller panels with single rows in each array to increase solar penetration below the array. For more information on dual-use systems and applications, please refer to our fact sheet.

Utility-scale projects typically have a footprint greater than 40,000 square feet or one acre and is directly tied to the grid, meaning that no energy is consumed onsite but rather that the owner(s) receives a 1:1 kilowatt energy credit or financial credit on their bill. Large-scale commercial projects are between 1 and 30 acres (system size limit is 4.95MWac). They are typically created for residential community solar farms or purchase power agreements. In contrast, utility-scale projects are greater than 20 acres and usually sell all of the power to a single entity or utility.

Excerpt from DACF's Determining Prime Farmland Soils and Soils of Statewide Importance for Siting Solar Projects in Maine (May 2020)

BACKGROUND

In 2019, the Maine Legislature enacted "An Act To Promote Solar Energy Projects and Distributed Generation Resources in Maine." This act requires the Maine Public Utilities Commission (PUC) to solicit long-term contract proposals for targeted amounts of energy capacity and renewable energy credits from developers of renewable distributed energy facilities of less than 5 MW. The act provides financial incentives for outside parties to develop appropriately sized solar projects creating significant interest from the public sector.

The Maine PUC issued a Procurement Announcement for prospective developers which includes requirements to qualify for each of 5 rounds of bidding. The Procurement Announcement also includes an Appendix A, which lists both Pricing Attributes and Project Attributes.

Appendix A Number 9 of the Project Attributes states as follows: Project is sited such that no more than 10% of the project is located on land containing soils defined by the USDA Natural resources Conservation Services as "Prime Farmland" or "Farmland of Statewide Importance," as determined by a field-based survey conducted by a licensed soil scientist. How to demonstrate that this requirement is met is indicated as follows: "An affidavit from a Soil Scientist licensed by the Maine Department of Professional and Financial Regulation." The purpose of this document is to provide guidance and consistency to Maine licensed soil scientists in meeting this requirement.

TECHNICAL GUIDANCE

Although Prime Farmland and Soils of Statewide Importance are listed by the USDA's Natural Resource Conservation Service (NRCS) which can be cross-referenced to widely available soil maps, these maps are not sufficient for calculation because their classification is based on soil map units, not soil series. All map units contain other soils besides the soil series for which a soil map unit is named. In addition, it will not be known where in the range of characteristics allowed for every soil series that the soil series on the property is until an on-site investigation is performed. Further, NRCS soil mapping concepts have changed over time and new soil series have been established since many of the soil maps were created. Also important is that significant alteration of the underlying soils may have occurred after the soil maps were made. As a result, the determination of whether a proposed solar project site has less than 10% of its soils meeting the definition of Prime Farmland or Farmland of Statewide Importance requires an on-site investigation using established technical criteria.

KEY DEFINITIONS

Prime Farmland

The National Soil Survey Handbook (NSSH) and 7 CFR 657 Prime and Unique Farmlands, defines Prime Farmlands as follows: "Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oilseed crops, and is also available for these uses (the land could be in cropland, pastureland, rangeland, forest land or other land, but not urban built-up land or water). It has the soil quality, growing season and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods."

Soils of Statewide Importance

According to 7 CFR 657, Prime and Unique farmlands is defined as follows: "Criteria for defining and delineating this land are to be determined by the appropriate State agency or agencies. Generally, additional farmlands of statewide importance include those that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods." (Emphasis added).